5. Land

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5.1 Overview

This chapter describes existing land values within and surrounding the Lower Fitzroy River Infrastructure Project (Project) and identifies potential impacts. The assessment addresses the terms of reference (ToR) for the environmental impact statement (EIS) specifically including:

- Scenic amenity and lighting (Part B, Sections 5.11 – 5.14)
- Topography, geology and soils (Part B, Section 5.15 – 5.23)
- Contaminated land (Part B, Sections 5.24 – 5.27)
- Land use and tenure (Part B, Sections 5.28 – 5.29).

A table cross-referencing the ToR requirements is provided in Appendix B. Where appropriate, management measures relating to these values are used to inform the environmental management plan (EMP) (Chapter 23 Environmental management plan).

5.2 Scenic amenity and lighting

5.2.1 Introduction

5.2.1.1 Approach and methodology

Landscape features are determined and/or influenced by physical, biological and cultural factors and may include soils, vegetation and land uses. As such, landscape impacts occur from changes in the physical landscape which may give rise to changes in its visual character and how visual character is experienced. This may in turn affect the perceived value of the landscape by the public.

The methodology for this study has been derived from:

- Guidelines for Landscape and Visual Impact Assessment, Second Edition (Landscape Institute and Institute of Environmental Management and Assessment 2002)
- Visual Landscape Planning in Western Australia (Western Australian Planning Commission 2007)
- A Manual for Forest Landscape Management (Forest Practice Board of Tasmania 2006).

This methodology includes:

- Review of existing information relevant to the visual environment
- A description of the Project and its visual components
- An evaluation of the existing landscape and visual environment
- Assessment of the significance of impacts on landscape character and visual amenity as a direct result of the Project.

The methodology for the identification of the existing environmental values of the area surrounding the site and the identification of the viewpoints comprised:

- Review of existing information and collation of relevant background information including planning, land use and regional landscape characteristics
- Identification of potentially affected receptors and viewpoints which are accessible to the public or are a place of residence and assessment of typical views and landscape

characteristics, particular landscape and / or visual features of importance within the visual environment, and local landscape character.

A qualitative assessment of landscape and visual impacts forms the second component of the assessment. Landscape impacts refer to the relative capacity of the landscape to accommodate changes. Impacts have been assessed from identified viewpoints and consider (through professional judgement) the scale of change including the:

- Extent to which the change (modification, removal and / or addition) of landscape alters the existing character
- Extent of area from which the effect is evident
- Duration of the effect (short / medium / long term, permanent/temporary)
- Physical state (or condition) of the landscape and its intactness from a visual perspective
- Effectiveness of any proposed mitigation measures.

Definitions used to describe this assessment are detailed in Table 5-1.

Table 5-1 Assessment of potential landscape impacts

Landscape impact	Definition
Large	A substantial / obvious change to the landscape due to total loss of, or change to, elements, features or characteristics of the landscape. Would cause a landscape to be permanently changed and its quality diminished. Change is likely to cause a direct adverse permanent or long term (more than 10 years) impact on the value of the receptor.
Moderate	Discernible changes in the landscape due to partial loss of, or change to the elements, features or characteristics of the landscape. May be partly mitigated. The change would be out of scale with the landscape, and at odds with the local pattern and landform and will leave an adverse impact on a landscape of recognised quality. Change is likely to adversely impact the integrity/value of the receptor but recovery is predicted in the medium term (5-10 years).
Small	Minor loss or alteration to one or more key landscape elements, features, or characteristics, or the introduction of elements that may be visible but may not be uncharacteristic within the existing landscape. Change is likely to adversely impact the integrity/value of the receptor but recovery is expected in the short term (0-4 years).
Negligible	Almost imperceptible or no change in the view as there is little or no loss of / or change to the elements, features or characteristics of the landscape. The existing landscape quality is maintained but may be slightly at odds with the scale, landform and pattern of the landscape.

Source: Landscape Institute and Institute for Environmental Management and Assessment (2002).

Visual impact is determined through the subjective assessment of sensitivity of the visual receptors (i.e. residents, outdoor recreational users) and the magnitude (scale) of the change in view. Factors that have been considered in assessing the response of receptors to changes in the visual amenity include:

- Interest in the visual environment and their distance/angle of view to the source of the impact
- The extent of screening/filtering of the view
- Magnitude of change in the view (i.e. loss/addition of features that change the view's composition)
- Integration of changes within the existing view (form, mass, height, colour and texture)
- Duration of the effect (temporary/permanent, intermittent/continuous)
- Effectiveness of the proposed mitigation.

Visual sensitivity definitions have been outlined in Table 5-2.

Table 5-2 Assessment of visual sensitivity

Sensitivity	Definition
High	• Occupiers of residential properties with long viewing periods, within close proximity to the proposed development • Users of outdoor recreational area including nature reserves, and nature based recreation (walking, horse riding trails, water based activities such as fishing) where their attention is focussed, in part, on the landscape and its amenity • Communities that place value upon the landscape and enjoyment of views of their landscape setting
Medium	• Outdoor workers who have a key focus on their work who may also have intermittent views of the Project area • Outdoor recreation users (i.e. sporting activities) where their attention is focussed predominately on the activity being undertaken • Occupiers of residential properties with long viewing periods, at a distance from or screened from the Project area
Low	• Road users in motor vehicles, trains or on transport routes that are passing through or adjacent to the study area and therefore have short term views • Viewers indoor at their place of work
Negligible	• Viewers from locations where there is screening by vegetation or structures where only occasional screened views are available and viewing times are short • Road users in motor vehicles, trains or on transport routes that are passing through/adjacent to the study area and have partially screened views and short viewing times

Source: Landscape Institute and Institute for Environmental Management and Assessment (2002).

For the purposes of this assessment, predicted impacts as a direct result of the Project have been described according to their significance, which is a function of the magnitude of the landscape impact and the visual sensitivity of the receptor as detailed in Table 5-3.

Table 5-3 Significance of the impact

		Landscape impact			
		Large	Moderate	Small	Negligible
Visual sensitivity	High	Major	High	Moderate	Minor
	Medium	High	Moderate	Minor	Negligible
	Low	Moderate	Minor	Negligible	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible

Source: modified from Landscape Institute and Institute for Environmental Management and Assessment (2002).

5.2.2 Description of environmental values

5.2.2.1 Landscape character

The following section provides an overview of the existing landform, land uses and vegetation in the vicinity of the Project. The features all contribute to the landscape and visual character of the areas.

Eden Bann Weir is located in a rural area, with beef cattle grazing the predominant land use. The large rural properties of the area are generally served by unsealed roads, branching from the major arteries of the Bruce and Capricorn highways. The existing road access to Eden Bann Weir is via the left (northern) bank.

The landscape of the Eden Bann Weir area is a mix of rugged high ranges, low undulating hills and alluvial plains. Flatter areas are predominantly cleared for grazing; however there are large areas of woodland vegetation on low rocky hills. The Fitzroy River in this area is wide and slow-flowing with a series of sand banks that are vegetated with Melaleuca. The riparian vegetation is narrow where adjacent to grazing land, and wider and more extensively vegetated adjacent to rocky hills. A series of side-tributaries join the Fitzroy River between Eden Bann Weir and Glenroy Crossing. The area surrounding Eden Bann Weir contains a high proportion of remnant vegetation cover relative to other sections of river within the Project area. Figure 5-1 shows the existing landscape character of the area surrounding Eden Bann Weir.

The Rookwood Weir site is located in a rural area, with beef cattle grazing the predominant land use. The large rural properties of the area are also generally served by unsealed roads utilising numerous formal and informal river crossings. The weir site itself is on the Fitzroy River however the river areas that will be influenced by the Project incorporate the confluence and upstream areas of the Dawson and Mackenzie Rivers.

The landscape of the Rookwood Weir site is predominantly flat and cleared for grazing, however low undulating rocky hills occur in places and retain remnants of native woodland vegetation. For the most part the section of the Fitzroy River that will be impacted by the proposed weir is generally narrower, more vegetated and dynamic than areas further downstream. There are no man-made weirs or barrages in this section of river and consequently, it retains many of the features of a natural riverine system including a less defined river channel than areas downstream with mature vegetation established on shallow sand banks within the river. Figure 5-2 shows the existing landscape character of the area surrounding the proposed Rookwood Weir site.

Figure 5-1 Eden Bann Weir landscape character

Eden Bann Weir – the characteristics of the river and the surrounding undulating landform are visible from this location.

Eden Bann Weir (upstream) – the vegetated riparian zone, steep banks and surrounding landscape along the Fitzroy River are shown.

River landscape at Eden Bann Weir wall and upstream. The water provides an attractive foreground while the vegetated hills and ridges frame the background view.

Figure 5-2 Rookwood Weir site landscape character

The river landscape immediately upstream of the proposed Rookwood site comprising channels and low banks.

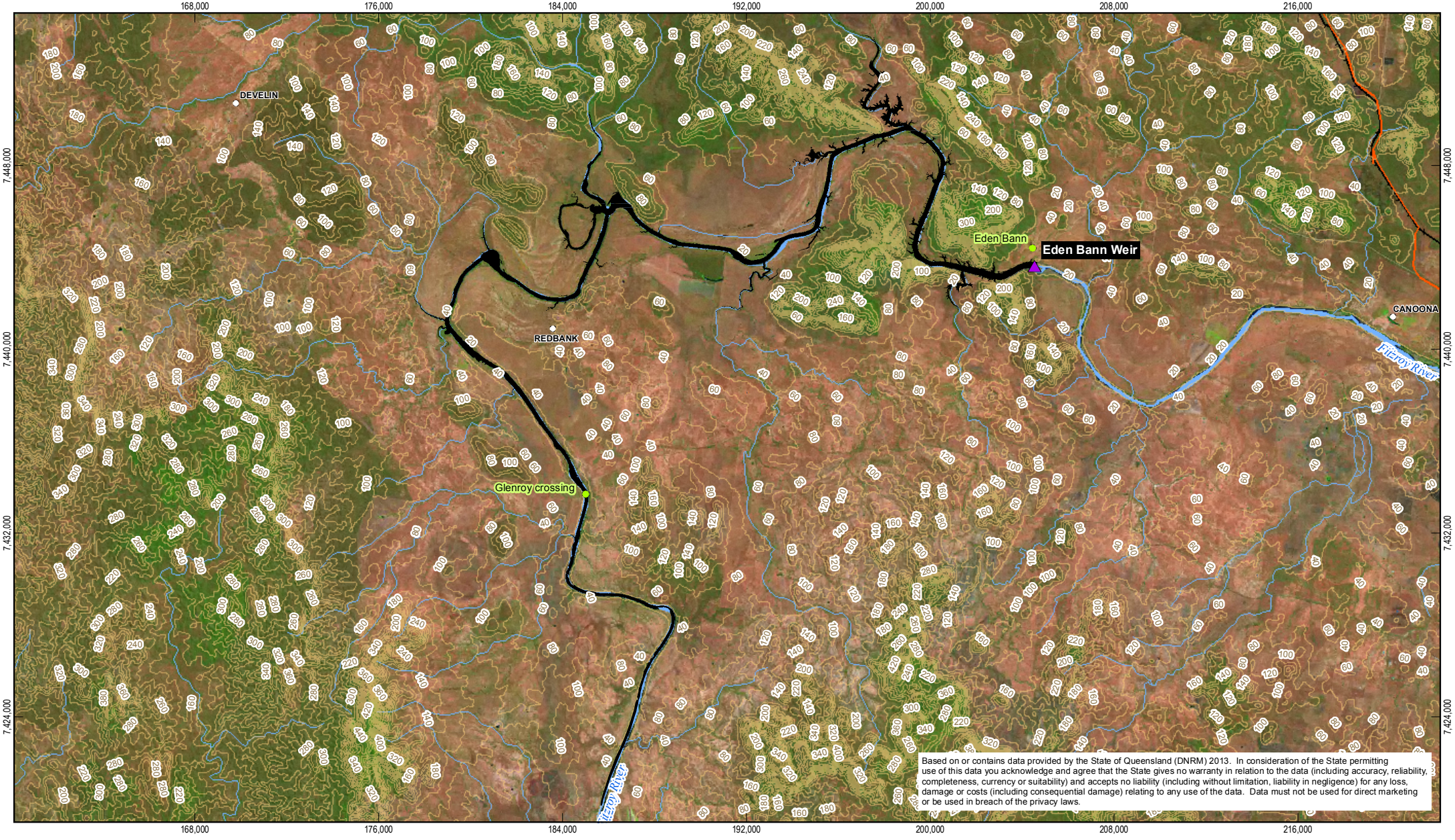
Rural character of the area in the vicinity of the Fitzroy River. Hills and vegetated ridges in the area provide the visual backdrop to the rural landscape.

5.2.2.2 View points

The characteristics of the Project areas are such that there are limited locations accessible to the public from which the weirs and the consequential inundation will be visible. The land adjacent to both Eden Bann Weir and the proposed Rookwood Weir site and associated inundation zones (on both sides of the Fitzroy, Dawson and Mackenzie rivers) is generally in private ownership and used for rural based activities limiting the ability for the general public to either view or access the rivers.

The viewpoints that have been identified and shown on Figure 5-3 are predominately comprised of public river crossings where upgrading works are proposed, elevated positions where views of the river may be possible and the weir sites themselves.

The existing visual environment is described in Table 5-4 and Table 5-5 for Eden Bann Weir and the proposed Rookwood Weir site, respectively.



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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
- Highway
- Major Road
- Railway
- Waterway
- Impoundment Area
- Homesteads
- View Point
- 10m Contour

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Gladstone Area Water Board

SunWater Making Water Work

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number	41-20736
Revision	A
Date	08 Jan 2014

Eden Bann Weir
View point locations

Figure 5-3

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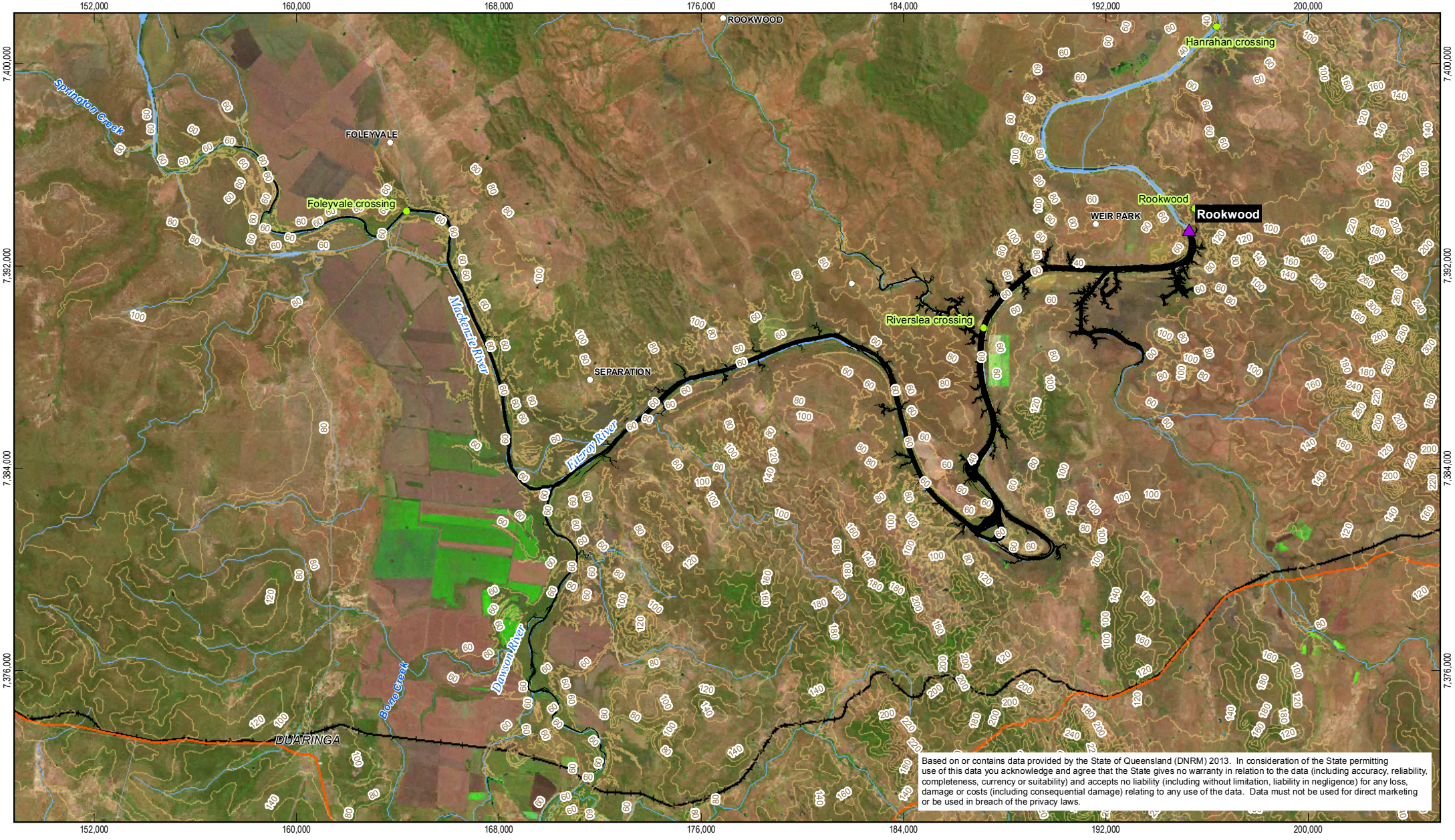
Level 9, 145 Ann Street Brisbane QLD 4000 Australia T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: © Copyright Commonwealth of Australia (Geoscience Australia): Places, Waterways (2007); Sunwater: Waterways, Weir Locations - 2008; DNRM: Railways, Roads, Contours -2010, Imagery - 2005. Created by: MS *See Appendix for disclaimers and copyrights.



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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
- Highway
- Major Road
- Railway
- Waterway
- Impoundment Area
- Homesteads
- View Point
- 10m Contour

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Gladstone Area Water Board

SunWater Making Water Work

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number	41-20736
Revision	A
Date	08 Jan 2014

Rookwood
View point locations

Figure 5-4

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Data Source: © Copyright Commonwealth of Australia (Geoscience Australia): Places, Waterways (2007); Sunwater: Waterways, Weir Locations - 2008; DNRM: Railways, Roads, Contours -2010, Imagery - 2005. Created by: MS *See Appendix for disclaimers and copyrights.

Table 5-4 Eden Bann Weir and impoundment existing visual environment

View point	Typical landscape character	Landform	Land use	Visual context
Road access and weir site Access to Eden Bann Weir (northern bank approach)		The landform in the vicinity of the weir is characterised by a wide river channel with defined banks (Figure 5-1). The steepness of the banks increases immediately upstream of the weir. The steep vegetated ridges upstream of the weir are visible from this location and provide the background views.	The area surrounding the weir is dominated by rural land uses although these uses are generally not visible from this location. A private road runs to the weir on the left bank.	Private road access to the weir (left bank) through private land provides views over the weir structure and the river upstream and downstream. The area is characterised by vegetated river banks and no visible buildings. No formal access is provided to the weir on the right bank within private land adjoining the site. The weir, while being a significant structure in the visual landscape at this location has some visual interest. In addition, Eden Bann Weir provides for the impoundment of the river which provides a visually appealing outlook.
Access to Eden Bann Weir (southern bank approach)				
Glenroy Crossing		The landform in the vicinity of the crossing is defined by a wide river channel that has a number of large sand deposits and rocky outcrops. The banks in this location are less steep than other parts of the Fitzroy River.	The area surrounding the crossing is dominated by rural land uses although these uses are not visible from this location. Glenroy Road (and crossing) is used as a 'through road' and has a local function providing access to properties on either side of the river. The crossing is considered important for communities located in the northern part of the region providing a link to Rockhampton.	The river crossing point provides one of the few opportunities to view the river. The view from this location is dominated by the river and the riparian vegetation. The seasonality of the river flows is such that the visual appearance of the river varies significantly throughout the year with the crossing also impassable due to high river levels for significant periods in most years. The river in this location has a reasonably natural appearance with few buildings or other structures visible.

View point	Typical landscape character	Landform	Land use	Visual context
			The crossing volume is estimated at 319 trips per month (two-way traffic).	Views from these locations are experienced by: • Road users travelling through the area • People accessing the river.
Elevated positions View of Eden Bann Weir showing wide river channel and adjacent ridges set back from the river.		The landform along the river is characterised by: • Defined river banks with mature riparian vegetation • The river banks are steep in parts with limited access available from the adjacent properties • River sections where the channel widens with deposits of sand.	Land uses along the length of the river are rural in nature with grazing being the main land use. Dwellings and other structures, with the exception of pump houses, are generally located away from the river.	No homesteads have views of the Eden Bann Weir due to the topography and screening vegetation. There are no known dwellings with views of the river. No dwellings are visible from the river largely due to the topography of the area and the screening vegetation. Where views are possible they will be experienced by: • Private landowners with both screened and unscreened views over long viewing periods • Activity focused rural workers.
Eden Bann Weir in the foreground; raised, vegetated ridgeline in the background				

Table 5-5 Rookwood Weir site and inundation zone existing visual environment

View point	Typical landscape character	Landform	Land use	Visual context
Road access and weir site Rookwood Weir site view downstream		The landform in the vicinity of the weir site is characterised by a wide river channel with defined, steep and rocky banks. The river channel at the weir site is characterised by rocky outcrops.	The area surrounding the weir site is dominated by rural land uses although these uses are generally not visible from this location due to screening vegetation.	Public access to the weir site (via a track) currently provides views over the site and the river upstream and downstream. The area is characterised by vegetated river banks and rocky outcrops. There is no existing infrastructure at the site.
Rookwood Weir site steep and rocky bank				
River crossings Riverslea Crossing		The landform in the vicinity of the crossing points are characterised by: • Defined river banks with mature vegetation • Rocky hills and outcrops occurring in places • Rocky pools • Areas of sand and gravel build-up.	The areas surrounding the river crossings are dominated by rural land uses although from the crossing points these land uses are generally not visible. The crossing is considered important for communities north of the river and provides access to Duaringa and Rockhampton. The crossing volume is estimated at	The river crossings provide some of the few opportunities to view the river with the visual context dominated by the river and the riparian vegetation. The river in these locations has a reasonably natural appearance with few buildings or other structures visible. Views from these locations are experienced by: • Road users travelling through the area

View point	Typical landscape character	Landform	Land use	Visual context
Foleyvale Crossing			331 trips per month (two-way). Foleyvale Crossing provides an important north-south connection. The crossing volume is estimated at 145 trips per month (two-way).	• People accessing the river.
Elevated positions View of the Rookwood Weir site from an elevated position on the bank		The landform along the river is characterised by: • Defined river banks with mature vegetation. The river banks are steep in parts with limited access available from the adjacent properties • Flat to gently undulating cleared grazing land • Rocky hills and outcrops occur in places.	Land uses along the length of the river are predominately rural in nature with grazing being the main land use. Dwellings and other structures, with the exception of pump houses, are generally located away from the river.	There are no dwellings with views of the Rookwood Weir site. There are no known dwellings that have views of the river largely due to the topography of the area and screening vegetation. Where views are possible they will be experienced by: • Private landowners with both screened and unscreened views over long viewing periods • Activity focused rural workers.
Elevated view looking towards the river on the western bank				

5.2.3 Potential impacts and mitigation measures

5.2.3.1 Visual project elements

The proposed construction works are summarised below, along with the elements, or consequences of the Project that will be visible during the operation stage. A detailed description of the Project is provided in Chapter 2 Project description.

The construction stage of the Project incorporates:

- Construction activities at the weir site to raise Eden Bann Weir include vegetation clearing, coffer dam construction, fish passage construction, establishment of storage and batching areas and weir construction – these works will be visible only when viewed from the current private access road
- Construction of Rookwood Weir including vegetation clearing, coffer dam construction, fish passage construction, establishment of storage and batching areas, and weir construction – access to this site is via a track and viewing of the works is limited by the location and remoteness of the access arrangements
- Upgrading and construction of access roads
- Construction of new river crossings, including bridge construction at Glenroy, Riverslea and Foleyvale crossings. The new bridges and crossings will be accompanied by works on the approach roads
- Lighting associated with night works.

The operational stage of the Project will incorporate:

- Inundation upstream of both weirs
- Dieback of riparian vegetation that is submerged due to inundation.

The constructed elements of the Project will be visible in the landscape. The operational infrastructure will not be permanently lit at night. Emergency maintenance activities may require some night time lighting.

5.2.3.2 Visual impact assessment

Table 5-6 and Table 5-7 detail the assessments of the potential landscape and visual impacts of the Project on viewpoints for both the construction and operational phases of the Project. The Project is assessed as having negligible visual impacts and mitigation measures are not proposed. Lighting impacts associated with the Project's construction and operations phases are addressed separately in Section 5.2.3.3.

Table 5-6 Eden Bann Weir visual impact assessment

View point	Visible project elements	Landscape impact	Visual sensitivity	Significance of the impact*
Road access and weir site	• Construction activities associated with weir raising • Access road construction • Increased stored water level following completion of weir • Submerged vegetation along the river due to increased stored water levels	During construction of the weir and access roads a temporary change to the landscape will be experienced. The operation of the weir and access roads will result in similar landscape impacts to those currently experienced. It is assessed that the Project will have a small (construction) to negligible (operation) landscape impact from this view point. Given that construction related impacts are temporary and short –term, the landscape impact overall is considered to be **negligible**.	The visual impacts resulting from the Project include: • Minor increased loss of naturalness • Minor changes to the landform. This location will provide for views of the increased stored water level which is often considered to be visually appealing. Road access to Eden Bann Weir already exists and the location is accessed by few people (Eden Bann homestead residents and farm workers). New road access will traverse private land accessed by farm workers. Short term views will be experienced. The visual sensitivity is considered to be **negligible**.	Negligible
Glenroy Crossing	• Upgrading of the crossing and road approaches • Increased stored water level following completion of weir • Submerged vegetation along the river due to increased stored water level	Bridge construction and loss of vegetation due to road works during construction will temporarily impact the landscape. The operation of the weir will result in increased stored water levels at this location. The operation of the crossing will result in landscape impacts equal to those currently experienced. It is assessed that the Project will have a **small** landscape impact from this view point during construction and operation.	Glenroy Crossing already exists and the location is experienced by road users. During construction, road users will experience short terms views of construction related activities. During weir and crossing operation road users will experience short term views of the increased stored water level which may improve the visual appearance of the river. The receptor sensitivity is considered to be **low** during construction and **negligible** during operations.	Negligible
Elevated positions in vicinity of the Project (weir site, river crossings and impoundment)	• Increased stored water level following completion of weir • Submerged vegetation along the river due to increased stored water level	No houses have views of the weir or Glenroy Crossing. No known houses have direct riverfront views largely due to the topography and riparian vegetation. The primary permanent change to the visual landscape is the change in stored water level during operations. It is assessed that the Project will have a **small** landscape impact during construction and a **negligible** landscape impact during operations.	Elevated positions set back from the river will retain views similar to those currently experienced. There are no homesteads with views of the weir or crossing. Eden Bann homestead and farm workers may experience short term views associated with the use of the access road equal to those currently experienced. Receptor sensitivity is considered **negligible**.	Negligible

*Refer to Table 5-3

Table 5-7 Rookwood Weir visual impact assessment

View point	Visible project elements	Landscape impact	Visual sensitivity	Significance of the visual impact*
Road access and weir site	• Weir construction and associated vegetation clearing • Access road construction • Stored water level following completion of weir • Submerged vegetation along the river due to stored water level	During construction of the weir and access roads a temporary change to the landscape will be experienced. The operation of the weir and access road will result in a permanent change to the landscape (weir structure and stored water level). It is assessed that the Project will have small (construction) and minor (operation) landscape impact. Given that construction related impacts are temporary and short-term, the landscape impact overall is considered **minor** to reflect the operational landscape impact.	The visual impacts resulting from the Project include: • Minor increased loss of naturalness • Minor changes to the landform. This location will provide for views of stored water which is often considered to be visually appealing. This location will also provide for views of the weir itself. The remote and isolated location limits views to farm workers. Short term views will be experienced. The visual sensitivity is assessed as being **negligible**.	Negligible
River crossings including: Riverslea Crossing Foleyvale Crossing	• Upgrading of the crossings and road approaches, and any associated vegetation clearing • Stored water following completion of weir • Submerged vegetation along the river due to stored water level	Bridge construction and loss of vegetation due to road works during construction will temporarily impact the landscape. The operation of the weir will result in stored water. The operation of the crossing will result in landscape impacts equal to those currently experienced. It is assessed that the Project will have a **small** landscape impact from these view points during construction and operation.	Riverslea and Foleyvale crossings already exist and the location is experienced by road users. During construction, road users will experience short term views of construction related activities. During weir and crossing operation road users will experience short term views of the stored water which may improve the visual appearance of the river. The receptor sensitivity is considered to be **low** during construction and **negligible** during operations	Negligible
Elevated positions (homesteads) in vicinity of the Project (weir site, crossings and along the river)	• Stored water following completion of weir • Submerged vegetation along the river due to stored water level	No houses have views of the weir or crossings. No known houses have direct riverfront views largely due to the topography and the extent of the riparian vegetation. The primary permanent change to the visual landscape is the change in stored water level during operation. It is assessed that the Project will have a **small** landscape impact during construction and a **negligible** landscape impact during operations.	Homesteads in elevated positions set back from the river will retain views similar to those currently experienced. There are no homesteads with views of the weir or crossings. Farm workers may experience short term views associated with the use of the access road. Receptor sensitivity is considered **negligible.**	Negligible

*Refer to Table 5-3

5.2.3.3 Lighting impacts and mitigation measures

Construction activities will as far as practicably possible be restricted to day light hours. In the event that lighting is required to facilitate night works (for example concrete pour operations) there is the potential for light pollution to temporarily impact on the homestead in the vicinity of Eden Bann Weir and disrupt nocturnal fauna behaviour (Chapter 7 Aquatic fauna and Chapter 8 Terrestrial fauna). No homesteads will be impacted as a result of light polluting at Rookwood Weir site or at river crossing locations.

The following measures will be implemented to manage these impacts:

- Night works will be restricted as far as is possible. In particular, consideration will be given to avoiding night works during turtle nesting periods and in areas directly adjacent to or within sensitive areas, such as remnant vegetation and within the river bed
- Notification will be provided to the Eden Bann homestead at least seven days in advance advising the date, time, duration and nature of night works
- Directional lighting and shields will be installed to minimise light spill outside of the immediate work areas having consideration of health and safety requirements
- Speed limits on site and along access roads will be reduced.

Safety and security lighting associated with construction site facilities (site office, workshops, sheds, storage areas etc.) will be minimised. Safety and security lighting will make use of directional lighting (with shields) that is sensor activated to reduce sky glow when the site is unoccupied.

Lighting at Eden Bann Weir and Rookwood Weir during operations will be limited to directional sensor activated lighting for safety and security purposes. As far as is possible, scheduled maintenance will be undertaken during day light hours. Night works during operations may be required in emergency situations. In the event that night works are required, directional lighting will be restricted to the immediate work area and in consideration of health and safety requirements. No lighting will be installed within the impoundment or at river crossings.

5.2.4 Summary

The Project is located in a rural area, with beef cattle grazing the predominant land use. The landscape generally comprises a mix of rugged high ranges, low undulating hills and alluvial plains. Low undulating rocky hills occur in places with retained remnants of native woodland vegetation. Flatter areas are predominantly cleared for grazing. The Fitzroy River near Eden Bann Weir is influenced by the existing weir and is wide and slow-flowing with a series of sand banks that are vegetated with Melaleuca. Near the proposed Rookwood Weir site, the river is not regulated and consequently it retains many of the features of a natural riverine system including a less defined river channel than areas downstream with mature vegetation established on shallow sand banks within the river. The river areas that will be influenced by the Project incorporate the confluence and upstream areas of the Dawson and Mackenzie Rivers.

Large rural properties border the weir sites and impoundments with limited public access. Public viewpoints within the Project area are limited to river crossings at Glenroy, Riverslea and Foleyvale with relatively low usage (AADTs of 53, 71 and 72 vehicles/day, respectively). Viewpoints at the weir sites are restricted through private access. There are no houses with views

of the weir sites or crossings. There are no known houses with direct riverfront views due to topography and the presence of riparian vegetation flanking the river.

The nature of the Project will result in changes to the visual landscape and amenity of the area but these changes will be viewed by a limited number of residents, farm workers and road users with short term viewing period. The overall significance of the impacts is assessed as negligible. A summary of the outcomes of the assessment is detailed in Table 5-8.

Unmitigated lighting has the potential to impact on a homestead in the vicinity of Eden Bann Weir and disrupt nocturnal fauna behaviour. The impact of lighting during construction and operation will be adequately and appropriately managed by restricting construction activities to daylight hours as far as possible and using directional sensor activated lighting during operations.

Table 5-8 Summary of impacts

View points	Landscape impact	Visual sensitivity	Significance of impact (construction and operation)
Eden Bann Weir			
Road access and weir site	Negligible	Negligible	Negligible
River crossing	Small	Low / negligible	Negligible
Elevated positions	Small / negligible	Negligible	Negligible
Rookwood Weir site			
Road access and weir site	Minor	Negligible	Negligible
River crossings	Small	Low / negligible	Negligible
Elevated positions	Small / negligible	Negligible	Negligible

5.3 Topography, geology and soils

5.3.1 Introduction

5.3.1.1 Approach and methodology

A desktop assessment was undertaken to determine existing environmental values in relation to topography, geology and soil. Geomorphological characteristics are addressed in Chapter 9 Surface water resources. The desktop assessment included a review of:

- Topography and geomorphology from the Fitzroy River Weir Study (Keane 2004) and via discussion with the report author
- Land systems and soils from Forster and Sugars (2000) *Land Suitability for Irrigated Agriculture along the Fitzroy River*, with mapping at 1:100,000 scale, along the Fitzroy River from Rockhampton to the confluence of the Mackenzie and Dawson rivers
- Land resources and soil types from Rolfe and Loch (2001) *Irrigation Development in the Fitzroy Basin: Production and Development Tradeoffs*
- Land resources and soil types from Speck et al (1968) *Lands of the Dawson-Fitzroy Area, Queensland*, McCarroll (1998) *Agricultural land evaluation of the Mackenzie River* and McCarroll and Forster (1999) *Agricultural land evaluation along the lower Dawson River*

- Good quality agricultural land (GQAL) maps published by the Queensland State Government (DERM 2007)
- Strategic cropping land trigger maps published by the Queensland State Government (DERM 2012)
- Geological analysis for Eden Bann Weir based on assessment, interpretation and analysis of available information including from four previous phases of site investigations (Houlsby 1976, Water Resources Commission 1990, Water Resources Commission 1995, SunWater 2009). A review of construction records was also undertaken as well as field inspections
- The geological analysis for the Rookwood Weir site is based on assessment, interpretation and analysis of available information including from three previous phases of site investigations (Department of Main Roads 2003, GHD 2007, SunWater 2008). Aerial photographic interpretation, field inspections and limited petrographic analyses and laboratory testing of core samples were also undertaken.

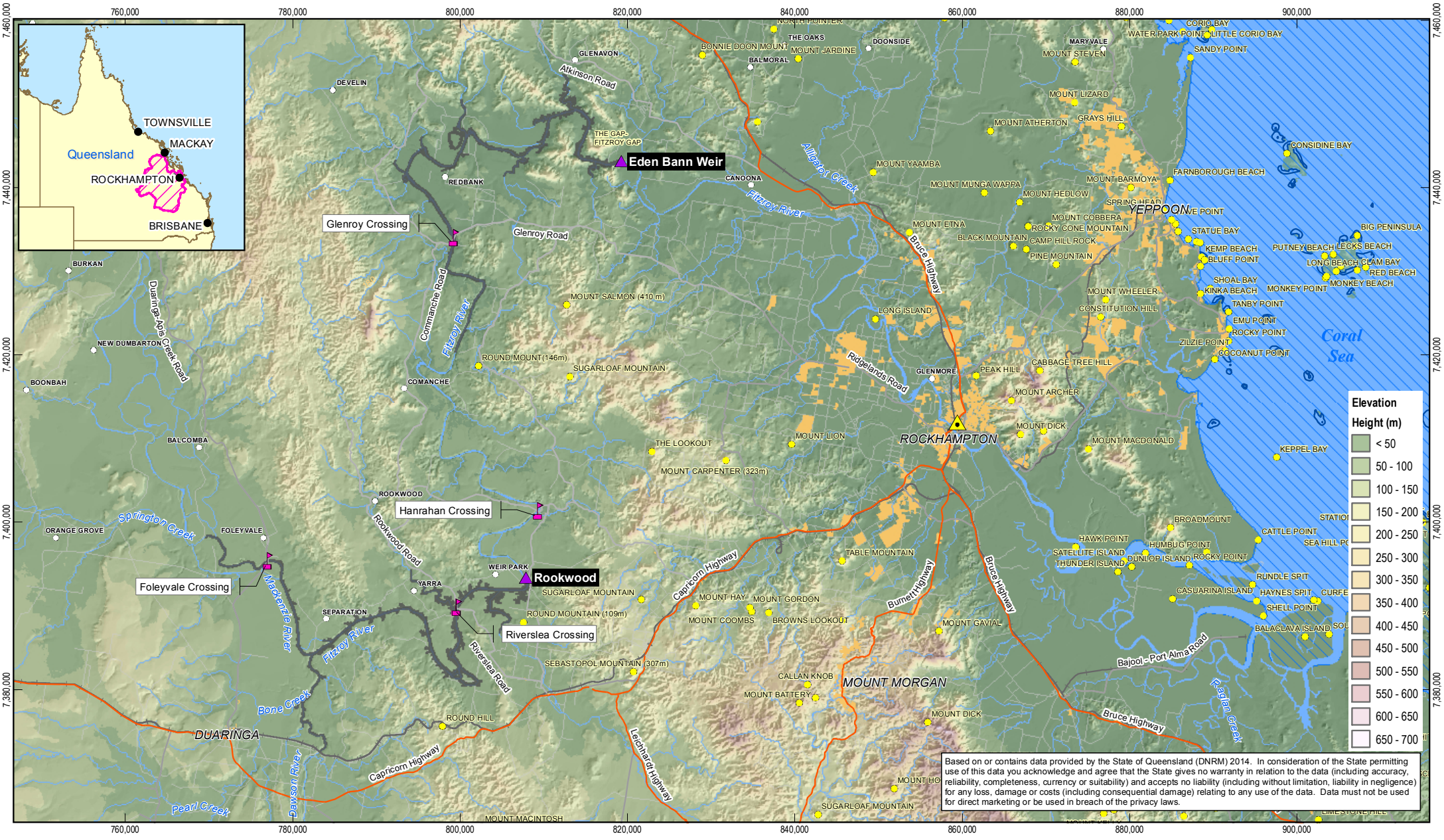
Soil surveys and associated site investigations were not undertaken for the draft EIS. It is proposed (Section 5.3.3.3) that soil surveys will be undertaken during detailed design once a development trigger is realised and consequently prior to construction for each development stage. Soil types within close proximity to the construction footprints have been identified from available mapping (Forster and Sugars 2000 and Speck et al. 1968). Chemical data was available for some soil types and used to determine dispersion potential and soil fertility. In the absence of chemical data, soil descriptions were used. Geological investigations undertaken for the Project provided information with which to progress concept/preliminary design components. Further geotechnical investigations will be undertaken to inform the detailed design phase. Inundation associated with normal operations of the weirs is confined to the river bed and banks. Vegetation clearing through mechanical means is restricted to the area immediately surrounding the weir abutments and will facilitate construction activities. Further soil investigations will inform the development of construction erosion and sediment control plans (ESCPs), stormwater management plans, rehabilitation plans and operational erosion control measures.

5.3.2 Description of environmental values

5.3.2.1 Topography

Topographical features within the Project region are illustrated in Figure 5-5. Mount Archer is the most notable landscape feature at 604 m above sea level and lies east of Rockhampton City within the Berserker Range. Figure 5-6 and Figure 5-7 provide an overview of the local topography at Eden Bann Weir and Rookwood, respectively (detailed topographical mapping is provided in Appendix G).

The upper 130 km of the Fitzroy River downstream from the junction of the Dawson and Mackenzie Rivers has a remarkably uniform channel. The deeply incised river channel here has a riverbed some 150 m to 200 m wide with typically 25 m high banks. This channel passes through undulating to relatively level country that is largely cleared for beef cattle grazing and occasional field crops (Keane 2004).



1:600,000 (at A4)

0 5 10 15 20

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
- Location
- River Crossing
- Fitzroy Barrage
- Homesteads
- Highway
- Major Road
- Railway
- Waterway
- Fitzroy Basin
- Urbanised Area
- Impoundment Area
- Great Barrier Reef World Heritage Area

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Regional topographic features

Figure 5-5

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Data Source: GHD: Proposed Bridge and Road Relignment, Elevation (2013); © Copyright Commonwealth of Australia (Geoscience Australia): Places, Waterways, Homesteads (2007); Sunwater: Waterways, Weir Locations (2008); DNRM: Railways, Roads, Localities - 2010, Hillshade - 2008, GBR WHA - 2010.
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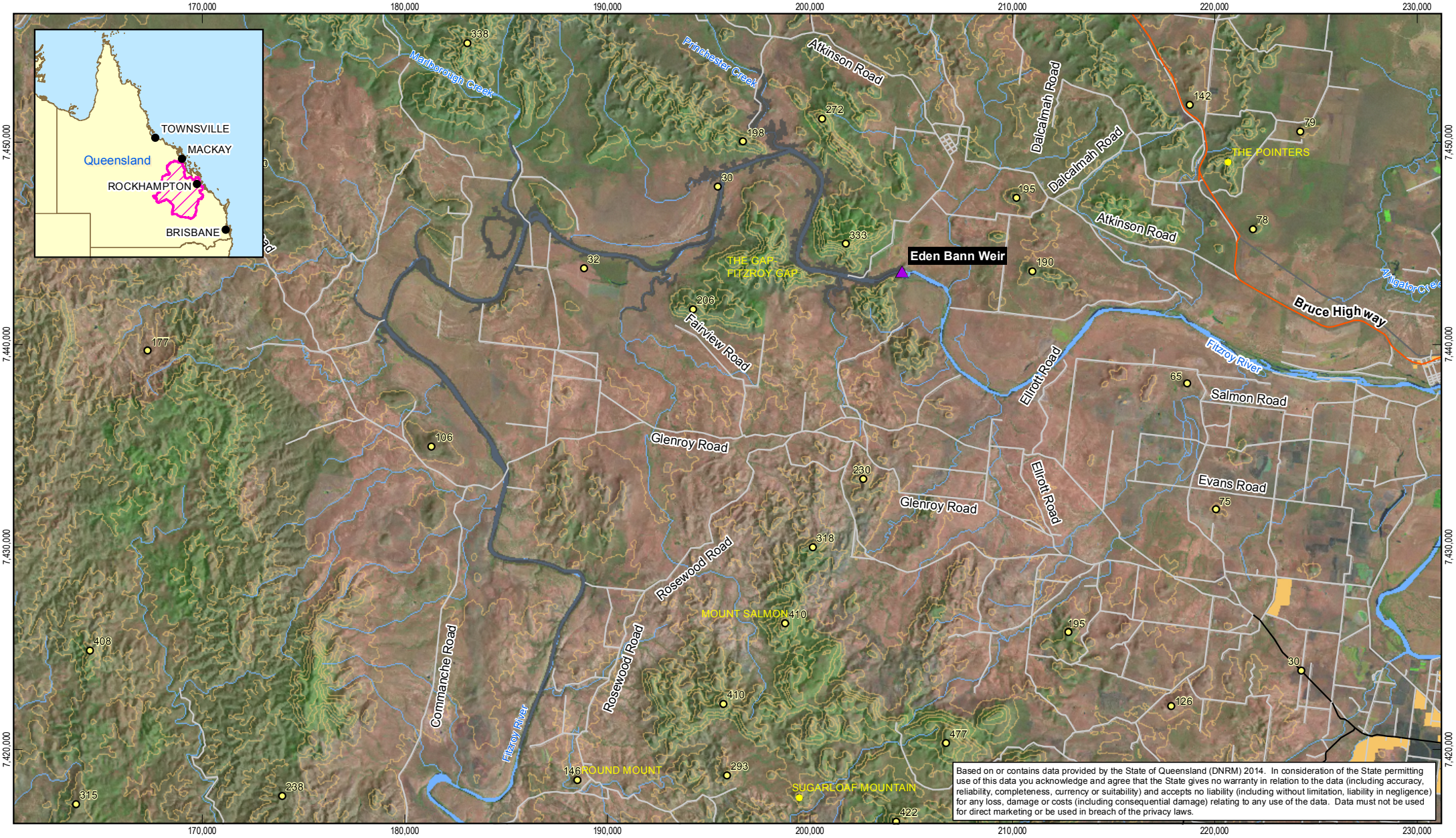

1:250,000 (at A4)

0 2.5 5 7.5 10

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
- Fitzroy Barrage
- Locations/Spot heights
- Highway
- Major Road
- Secondary Roads
- 10m Contour
- Fitzroy Basin
- Urbanised Area
- Impoundment area
- Waterway

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Eden Bann Weir Project area topographical features

Figure 5-6

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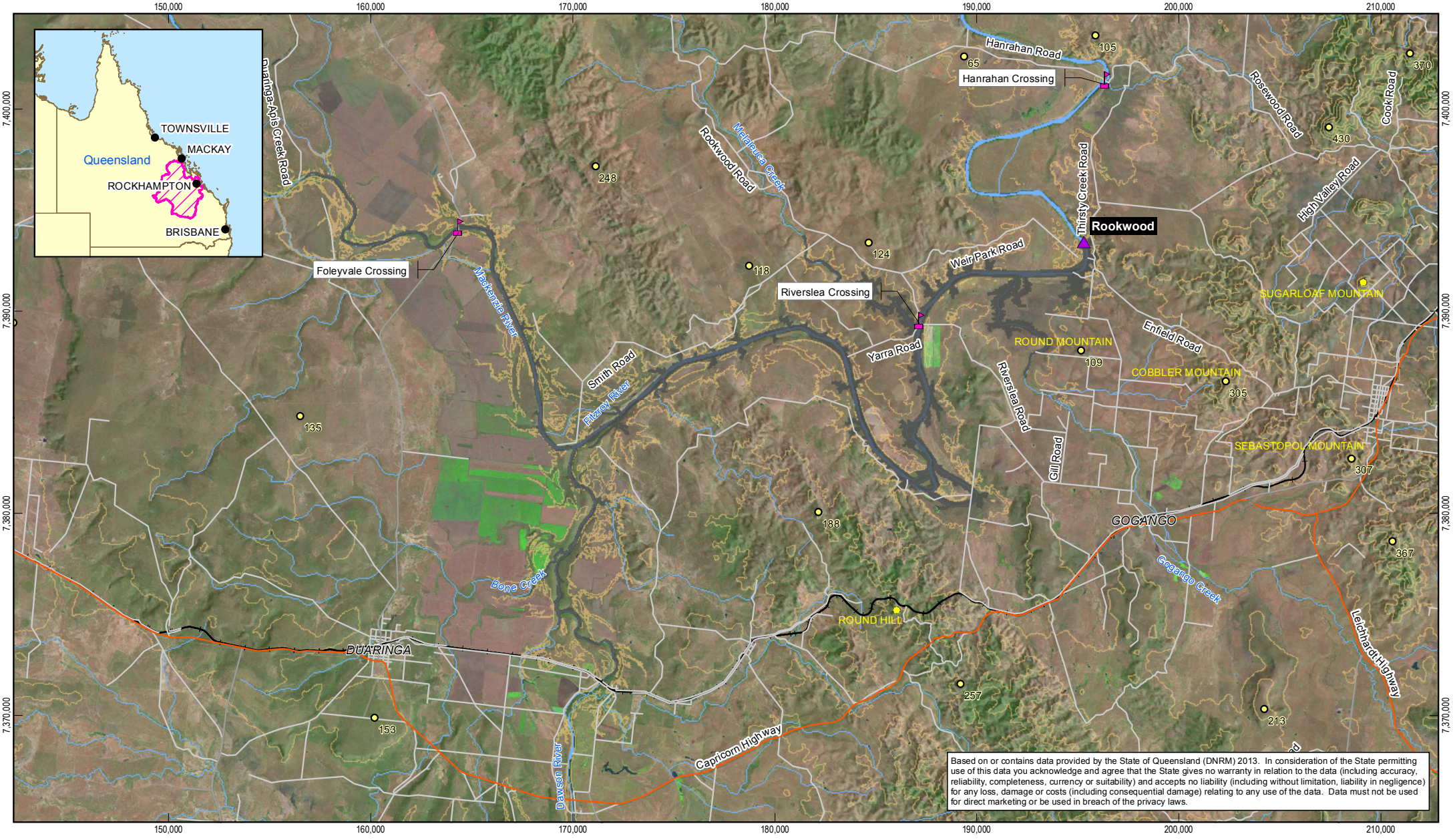

1:250,000 (at A4)

0 2.5 5 7.5 10

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
- River Crossing
- Locations
- Highway
- Major Road
- Secondary Roads
- 10m Contour
- Fitzroy Basin
- Urbanised Area
- Impoundment Area
- Waterway

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Date 24 Mar 2014

Rookwood Project area topographical features

Figure 5-7

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The high banks contain most flows. During low river flows, the river channel consists of long pools separated by fairly short riffle zones. With moderate to high flood flows, the river maintains a uniform gradient of about 0.2 m fall per kilometre of river length (Keane 2004). The Fitzroy River's strong meandering habit suggests the river course is controlled by the underlying structural geology. Relatively straight 3 km to 7 km long sections of river are followed by sharp angular bends, often where the channel has encountered more resistant geological barriers. This 130 km section of river covers a straight line distance of only 62 km (Keane 2004).

From Redbank to Eden Bann Weir, the Fitzroy River flows through the rugged coastal ranges dominated by serpentinite and volcanic rocks of the Marlborough Block. The ranges comprise the largest serpentinite mass in Queensland, which is the origin of the lateritic nickel and magnesite deposits. This section of the Fitzroy River channel is now affected by the existing Eden Bann Weir impoundment (Keane 2004).

At the 'Fitzroy Gap' (also known as The Gap) (located between 143 and 149 km Adopted Middle Thread Distance (AMTD) rugged high ranges (between 250 m and 200 m) are located on both immediate sides of the Fitzroy River channel. A 1977 feasibility study considered dams here with full supply levels up to (elevated levels) 56 m with a storage capacity of 10 million megalitres (Keane 2004). Eden Bann Weir was constructed in 1994 on a granodiorite rock bar immediately downstream of The Gap.

Below Eden Bann Weir, the Fitzroy River passes through cleared grazing country. The bank height of the Fitzroy River channel reduces in this section while the channel width increases and a defined and continuous Fitzroy River floodplain exists through to the river mouth (Keane 2004). Within this area the Fitzroy River Barrage impoundment extends from 59 km AMTD to its upstream limit at 115 km AMTD.

Downstream of Rockhampton to the river mouth in Keppel Bay, a broad flat floodplain adjoins the river, which merges into the Fitzroy River delta and low coastal flats. In places this floodplain is up to 15 km wide. The lower Fitzroy River near its mouth contains a number of low flat islands separated by flood channels fringed with mangroves. These flat clear areas are used for grazing, while the evaporation ponds of two salt works are located along the access road to Port Alma, located at the Fitzroy River's mouth (Keane 2004).

5.3.2.2 Geology

Regional geology

Eden Bann Weir is situated within the Marlborough Block, an area of structurally complex geology with north-west and north-east faults, associated with late Permian orogenic events. The basement rocks consist of late Proterozoic to early Palaeozoic age metamorphic rocks of the Princhester Serpentinites (probably altered olivine basalts). The Serpentinites possibly include amphibolites. The weir itself is situated on a Permian-Triassic age pluton, the Wattlebank Granodiorite that has intruded into the Serpentinites along a very irregular contact zone. There are numerous dolerite, gabbro and diorite dykes intruded into the granodiorites and serpentinites.

The channel of the Fitzroy River at the Eden Bann Weir site is located at a bend in the river where it changes direction from east-north-easterly to south-easterly, and is interpreted to be controlled by major regional geological structures.

An older channel of the Fitzroy River flowed in a north-easterly direction before the bend, immediately upstream of the Eden Bann Weir site. This palaeochannel is now buried by an alluvial terrace of Quaternary (Pleistocene) age, about 1 km in width and contains a large fresh water lake approximately 500 m wide and 800 m long that is filled by the river during exceptional floods. This north-easterly channel is considered to overlie a geological fault, identified by SunWater (2009) as the Planted Creek fault.

Quaternary (Holocene) surface deposits in the form of fluvial sands and gravels in the present river channel and sands, silts and clays on river terraces on the banks are present within the wide river valley floor of the region. Colluvial deposits derived from the underlying granodiorite and serpentinite occur on the hill slopes above the Eden Bann Weir right (southern) and left (northern) banks respectively.

The proposed Rookwood Weir site is situated within the formerly entitled Gogango Over-folded Zone, an area of structurally complex geology associated with late Permian orogenic events. This fold-belt generally lies parallel and west of the interpreted thrust zone, giving rise to its more recent description as the Gogango Thrust Zone.

The channel of the Fitzroy River strikes north-westerly at the proposed Rookwood Weir site, and is interpreted to be controlled by a major regional geological structure. Historic geological mapping suggested the presence of a structure in this area, but more recent 1:100,000 scale mapping (GHD 2007), with additional data provided by airborne magnetic surveys, has confirmed the presence of a major regional thrust underlying the deep alluvium along the left (western) bank of the Fitzroy River at Rookwood (GHD 2007).

The solid geology of the Rookwood area is generally of Permian Age, although a rhyolite intrusion of the Mount Salmon Volcanics of Cretaceous Age occurs at the upstream bend on the right (eastern) bank while Tertiary and Quaternary deposits are distributed throughout the area, generally associated with the region's drainage systems.

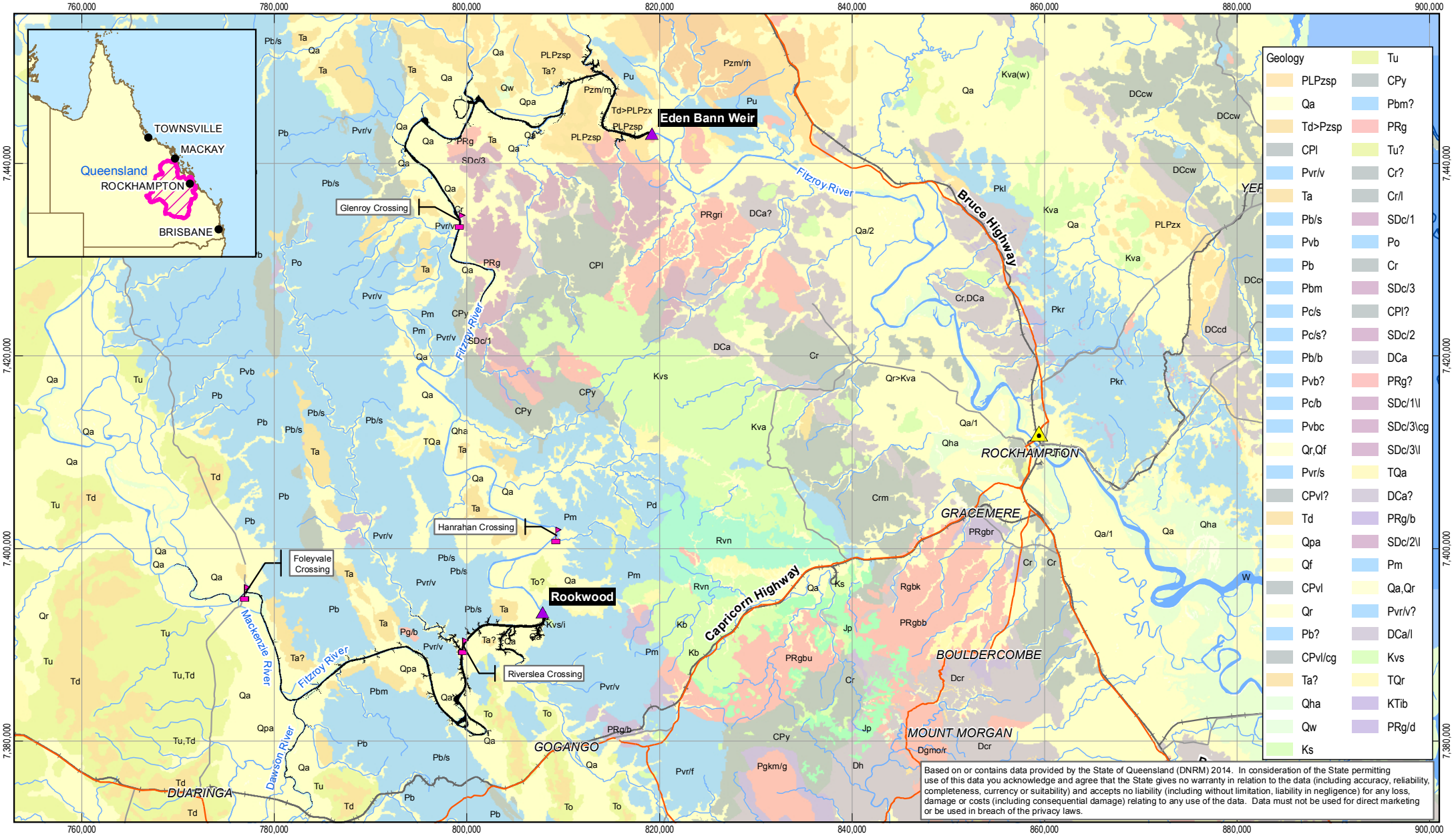
The Rookwood Volcanics and Back Creek Group beds are the oldest geological units in the area, ranging from Lower to Upper Permian in age. Whilst the Rookwood Volcanics are stratigraphically the oldest in the sequence, they have been mapped in the area to overlie the younger Permian strata, indicating the easterly volcanic strata have been thrust-faulted at low angles over the sedimentary strata to the west of the Fitzroy River.

The published 1:100,000 scale geological map sheet of Mount Morgan that includes the proposed Rookwood Weir site describes the Rookwood Volcanics as basaltic pillow lava, and breccia, minor chert, sandstone, siltstone, some dolerite sills or dykes. The Back Creek Group rocks at the Rookwood Weir site are described as mudstone, siltstone and lithic sandstone.

Rhyolite intrusions of Cretaceous age appear to be related to a structural feature associated with the northwest to southeast trend of the Fitzroy River at the Rookwood Weir site and continuing to the southeast with outcrops of rhyolite where it crosses the Capricorn Highway.

Tertiary sedimentary deposits occur and outcrop to the west and north of the Rookwood Weir site. They are considered to underlie the upper 15 m to 20 m of surface alluvial deposits on the left (western) bank. Quaternary (Holocene) surface deposits in the form of fluvial alluvium in the present river channel and river terrace deposits are present within the wide river valley floor of the region. Colluvial and residual soil deposits derived from the underlying basalts, occur on the slopes and top of the right (eastern) bank.

An overview of the regional geology of the Project area is illustrated in Figure 5-8.



1:525,000 (at A4)

0 5 10 15 20

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
- Fitzroy Barrage
- River Crossing
- Highway
- Major Road
- Railway
- Waterway
- Fitzroy Basin
- Impoundment Area

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision D
Date 24 Mar 2014

Regional geology

Figure 5-8

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Data Source: © Copyright Commonwealth of Australia (Geoscience Australia) 2007: Populated Places, Soils - 2007; Sunwater: Waterways, Weir Locations - 2008; DNRM: Railways, Roads - 2010, Geology -2007. Created by: MS *See Appendix for disclaimers and copyrights.

Eden Bann Weir site local geology

Eden Bann Weir is situated on the Wattlebank Granodiorite intruded into the Princhester Serpentinites on either side of the Fitzroy River. Figure 5-9 provides the geological section for the Eden Bann Weir site. The main divisions within the geology on the section are between the transported alluvial soils in the river channel or colluvial soils on the hill slopes, and the bedrock. The bedrock is divided into the younger granodiorite and older serpentinites.

No fossils are mapped as present at Eden Bann Weir or within the impoundment area (Ridgelands geological series sheet 8951) (DNRMW 2006). Eden Bann Weir and the adjacent right bank are situated on granodiorite (igneous rock) while the adjacent left bank is situated in serpentinite (metamorphosed ultrabasic igneous rock). Igneous and metamorphic igneous rocks do not contain fossils. It is considered very unlikely that fossils exist in the Quaternary alluvial deposits in the reservoir channel. In the event that fossils do occur it is considered they would be widespread as the alluvial deposits are extensive.

Rookwood Weir site local geology

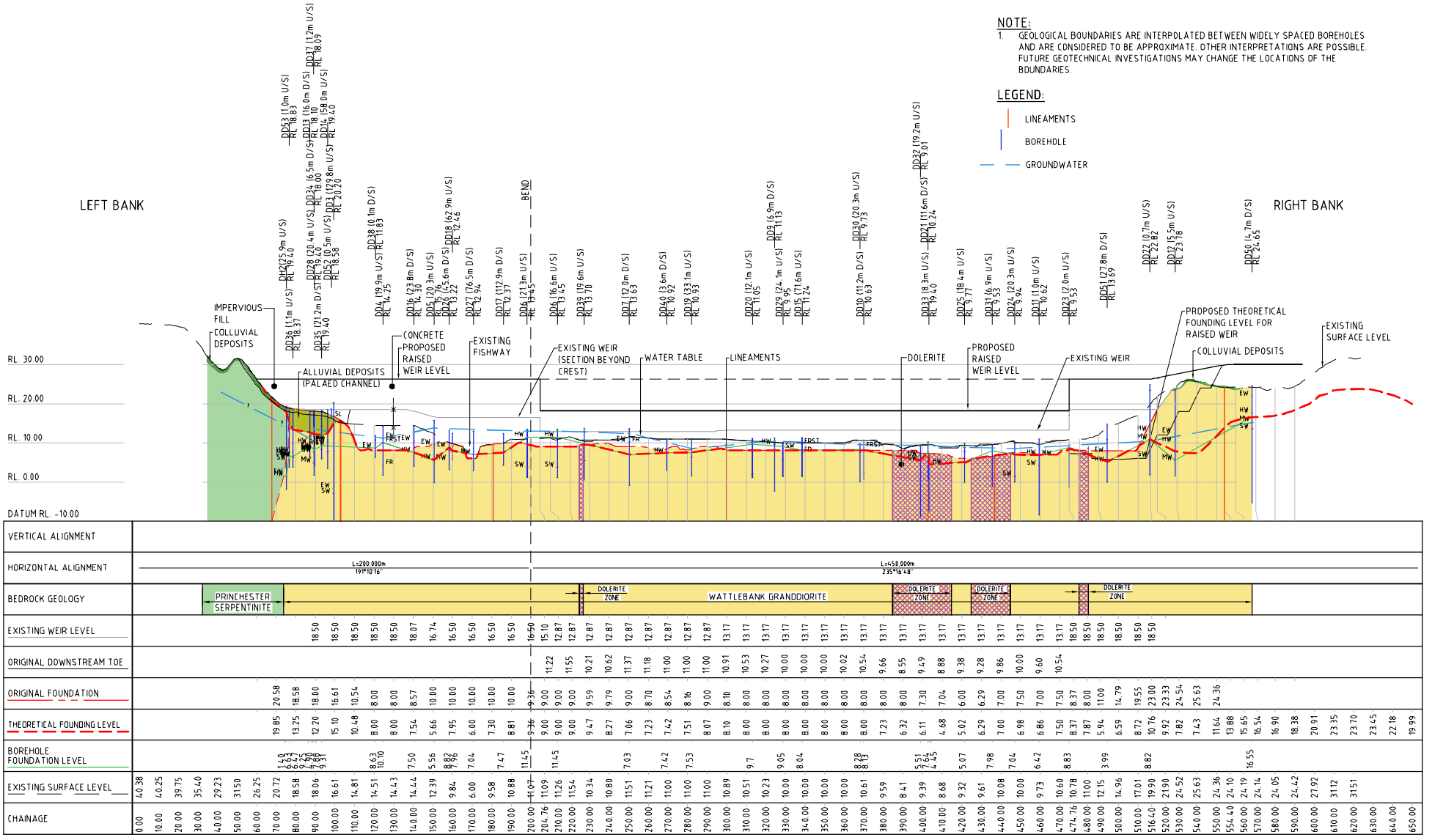
The foundation conditions of the proposed weir are relatively complex, comprising Holocene to Tertiary poorly to well consolidated alluvial deposits, underlain by Permian sedimentary rocks on the left bank and volcanic rocks under the river channel and right bank. In addition, a geological fault is located under the left bank of the Fitzroy River channel separating the older Rookwood Volcanics from the younger sedimentary rocks. Figure 5-10 provides a geological section for the Rookwood Weir site. The main divisions within the geology on the section are between transported alluvial or colluvial soils and bedrock. The bedrock is divided into the younger siltstones and slightly older volcanic lavas.

No fossils are shown to be present at the Rookwood Weir site or within the impoundment (Mount Morgan geological series sheet 8950; Rookwood geological series sheet 8851) (DNRMW 2006a). The proposed Rookwood Weir and adjacent right bank is situated on basaltic pillow lavas of the Rookwood Volcanics. These igneous rocks do not contain fossils. The adjacent left bank and reservoir are situated in Quaternary alluvial deposits in which fossils are considered unlikely.

River crossings

An overview of the geology at Glenroy Crossing, Riverslea Crossing and Foleyvale Crossing is provided:

- Glenroy Crossing: The bedrock geology at the Glenroy Site river crossing consists of basaltic lavas with a vesicular texture and some quartz veining which appear to be metamorphosed to some extent so that they could be referred to as metabasalts. The grain size is generally fine but occasionally coarse and the surface unweathered rocks have a high strength. These metabasalts are located at or near to the existing ground surface level, and have an allowable bearing capacity of 10 megapascals. The basaltic pillow lavas of the Rookwood Volcanics found at Glenroy Crossing are igneous rocks and do not contain fossils. The adjacent left and right banks are situated in Quaternary alluvial deposits in which fossils are considered unlikely. No fossils are indicated as being present at Glenroy Crossing (DNRMW 2006a).



0 5 10 15 20 25m
SCALE 1:500 AT ORIGINAL SIZE

0 10 20 30 40 50m
SCALE 1:1000 AT ORIGINAL SIZE

A SECTION

Figure 5-9 Eden Bann Weir geological section

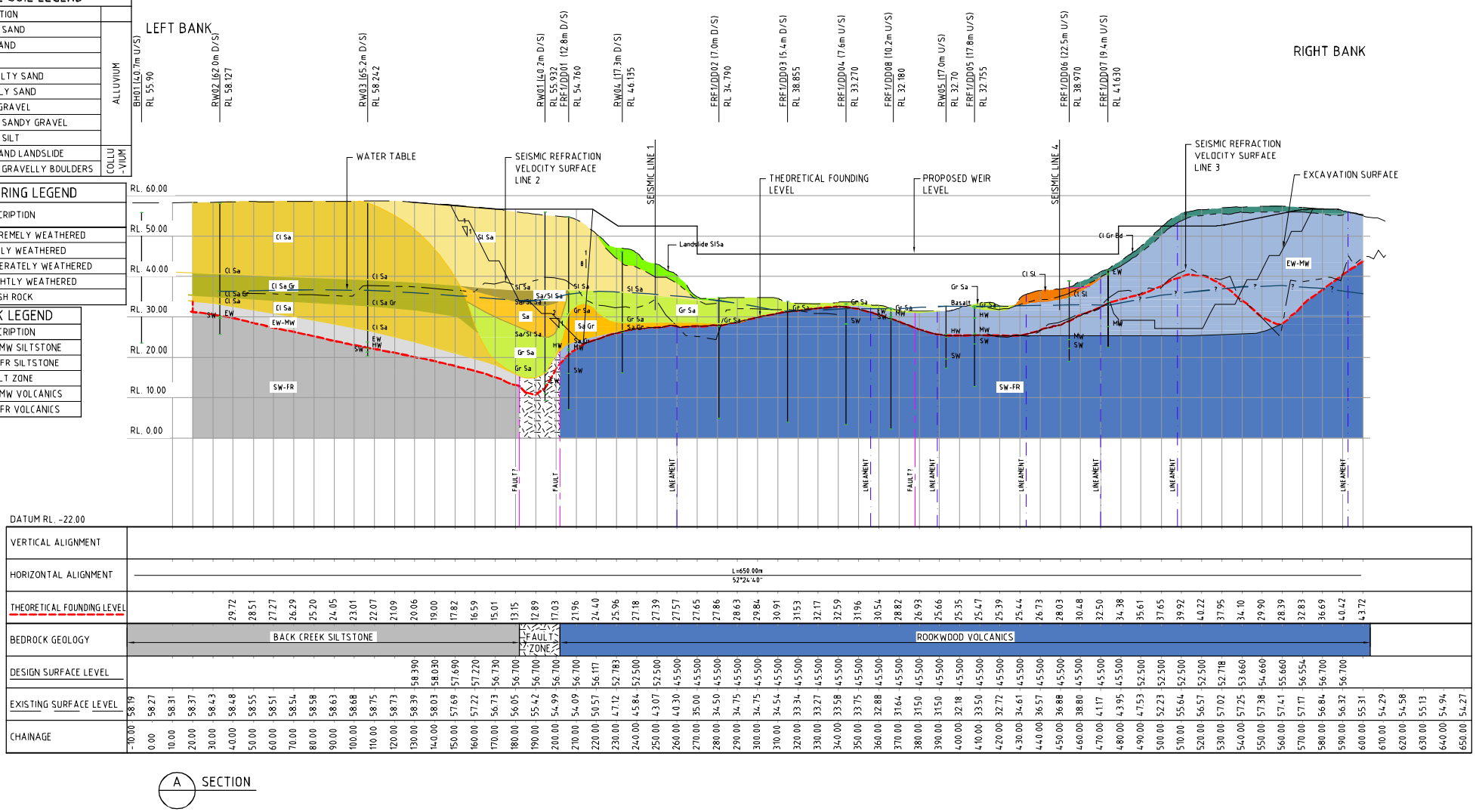
NOTES:

1. THE GEOLOGICAL SOIL LEGEND DESCRIBES THE MAIN SOIL CONSTITUENTS IN EACH UNIT AND CAN BE EXPECTED TO VARY. THEY DO NOT REPRESENT GEOTECHNICAL SOIL GROUPS.
2. GEOLOGICAL BOUNDARIES ARE INTERPOLATED BETWEEN WIDELY SPACED BOREHOLES AND ARE CONSIDERED TO BE APPROXIMATE. OTHER INTERPRETATIONS ARE POSSIBLE. FUTURE GEOTECHNICAL INVESTIGATIONS MAY CHANGE THE LOCATIONS OF THE BOUNDARIES.

GEOLOGICAL SOIL LEGEND		
ABBREVIATION	DESCRIPTION	
ClSa	CLAYEY SAND	ALLUVIUM
SlSa	SILTY SAND	
Sa	SAND	
Sa/Sl Sa	SAND/SILTY SAND	
GrSa	GRAVELLY SAND	
SaGr	SANDY GRAVEL	
ClSaGr	CLAYEY SANDY GRAVEL	
ClSl	CLAYEY SILT	
SlSa	SILTY SAND LANDSLIDE	COLLUVIUM
ClGrBd	CLAYEY GRAVELLY BOULDERS	

WEATHERING LEGEND	
ABBREVIATION	DESCRIPTION
EW	EXTREMELY WEATHERED
HW	HIGHLY WEATHERED
MW	MODERATELY WEATHERED
SW	SLIGHTLY WEATHERED
FR	FRESH ROCK

ROCK LEGEND	
	DESCRIPTION
	EW-MW SILTSTONE
	SW-FR SILTSTONE
	FAULT ZONE
	EW-MW VOLCANICS
	SW-FR VOLCANICS



A SECTION

0 10 20 30 40 50m
SCALE 1:1000 AT ORIGINAL SIZE

0 5 10 15 20 25m
SCALE 1:500 AT ORIGINAL SIZE

Figure 5-10 Rookwood Weir site geological section

- Riverslea Crossing: Large areas of rock outcropping are present in the river channel at the Riverslea Crossing. The bedrock geology consists of interbedded sandstones and shales. General bedrock elevation is RL 34.0 m to RL 34.5 m. The sandstones and shales appear to be slightly metamorphosed to quartzites and slates. They are moderately weathered and high to medium strength. The mudstone, siltstone and sandstone of the Back Creek Group found at Riverslea Crossing are sedimentary and may contain fossils but this geological unit is generally above reservoir level and is widespread. The adjacent left and right banks are situated in Quaternary alluvial deposits in which fossils are considered unlikely. No fossils are indicated as being present at Riverslea Crossing (DNRMW 2006a).
- Foleyvale Crossing: The bedrock geology in the river channel at the Foleyvale Bridge site consists of interbedded sandstones and shales. The rocks are slightly to moderately weathered and medium to high strength. Foleyvale Crossing is situated on mudstone, siltstone and sandstone of the Boomer Formation, Back Creek Group. General bedrock elevation is RL 46.0 m to RL 47.0 m. A single plant fossil record exists for the Quaternary raised alluvial terrace on the right bank at Foleyvale Crossing (DNRMW 2006b).

5.3.2.3 Land systems and soils

Overview

Soil types mapped along the Fitzroy River at the 1:100,000 scale by Forster and Sugars (2000) were categorised according to field and laboratory descriptions, lithology of the parent material and location within the broader landscape. Forster and Sugars (2000) identified 11 land systems and 68 soil types within a 5 km buffer of the Fitzroy River, from Rockhampton to the confluence of the Mackenzie and Dawson Rivers.

Broadscale mapping reported in Speck et al (1968) characterises soil types in the vicinity of the Mackenzie and Dawson Rivers. Three major soil types were identified and classified within two land units, namely Coolibah and Coreen that border the Mackenzie and Dawson Rivers.

Soil types in the Project area are described using terms defined in the Australian Soil Classification (Isbell 1996). Soil orders are described for the Project area, as follows:

- Chromosols (CH), soils with a strong texture contrast between A horizons and B horizons. The latter are not strongly acid and are not sodic. The soils of this order are among the most widespread soils used for agriculture in Australia, particularly those with red subsoils and in the southern states. Chromosols are only infrequently used for broadacre crop production in Queensland
- Dermosols (DE), soils with structured B2 horizons and lacking strong texture contrast between A and B horizons. Although there is some diversity within the order, it brings together a range of soils with some important properties in common
- Ferrosols (FE), soils with B2 horizons which are high in free iron oxide, and which lack strong texture contrast between A and B horizons
- Kandosols (KA), soils which lack strong texture contrast, have massive or only weakly structured B horizons, and are not calcareous throughout. The soils of this order range throughout the continent, often occurring locally as very large areas
- Kurosols (KU), soils with strong texture contrast between A horizons and strongly acid B horizons. Many of these soils have some unusual subsoil chemical features (high magnesium, sodium and aluminium)

- Rudosols (RU), soils that have negligible pedalogic organisation. They are usually young soils in the sense that soil forming factors have had little time to pedalogically modify parent rocks or sediments. The component soils can obviously vary widely in terms of texture and depth; many are stratified and some are highly saline
- Sodosols (SO), soils with strong texture contrast between A horizons and sodic B horizons which are not strongly acid
- Tenosols (TE), soils with generally only weak pedalogic organisation apart from the A horizons
- Vertosols (VE), clay soils with shrink-swell properties that exhibit strong cracking when dry and at depth have slicken sides and/or lenticular structural aggregates.

Table 5-9 describes soil types and land systems adjacent to the Project area along the Fitzroy River.

Soil types adjacent to the Dawson River fall within the Coreen land unit and are dominated by Vermont soil type. Vermont soil types comprise frequently flooded, deep alluvial cracking clays that exhibit some gilgai microrelief. These soils are classified as Vertosols according to the Australian Soil Classification system and are potentially the most productive in the Dawson-Fitzroy area. Vermont soils merge into Pegunny soils on lower slopes and are characterised by deep, uniform, medium to heavy clays that demonstrate strong gilgai microrelief. Pegunny soils display low fertility and problematic regeneration following clearing is reported (CSIRO 1968).

Land units of the lower Mackenzie River are categorised as Coreen and Coolibah (Speck et al 1968) typified by cracking clays on alluvium. Vermont is the dominant soil type in both land units, followed by Clematis. Clematis is a non-cracking clay that occurs on back plains, in major depressions, levees and on slopes less than 0.5 per cent. Moderate fertility is reported to occur in Clematis soil types and frequent flooding may impact on growth of vegetation.

Soil types within Project areas have been identified from available 1:100k and 1:2M mapping (Fosters and Sugars 2000; Speck et al 1968) and are illustrated in Figure 5-11 and Figure 5-12. Chemical data was available for soil types 1ATE1, 1AVE6, 1ADE2 and 1ARU1, and was used to determine dispersion potential and soil fertility. In the absence of chemical data, soil descriptions were used. A high potential for dispersion occurs when the exchangeable sodium percentage (ESP) is greater than 6 per cent, this is exacerbated when found in conjunction with a calcium magnesium ratio (Ca:Mg) of less than 1. Drainage of each soil type was categorised by Forsters and Sugars (2000) according to rate of drainage, permeability of soil and slope. Limitations affecting rehabilitation were determined from chemical analysis where available, in addition to physical descriptions of soil types. The potential for dispersal, drainage and limitations for rehabilitation are described in Table 5-10.

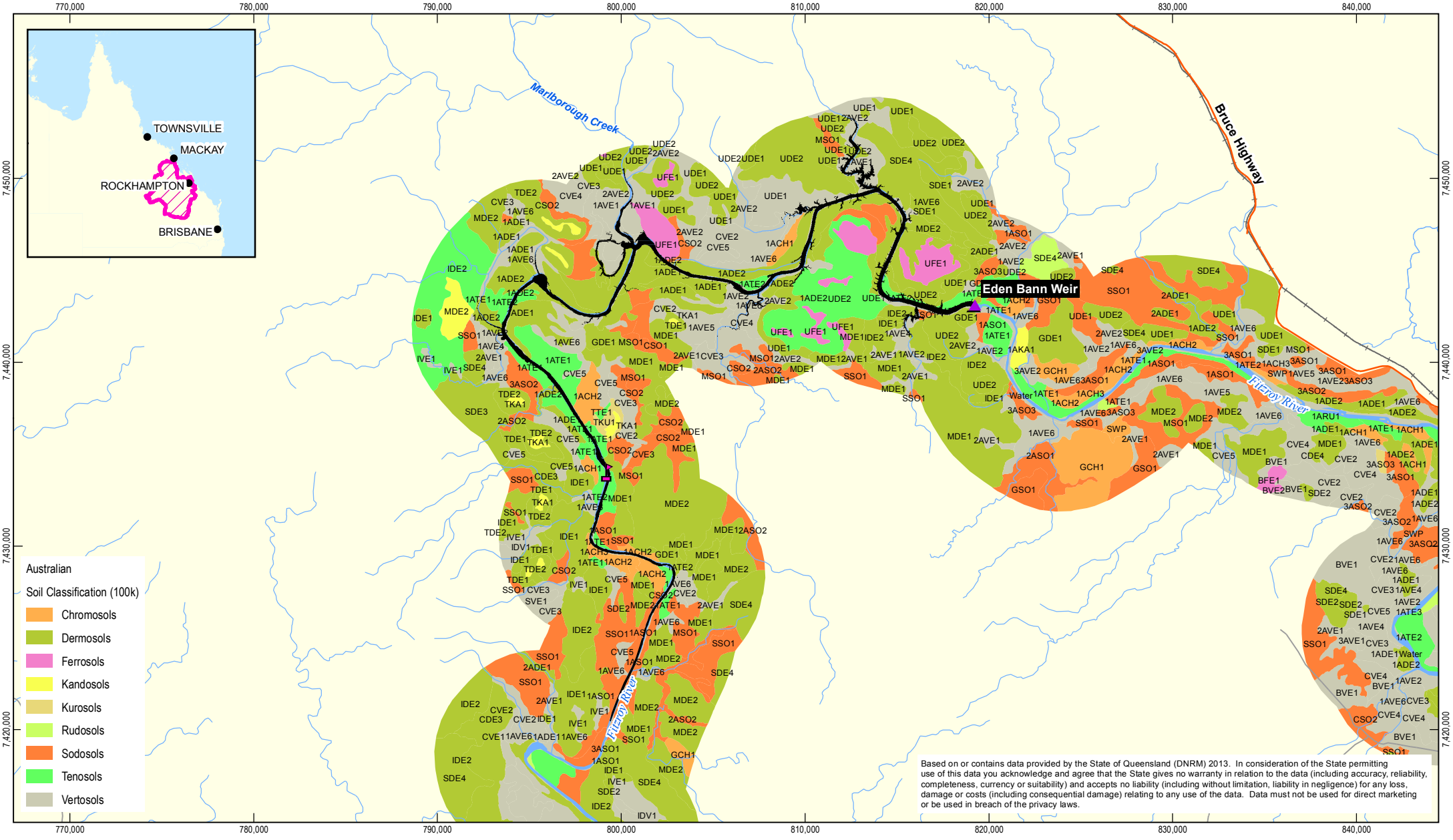
Table 5-9 Land systems and soils within a 5 km buffer along the length of the Fitzroy River

Soil landscape description	Landform	Dominant soil types*	Australian Soil Classification
Soils overlying recent alluvium	Level to gently undulating plains, terraces, active levees and backplains	Uniform sands and loams: 1ATE1, 1ARU1 Gradational soils and non-cracking clays: 1AKA1, 1ADE1 Texture contrast soils: 1ACH1, 1ACH2, 1ASO1 Cracking clays: 1AVE1, 1AVE2, 1AVE3, 1AVE4 and 1AVE5	Orthic tenosol, stratic rudosol Brown kandosol, black / brown dermosol Brown / black chromosol, brown / grey chromosol, brown / grey sodosol Black vertosol, black / grey vertosol, black vertosol, black / grey vertosol, black vertosol
	Dissected floodplains with scrolls, swales, channel benches, billabongs and floodways	Uniform sands and loams: 1ATE2, 1ATE3 Gradational soils and non-cracking clays: 1AKA2, 1ADE2 Texture contrast soils: 1ACH3 Cracking clays: 1AVE6	Orthic tenosol, stratic rudosol / orthic tenosol Brown kandosol, black / brown dermosol, Brown / grey chromosol, Black / brown vertosol
Soils overlying local alluvium and colluvium	Valley flats, drainage depressions and fans	Gradational soils and non-cracking clays: 2ADE1 Texture Contrast Soils: 2ASO1, 2ASO2 Cracking clays: 2AVE1, 2AVE2	Black / brown dermosol Grey sodosol, black / brown sodosol Black vertosol, black / brown vertosol
Soils overlying older alluvium	Level to gently undulating plains and relict levees	Texture contrast soils: 3ASO1, 3ASO2, 3ASO3 Cracking clays: 3AVE1, 3AVE2	Brown sodosol, black / grey sodosol, grey / brown sodosol; grey kurosol Black vertosol, brown / grey vertosol
Soils overlying unconsolidated Cainozoic sediments	Level to undulating plains	Gradational soils and non-cracking clays: CDE1, CDE2, CDE3, CDE4 Texture contrast soils: CCH1, CSO1, CSO2 Cracking clays: CVE1, CVE2, CVE3, CVE4, CVE5	Red dermosol, black / brown dermosol, black, brown, red dermosol, black / brown dermosol Brown / grey chromosol, black / grey sodosol, black / brown sodosol Black / brown vertosol, black / brown vertosol, black / brown vertosol, grey vertosol, grey / brown / black vertosol
Soils overlying deeply weathered, flat lying tertiary sedimentary rocks	Flat to gently inclined summit surfaces and gently undulating rises	Uniform Sands: TTE1 Gradational soils and non-cracking clays: TKA1, TDE1 Texture contrast soils: TKU1	Bleached-orthic tenosol Red kandosol, brown / red dermosol Yellow / brown kurosol

Soil landscape description	Landform	Dominant soil types*	Australian Soil Classification
	Steep slopes and escarpments	Gradational soils: TDE2	Brown / grey dermosol; grey kandosol
Soils overlying basalt	Gently undulating plains to undulating rises	Gradational soils and non-cracking clays: BFE1 Cracking clays: BVE1, BVE2	Red ferrosol Black vertosol, black vertosol
Soils overlying intermediate volcanic rocks	Gently undulating plains to undulating rises	Gradational soils and non-cracking clays: IDE1, IDV1 Cracking clays: IVE1	Red / brown / black dermosol and red vertosol, red dermosol and black / red Vertosol Black vertosol
	Undulating to rolling low hills	Gradational soils and non-cracking clays: IDE2	Red / brown dermosol; leptic tenosol
Soils overlying granitic rocks	Gently undulating rises	Gradational soils and non-cracking clays: GDE1 Texture contrast soils: GCH1, GSO1	Brown / red dermosol Brown / red chromosol, brown sodosol
Soils overlying mixed acid and intermediate volcanic and sedimentary rocks	Gently undulating plains to undulating rises	Gradational soils and non-cracking clays: MDE1 Texture Contrast soils: MSO1	Brown / red dermosol Brown sodosol
	Undulating to steep low hills	Gradational soils and non-cracking clays: MDE2	Brown / red dermosol
Soils overlying steeply dipping and folded sedimentary rocks	Gently undulating plains to undulating rises	Gradational soils and non-cracking clays: SDE1, SDE2, SDE3 Texture contrast Soils: SSO2 Cracking clays: SVE1	Brown dermosol, brown / grey dermosol, red dermosol Brown / grey sodosol Black vertosol
	Undulating to steep low hills	Gradational Soils and non-cracking clays: SDE4	Grey / brown dermosol / brown kandosol
Soils overlying ultramafic rocks	Gently undulating rises	Gradational soils and non-cracking clays: UDE1	Red / brown dermosol
	Undulating low hills to steep hills and mountains	Gradational soils and non-cracking clays: UFE1, UDE2	Red ferrosol, red / black dermosol / leptic tenosol.
	Swamps	-	-

* Nomenclature of soil types derived by codes associated with soil landscape, soil type according to the Australian Soil Classification (Isbell 1996) and sequence of soils within a particular landscape.

Source: Foster and Sugars (2000).



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0 2 4 6 8 10

Kilometres

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

N

LEGEND

- River Crossing
- Weir Location
- Highway
- Major Road
- Railway
- Waterway
- Fitzroy Basin
- Impoundment Area
- 1ACH1 Dominant Soil Types

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision E
Date 28 Jul 2014

Soil types - Eden Bann Weir

Figure 5-11

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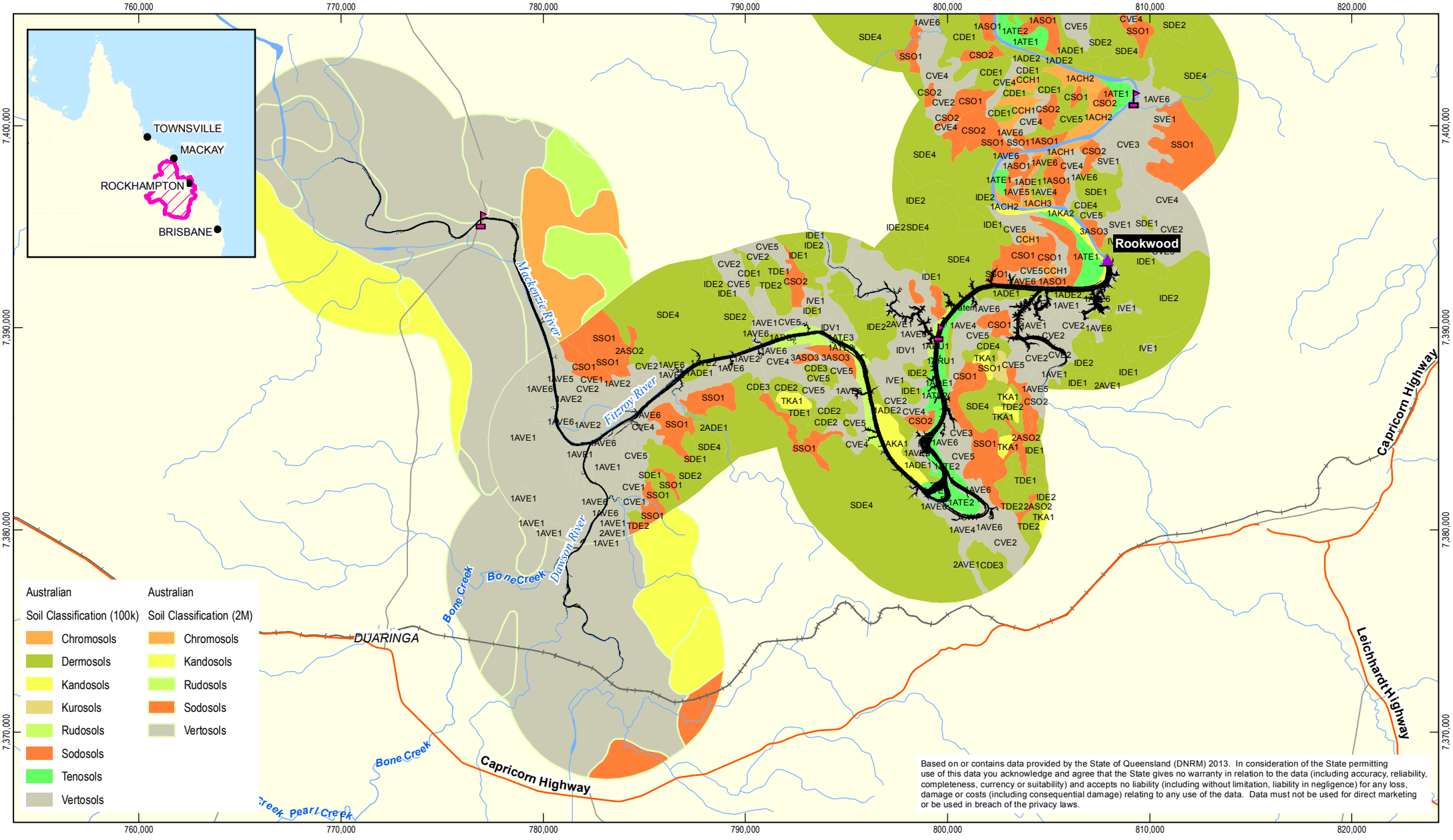
Data Source: © Copyright Commonwealth of Australia (Geoscience Australia): Places, Waterways (2007); Sunwater: Waterways, Weir Locations - 2008; DNRM: Railways, Roads, QLD Combined Soils 100k and 2M - 2010. Created by: MG *See Appendix for disclaimers and copyrights.



1:250,000 (at A4)

0 2 4 6 8 10

Kilometres

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

N

LEGEND

- River Crossing
- Weir Location
- Highway
- Major Road
- Railway
- Waterway
- Fitzroy Basin
- Impoundment Area
- 1ACH1 Dominant Soil Types

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision E
Date 28 Jul 2014

Soil types - Rookwood

Figure 5-12

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Data Source: © Copyright Commonwealth of Australia (Geoscience Australia): Places, Waterways (2007); Sunwater: Waterways, Weir Locations - 2008; DNRM: Railways, Roads, QLD Combined Soils 100k and 2M - 2010. Created by: MG *See Appendix for disclaimers and copyrights.

Table 5-10 Soil characteristics of Project area construction footprints

Construction area	Soil type	Dispersal potential	Drainage	Limitations for rehabilitation
Eden Bann Weir	Dermosol (GDE1)	Data not available	• Well drained • Slope 2%	• Hardsetting surface may be problematic for seeding • Shallow rooting depth, parent material occurs at 0.4 to 0.8 m BGL • Low to moderate soil fertility (expressed by low to moderate cation exchange capacity (CEC)
	Tenosol (1ATE1)	• Non-dispersive • ESP <6% • Ca:Mg >1	• Well drained • High permeability • Slope 0.5%	• Moderate surface fertility, decreasing to low fertility in the subsoil • Establishment of vegetation may be problematic due to frequent flooding • Selection of vegetation species is important to withstand frequent flooding
	Sodosol (1ASO1)	• Dispersive • Subsoil ESP >6%	• Moderately well drained • Moderately permeable	• Low surface fertility in bleached sandy surface horizon • Limitations for rooting in sodic subsoil (from 0.4 m depth)
Glenroy Crossing	Tenosol (1ATE1) to west of river	• Non-dispersive • ESP <6% • Ca:Mg >1	• Well drained • High permeability • Slope 0.5%	• Moderate surface fertility, decreasing to low fertility in the subsoil • Establishment of vegetation may be problematic due to frequent flooding • Selection of vegetation species important to withstand frequent flooding
	Dermosol (MDE1) to east of river	Data not available	• Well drained • Moderately permeable • High surface runoff, slope 8%	• Hardsetting surface may be problematic for seeding
Hanrahan Crossing	Vertosol (1AVE6) in river bed and to east of river	• Potentially dispersive • ESP >6% • Ca:Mg = 1 • Subject to erosive flooding and channelled due to frequent flooding	• Well drained • Moderately permeable • Slope 0.5%	• Establishment of vegetation may be problematic due to regular flooding • Selection of vegetation species important to withstand regular flooding • Though the surface is highly fertile, subsoil is sodic, limiting effective rooting depth

Construction area	Soil type	Dispersal potential	Drainage	Limitations for rehabilitation
	Tenosol (1ATE1) to west of river	• Non-dispersive • ESP <6% • Ca:Mg >1	• Well drained • High permeability • Slope 0.5%	• Moderate surface fertility, decreasing to low fertility in the subsoil • Establishment of vegetation may be problematic due to frequent flooding • Selection of vegetation species important to withstand frequent flooding
Rookwood Weir	Dermosol (1ADE2)	• Potentially dispersive • Two soil descriptions indicate differences in sodicity • ESP <6% and >6% • Ca:Mg <1 in subsoil	• Well drained • Moderately permeable • Moderately rapid run-off, slope <1%	• Hardsetting surface, causing problems for seeding • Establishment of vegetation may be problematic due to regular flooding • Selection of vegetation species important to withstand regular flooding • Though the surface highly fertile, subsoil is sodic, limiting effective rooting depth • Low fertility, expressed as low CEC
	Kandosol (1AKA2) to west of river	Data not available	• Well drained • Highly permeable • Slope <0.5%	• Hardsetting surface may be problematic for seeding • Establishment of vegetation may be problematic due to regular flooding • Selection of vegetation species important to withstand regular flooding • Frequently overlies buried sandy or loamy layers, potentially limiting fertility and effective rooting depth
	Tenosol (1ATE1) marginal	• Non-dispersive • ESP <6% • Ca:Mg >1	• Well drained • High permeability • Slope 0.5%	• Moderate surface fertility, decreasing to low fertility in the subsoil • Establishment of vegetation may be problematic due to frequent flooding • Selection of vegetation species important to withstand frequent flooding
Riverslea Crossing	Rudosol (1ARU1)	• Non-dispersive • ESP <6% • Ca:Mg>1	• Well drained • Moderately to highly porous • Slope 0.5%	• Hardsetting surface may be problematic for seeding
Foleyvale Crossing	Vertosol (Vermont)	No data available	• Drainage imperfect to poor • Mostly level	• Establishment of vegetation may be problematic due to regular flooding • Selection of vegetation species important to withstand regular flooding
	Non-cracking clay (Clematis)	No data available	• Good to imperfect drainage • Levees, back slopes and low rises	• No limitations identified at broad scale mapping

Sodicity

Soils containing a high exchangeable sodium percentage are prone to dispersion, which may lead to erosion. From laboratory and field results (Forster and Sugars 2000), it was ascertained that various states of sodicity exist within soil types. The following soils were identified as having high to very high levels of exchangeable sodium percentage in the subsoil:

- Sodosols overlying
  - Older alluvium (2AS02)
- Vertosols overlying
  - Recent alluvium (1AVE1, 1AVE2, 1AVE4)
  - Older alluvium (2AVE1)
  - Unconsolidated Cainozoic sediments (CVE1, CVE2, CVE3, CVE4, CVE5)
- Chromosols overlying
  - Recent alluvium (1ACH1)
  - Unconsolidated Cainozoic sediments (CCH1,CS01,CS02)
- Dermosols overlying
  - Unconsolidated Cainozoic sediments (CDE1, CDE2, CDE3, CDE4).

Salinity

Forsters and Sugars (2000) report that while no salinity occur in land appropriate for irrigation adjacent to the Project area, two salinity outbreaks have been recorded in the wider vicinity of the Project area. Outbreaks have been reported in the granitic landscape north-west of Ridgelands and a localised patch of 0.5 ha in the Etna Creek area (Forsters and Sugars, 2000) (outside of the Project area downstream of the existing Eden Bann Weir). To date, salt content in topsoils and subsoils within the Project area is not mobilised and is therefore not expressed as salinity (Forsters and Sugars, 2000).

A number of vertosols (1AVE3, 1AVE4, CVE3, CVE4 and CVE5) have been identified as displaying moderate to high levels of soluble salts in the subsoil horizons.

Soils have been classified by Forsters and Sugars (2000) in their susceptibility to accumulate a high level of salt in the topsoil and root zones, a characteristic that has the potential to reduce crop productivity. Soils with the greatest level of susceptibility are listed as follows:

- Sodosols overlying
  - Recent alluvium(2ASO1)
  - Older alluvium (3ASO1 and 3ASO2)
  - Unconsolidated sediments (CSO1 and CSO2)
  - granite (GSO1),
  - Overlying mixed lithology (MSO1)
  - Sedimentary rocks (SSO1)
- Vertosols overlying
  - Recent alluvium (1AVE4 and 1AVE5)
  - Older alluvium (3AVE2)

  - Unconsolidated sediments (CVE3, CVE4 and CVE5)
- Dermosols overlying
  - Unconsolidated sediments (CDE2)
  - Sedimentary rocks (SDE2).

Acid sulfate soils

In Queensland, acid sulfate soils (ASS) are largely associated with naturally occurring marine sediments where coastal lowlands have surface elevations less than 5 m Australian Height Datum (AHD). Older estuarine sediments formed during the Holocene or Pre Holocene age (<10,000 years) have been found at depth in areas with surface elevations up to 20 m AHD. ASS may also occur where pyrite and other sulfide minerals are concentrated as a result of weathering of parent rock. Such areas occur in highly mineralised areas and coal deposits where rocks contain pyritic material deposited either through depositional and hydrothermal processes.

It is unlikely that ASS would be encountered during construction activities as excavation below 5 m AHD is not anticipated. If ASS or potential ASS is encountered during pre-construction investigations, an ASS management plan will be developed based on the requirements of the Queensland Acid Sulfate Soils Investigation Team Acid Sulfate Soil Technical Manual (Dear et al. 2004; Ahern et al. 2004; Dear et al. 2002; Ahern et al. 1998) inclusive of monitoring and validation requirements (Chapter 23 Environmental management plan).

Land suitability

In Forster and Sugars (2000), land surrounding the Fitzroy River has been categorised into perceived suitability for irrigation based on 18 limitations, such as salinity, soil wetness and potential for erosion. Three forms of irrigation have been correlated with production of various crops:

- Furrow irrigation of cotton, sorghum and wheat
- Overhead spray irrigation of wheat, soybean, navy bean and peanuts
- Trickle or microspray irrigation of citrus, macadamia, grapes and vegetables.

The majority of land suitable for irrigated agriculture is located close to the banks of the river and is fragmented along its length due to soil limitations and topographical features of the riverbanks. The largest area considered suitable for irrigated crop production is located in the vicinity of the junction of the Mackenzie and Dawson Rivers. Soils are mostly black vertosols situated on flood plains and are suitable for winter wheat production.

Mapping (1:250,000) of potential irrigation areas of the lower Mackenzie and Dawson Rivers by McCarroll and Forster (1999) and McCarroll (1998) indicate cracking clays and non-cracking clays may be suitable for furrow irrigation of cotton.

Agricultural land

The State's interest in planning for agriculture as defined in the State Planning Policy (SPP) (DSDIP 2013) is to:

- Reduce the potential for conflict between agricultural land and other uses
- Protect resources from inappropriate development
- Minimise encroachment to ensure viable tracts of agricultural land are maintained

- Improve opportunities for increased agricultural investment, production and diversification.

The SPP recognises important agricultural areas (IAAs) as areas with a critical mass of appropriate resources (soil, water, climate, etc.) and infrastructure investment to support strong agricultural productivity. An IAA is an area identified in the Queensland Agricultural Land Audit and shown in the SPP Interactive Mapping System as an important agricultural area. There are no IAAs within the Project footprints. The closest IAA to the Project footprint is the Dawson River Valley IAA located 11 km upstream of the Rookwood Weir impoundment adjacent to the Dawson River (27 km AMTD).

Under the SPP, agricultural land class refers to the agricultural land classes identified and mapped in the 2013 Queensland Agricultural Land Audit. The approach is based on a four-tier hierarchy ranging from Class A through to Class D as follows:

- Class A - crop land defined as land that is suitable for a wide range of current and potential crops with nil to moderate limitations to production
- Class B - limited crop land defined as land that: is suitable for a narrow range of current and potential crops; is marginal for current and potential crops due to severe limitations, but is highly suitable for pastures; and may be suitable for cropping with engineering and/or agronomic improvements
- Class C - land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production. Some areas may tolerate a short period of ground disturbance for pasture establishment
- Class D - land not suitable for agricultural uses due to extreme limitations.

Class A and Class B agricultural land is the most productive agricultural land in Queensland, with soil and land characteristics that allow successful crop and pasture production and the policy seeks to protect this land for sustainable agricultural use by:

- Avoiding fragmentation of Class A or Class B land into lot sizes inconsistent with the current or potential use of the land for agriculture
- Avoiding locating non-agricultural development on or adjacent to Class A or Class B land
- Maintaining or enhancing land condition and the biophysical resources underpinning Class A or Class B land.

The SPP Interactive Mapping System shows that Class A agricultural land is mapped in scattered and fragmented parcels along the Fitzroy, Mackenzie and Dawson rivers. While the SPP Interactive Mapping System does not show Class C agricultural land, former good quality agricultural land mapping shows that the Class A agricultural land is interspersed with Class C parcels. The definition of Class C agricultural land is consistent between the two data sets. Four isolated parcels of Class B agricultural land are located in the vicinity of the Project but away from the river margins.

As discussed in Section 5.5.2 the majority of land adjacent to the Project areas (outside of the river bed and banks) is utilised for grazing. Isolated areas adjacent to the river bed and banks but outside the Project footprint is utilised for cropping (irrigated and non-irrigated).

Strategic cropping land

Trigger maps published by the Queensland Government (DNRM 2012) were reviewed along with strategic cropping area (SCA) mapping using the (then) Department of State Development, Infrastructure and Planning's interactive mapping system. Mapping shows that the Project is located within the Central Highlands Isaac strategic cropping criteria sub-zone of the Western Cropping criteria zone. There are no strategic cropping protection areas within the vicinity of the Project. Potential SCAs mapped as fragmented parcels along the Fitzroy, Mackenzie and Dawson rivers are shown in Figure 5-13 and Figure 5-14 for Eden Bann Weir and Rookwood Weir respectively. It is noted that potential SCA mapping includes some inaccuracies, such as potential SCA mapped within the watercourse area of the Fitzroy River and the accuracy of this mapping will need to be confirmed.

5.3.3 Potential impacts and mitigation measures

5.3.3.1 Topography

There are no significant topographical features associated with Eden Bann Weir and Rookwood Weir sites or the locations of river crossings. The Project will not impact on topographical features and no mitigation is proposed.

Inundation associated with the Project is contained within the river bed and banks and will not impact topographical features. No mitigation is proposed.

Objectives for re-contouring or consolidation, rehabilitation, landscaping, fencing and monitoring are discussed in Chapter 23 Environmental management plan.

5.3.3.2 Geology

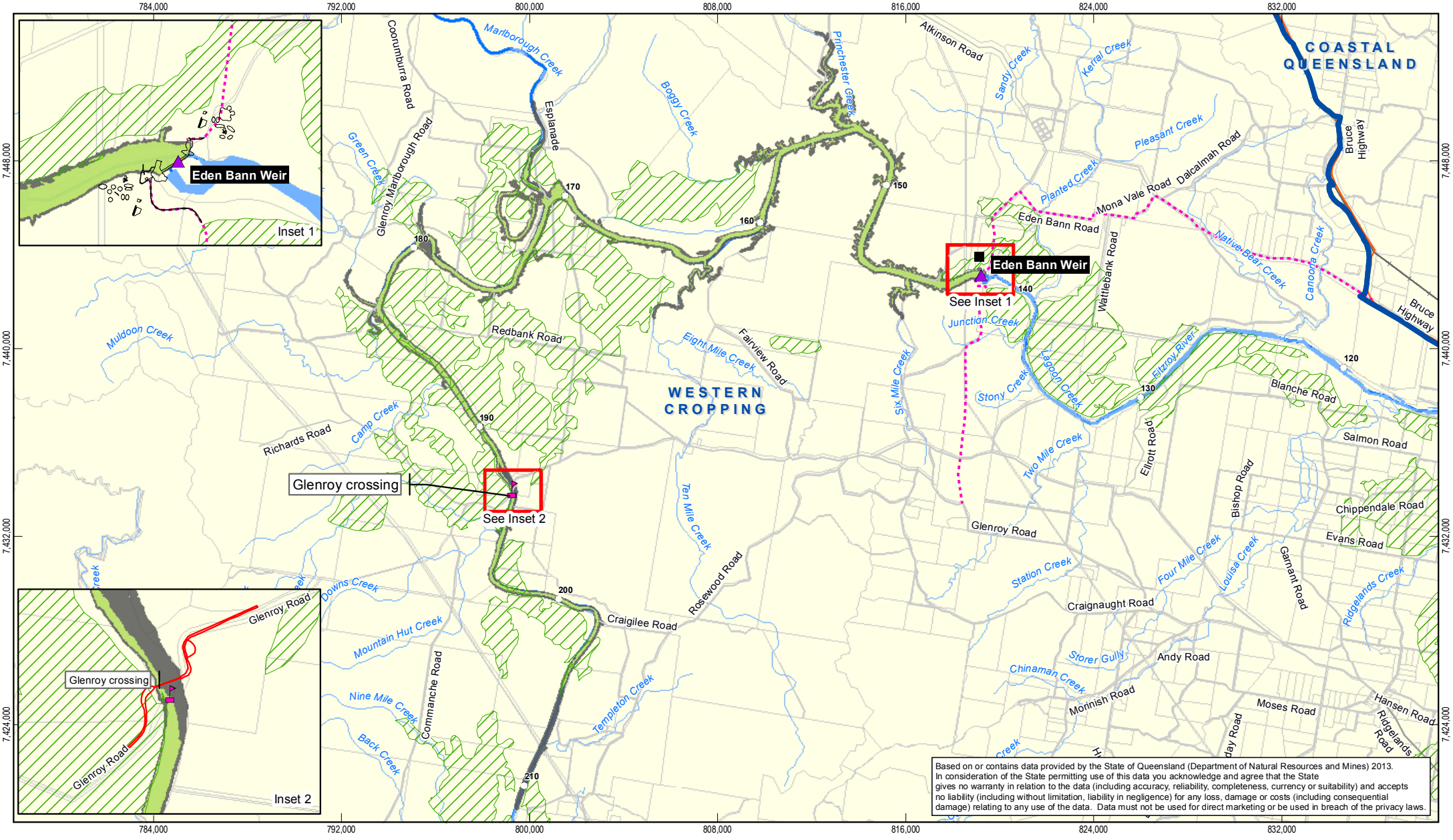
Eden Bann Weir has good founding conditions on relatively massive fresh granodiorite. These conditions are suitable for raising the weir by at least another 5 m to 10 m. Construction of a roller-compacted concrete structure at the Rookwood site is supported by the outcomes of geotechnical investigations undertaken during concept and preliminary design phases. Further geotechnical investigations will be undertaken to support detailed design.

A plant fossil is indicated as being collected in the Quaternary elevated alluvial terrace on the right bank in the vicinity of the Foleyvale Crossing. The approach road to the crossing is situated on this terrace, however the geological unit is extensive and previously disturbed through construction of the existing crossing. It is not considered that the Project will result in any significant loss of scientific knowledge at this location and no mitigation is proposed.

Sedimentary rock in the vicinity of Riverslea and Foleyvale Crossings is considered to have the potential to contain fossils. These areas are generally above the reservoir level and widespread such that it is considered that the Project will not result in any significant loss of scientific knowledge.

Geomorphology impacts are discussed in Chapter 9 Surface water resources.

The presence of geological fault zones has been accounted for in preliminary design through selection of appropriate embankment types and zones, embankment geometry, foundation treatment and seepage cutoff. Consequently, it is unlikely that fault zones will impact on weir stability.



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0 2 4 6 8

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
- Highway
- Major Road
- Streets (Local)
- Waterway
- Fitzroy Basin
- Property Boundary
- Strategic Cropping Land Zones
- Strategic Cropping Land Trigger
- Eden Bann Weir Stage 2 impoundment
- Eden Bann Weir Stage 3 impoundment
- Construction Corridor
- Construction Footprints
- Homestead
- River Crossing
- Access Road

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

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Revision B
Date 09 Jan 2014

Eden Bann Weir
Strategic cropping land

Figure 5-13

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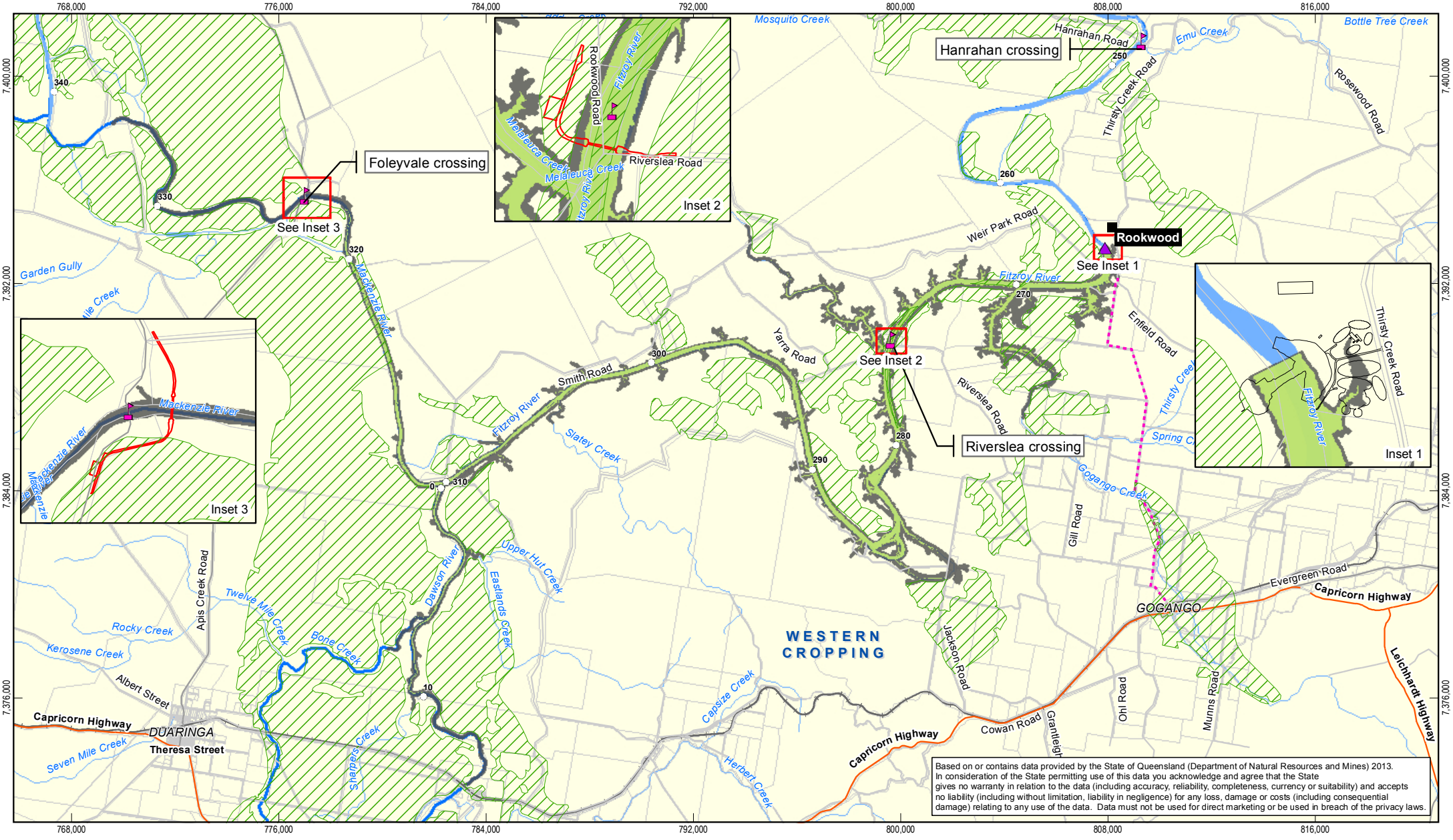

1:195,000 (at A4)

0 2 4 6 8

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
- Highway
- Major Road
- Streets (Local)
- Railway
- Waterway
- Fitzroy Basin
- Property Boundary
- Strategic Cropping Land Zones
- Strategic Cropping Land Trigger
- Rookwood Weir Stage 1 impoundment
- Rookwood Weir Stage 2 impoundment
- Construction Footprints
- Construction Corridor
- Homestead
- River Crossing
- Access Road

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision A
Date 09 Jan 2014

Rookwood Weir
Strategic cropping land

Figure 5-14

G:\41\20736\GIS\Projects\MXD\200_Report\4120736_320_rev_a.mxd

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5.3.3.3 Land systems and soils

Erosion

Soil erosion (through wind and water) can result in a loss of soil resources which can affect the ability of disturbed areas to be rehabilitated. Releases of sediment to surface waters can also affect water quality and aquatic ecosystems.

Construction activities that have the potential to cause erosion and land instability include:

- Vegetation clearing at Eden Bann Weir and at Rookwood Weir site to accommodate the establishment of construction site facilities (site office and workshops, storage and laydown areas, batching plants and stockpiles) (Chapter 2 Project description)
- Vegetation clearing to accommodate access, namely a new track to access the right bank of Eden Bann Weir and in areas along Thirsty Creek Road where road upgrades are required to facilitate construction traffic access to Rookwood
- Vegetation clearing associated with construction activities at river crossings
- Excavation and construction of earthworks, coffer dams and embankments
- Establishment of stockpiles and movement of spoil material.

It is not proposed to undertake large-scale clearing from within the bed and banks of the rivers prior to impoundment.

A soil management programme is described in Chapter 23 Environmental management plan. Erosion and sediment control measures employed during construction will be consistent with the practices described in the International Erosion Control Association (IECA), Best Practice Erosion and Sediment Control Guideline (IECA 2008) and/or Queensland Division of the Australian Institute of Engineers' (Institute of Engineers Australia 1996) Erosion and Sediment Control: Engineering Guidelines for Queensland Construction Sites. Prior to commencing construction (per development stage) a site-specific soil survey will be undertaken to inform development of drainage control plans and ESCPs in accordance with IECA guidelines and will address all aspects of construction and include performance criteria for all controls to be implemented across the Project.

With these design measures and management commitments in place, erosion risk during the construction phase is not predicted to adversely impact on environmental values.

Operational activities with the potential to cause erosion are largely related to flow regimes (Chapter 9 Surface water resources) and bank slumping resulting in mass movement of river bank material. Bank slump is a naturally occurring process in areas along river banks, in particular in areas devoid of vegetation, where geological failures occur and/or where river flows undercut lower portions of the channel bank and effectively scour the bank.

The Project is not expected to cause erosion within the impoundment upstream of the weirs. Vegetation within the impoundments is not proposed to be cleared prior to the area being inundated which would assist (in the short-term) in maintaining the stability of the banks as the impoundment fills and facilitate (in the long-term) regeneration and regrowth of riparian vegetation along the river banks. Drawdown of water in the impoundment during operation occurs relatively slowly over an extended period of time (a number of months) and would generally not create flows within the impoundment capable of eroding. Water quality parameters (including sedimentation) are discussed in Chapter 11 Water quality.

There is the potential for releases to cause erosion downstream of the weirs during operation. A number of measures have been incorporated into the design of the weirs to minimise the impact of water released downstream during operation. These include:

- Undertaking further physical modelling as appropriate. Physical model studies are proposed to be undertaken to inform functioning of fish passage infrastructure and operation of outlet works
- Stabilisation of existing bank slopes where appropriate using rip rap and other means as necessary
- Controlled releases will be made through the outlet works into the defined (main) river channel
- Spillway design considers the need to dissipate flows downstream to protect against erosion.

Prior to inundation and once a Project trigger is initiated, a geomorphological assessment will be undertaken, informed by more detailed operational strategies. Prior to inundation high and low bank areas will be surveyed and defined (Section 5.5.3) to inform land acquisition and, in consultation with landholders, a monitoring programme will be developed to monitor areas upstream and downstream of the weirs for potential erosion and bank slump. The monitoring programme will also serve to identify any erosion that may occur from inundation of problematic sodic soils. Rehabilitation and remediation works will be undertaken as required. This would include stabilisation of banks through revegetation or mechanical means and negotiated compensation through consultation with landholders in the event of significant land losses attributable to weir operations versus natural river function.

Agricultural land

The majority of land associated with the Project construction areas is mapped as Class A and Class C agricultural land. Small areas of mapped Class A will be impacted by the access road and temporary construction site facilities (site establishment, stockpiles, access routes, batching plants, etc.) and hard stand access areas and office/store facilities retained during operations at Eden Bann Weir. Approximately 0.26 ha of mapped Class A agricultural land will be lost due to the proposed Rookwood Weir structure on the left bank. This equates to 0.1 per cent of the larger Class A area adjacent to the river and will not result in fragmentation of agricultural land. Given the limited extent of construction activities and the proximity to the river, the impact on Class A agricultural land is considered negligible.

As inundation will be confined to the bed and banks of existing watercourses, the area of inundation is considered to have limited effect on agricultural potential. The majority of land holdings adjacent to the river are not expected to be significantly adversely impacted as a result of the Project (one per cent loss of total land holdings as described in Chapter 18 Social impact assessment). Class A agricultural land mapped in these areas is not expected to be impacted as it sits outside the bed and banks of the river. There is no mapped Class B agricultural land associated with the impoundment. A saddle dam prevents potential flood runners (Chapter 2 Project description) and weir design facilitates limited changes to flooding pre- and post-development (Chapter 9 Surface water resources and Chapter 18 Social impact). As such, the loss of land as a result of the Project will not impact on the current use of land for agriculture and minimal impacts on rural land use practices are expected as a result of the development of the Project.

Strategic cropping land

Fragmented strategic cropping land is mapped along the Fitzroy, Mackenzie and Dawson rivers. While mapping indicates the land is within impoundment areas, given these areas are actually within the river bed and banks it is considered unlikely that the mapping accurately reflects the extent of the strategic cropping land.

Strategic cropping land associated with Eden Bann Weir construction activities (including access) are limited to approximately 0.4 ha along the new right bank access and in the order of 0.8 ha at Glenroy Crossing. Mapping shows 0.5 ha of strategic cropping land impacted at the proposed Rookwood Weir site where the mapped area flanks the river boundary. In the order of 2.9 ha of mapped strategic cropping land is impacted by crossings at Riverslea Road, Foleyvale Crossing and Hanrahan Road. It is not expected that the loss of strategic cropping land mapped as occurring near the river crossings will adversely impact cropping ability in the Project area as Project footprints traverse the outer edges of mapped areas/polygons and, in the case of river crossings, Project infrastructure is co-located and aligned with existing road ways. Further, during detailed design, the development of temporary infrastructure (in particular site laydown areas associated with river crossings) will be reviewed and co-located within pre-existing disturbed areas as far as is possible and practicable. Inundation associated with the Project is confined to the river bed and banks and will not impact on strategic cropping land, cropping practices and/or the productive capacity of the surrounding land. Negligible impacts on landholdings are predicted as a result of incremental changes to flood regimes as discussed further in Chapter 9 Surface water resources and Chapter 18 Social impact.

5.3.4 Summary

Soil types in the Project area are described in accordance with the Australian Soil Classification and as mapped by Forster and Sugars (2000), Speck et al (1968) McCarroll (1998) and McCarroll and Forster (1999). Soil surveys were not undertaken for the draft EIS. Geological investigations undertaken for the Project provide information with which to progress concept/preliminary design components.

The 'Fitzroy Gap' (within the Eden Bann Weir impoundment) comprises rugged ranges flanking the Fitzroy River. The Fitzroy River has a strong meandering habit and passes through undulating to relatively level country that is largely cleared for beef cattle grazing and occasional field crops. Given the lack of significant topographical features associated with Eden Bann Weir and Rookwood Weir sites, the Project is not expected to impact on topographical features.

Eden Bann Weir has good founding conditions, suitable for raising the weir by at least another 5 to 10 m. Construction of a weir at the Rookwood site is supported by the outcomes of geotechnical investigations. The channel of the Fitzroy River at the Eden Bann Weir site and proposed Rookwood Weir site is interpreted to be controlled by a major regional geological structure.

Sedimentary rock in the vicinity of Riverslea and Foleyvale Crossings is considered to have the potential to contain fossils. These areas are generally above the reservoir level and widespread such that it is considered that the Project will not result in any significant loss of scientific knowledge.

Laboratory and field assessments (undertaken for studies referenced above) for soil revealed that various states of sodicity exist within the soil types, with some soils having high to very high levels of exchangeable sodium percentage in the subsoil. Soils containing a high exchangeable sodium

percentage are prone to dispersion, which may lead to erosion. Some soils were identified as being susceptible to accumulating high levels of salt in the topsoil and root zones. To date, salt content in topsoils and subsoils is not mobilised therefore not expressed as salinity. High levels of salt in the root zone have the potential to reduce crop productivity. While no salinity outbreaks were reported in land appropriate for irrigation in the Project area, some soils display moderate to high levels of soluble salts in subsoils.

Construction activities and vegetation clearing within the development footprints have the potential to cause erosion and land instability that could result in a loss of soil resources and the release of sediments to surface waters, further affecting water quality and aquatic ecosystems. An ESCP would be developed prior to construction in accordance with the Best Practice Erosion and Sediment Control Guideline (IECA 2008) to minimise erosion and releases of sediment to the river. The Project is not expected to cause erosion in the impoundment areas upstream of the weirs.

During operation, there is potential for releases to cause erosion downstream, largely relating to flow regimes. Measures to minimise the impact of erosion from water releases have been incorporated into the design of the weirs. Further geomorphological assessment to inform development of a monitoring programme will also be undertaken to identify areas to be monitored upstream and downstream of the weirs for potential erosion and bank slump, while also monitoring for erosion from sodic soil inundation. Rehabilitation and remediation works will be undertaken as required.

It is unlikely that ASS would be encountered during construction activities as excavation below 5 m AHD is not anticipated. If ASS or potential ASS is encountered during pre-construction investigations, an ASS management plan will be developed based on the requirements of the Queensland Acid Sulfate Soils Investigation Team Acid Sulfate Soil Technical Manual (Dear et al. 2004; Ahern et al. 2004; Dear et al. 2002; Ahern et al. 1998).

Class A agricultural land and strategic cropping land are mapped in areas along the Fitzroy, Mackenzie and Dawson rivers. The Project's impact on agricultural land and strategic cropping land is negligible, as there is a limited development footprint outside of the river bed and banks and limited changes to flooding pre- and post-development (Chapter 9 Surface water resources). Inundation during operations is confined within the river bed and banks and will not impact on the productive capacity of the surrounding land. Further discussion is provided in Chapter 18 Social impact.

5.4 Contaminated land

5.4.1 Introduction

5.4.1.1 Approach and methodology

Site information and site history research was gathered for the Project areas as part of a Stage 1 Site Contamination Assessment. The Stage 1 site contamination assessment was undertaken with reference to the Queensland guidelines and Australian Standard AS 4482.1-2005: Guide to the Investigation and Sampling of Sites with Potentially Contaminated Soil.

The information gathered during the Stage 1 site contamination assessment was based on historical and desktop information and is not a true indication of the actual presence of contamination on site. It is therefore noted that any sites identified as being potentially

contaminated in the assessment will need to be verified through a detailed site inspection and soil and / or groundwater investigations.

The Stage 1 site contamination assessment objectives are as follows:

- Assess the historical potential for soil and / or groundwater contamination as a result of the Project
- Assess the need for further investigation of potentially contaminated sites such as site inspection and soil and / or groundwater investigations.

The Stage 1 site contamination assessment comprised a desktop study for each subject lot associated with the Project. The following tasks were undertaken:

- A geology and hydrogeology assessment including the following:
  - Regional geology and hydrogeology data was sourced from the Queensland Digital Dataset, 2006. Resolution of the dataset is 1:250,000, therefore, the boundaries between the individual units may only be accurate to approximately 100 m
  - Groundwater information was sourced from the Groundwater Database (DERM 2009). This database contains all registered bores, however unregistered and private bores may also exist in these areas
  - The database search was based on subject lots and a 5 km radius of the Project area.
- A review of past and current land uses and site ownership, through reviewing past and current land titles for subject lots associated with the Project areas
- A review of readily available historical aerial photographs for the Project areas to assist in establishing the physical patterns of development over time, specifically:
  - A series of aerial photographs spanning 1952 (as the earliest available) to 1994 and 1960 to 1999 were reviewed in relation to Eden Bann Weir and Rookwood, respectively
  - Areas of interest, such as potential cattle dips and cattle pens with structures identified (as per individual aerial photograph) were identified.
- Search and review of the Environmental Management Register (EMR) and Contaminated Land Register (CLR)
- Compilation of relevant information from landholder surveys undertaken as part of the Social Impact Assessment (Chapter 18 Social impact)
- Identification of potential contamination sites and areas of interest within the Project area
- An assessment of potential contamination within Project areas and the need for further investigation. Potential contamination sites identified at the weirs sites and river crossings and within 500 m[1] of the full supply level of the impoundments were assessed further
- Review of the Department of Defences' website to identify unexploded ordnance potential within the Project areas (Chapter 20 Hazard and risk).

For the purpose of the Stage 1 site contamination assessment, potential contamination was related to the presence of structures or activities that may cause environmental harm. These could include but are not limited to:

- Aboveground storage tanks and sheds that may hold petroleum fuel and/or herbicides

[1] A 500 m buffer was nominated to allow consideration of potential flood impacts (Chapter 9 Surface water resources).

- Small structures and/or land features that may be related to livestock dips and/or spray races.

5.4.1.2 Regulatory framework

In Queensland the legislative requirements covering contaminated land are primarily contained in the *Environmental Protection Act 1994* (Qld) (EP Act) and subordinate legislation and policies. The EP Act is administered by the Department of Environment and Heritage Protection (DEHP). Land that has been used for notifiable activities, or is 'contaminated land', is recorded in the EMR so that any potential impacts can be assessed and managed. The EMR provides information on historical and current land use, including whether the land has been or is currently used for a notifiable activity, or has been contaminated by a hazardous contaminant. Further, where land is proven to be contaminated and is causing or may cause environmental harm, this land is recorded on the CLR. The EP Act contains a number of provisions in relation to the investigation, management and remediation of contaminated land.

The extent to which contaminants may pose a risk to human health and the environment depends on the quantity and concentration of contaminants. Levels at which contaminants may be considered harmful have been set based on toxicity data and other hazardous properties. Contaminant levels are reported in Queensland with regard to:

- The National Environment Protection (Assessment of Site Contamination) Measure (National Environment Protection Council 2013)
- Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland ('the Queensland guidelines') (Department of Environment 1998).

Soil and groundwater suspected of being contaminated must be adequately investigated in accordance with the EP Act and the Queensland guidelines. Therefore, identifying, quantifying and remediating the potential soil and groundwater contamination risks associated with key sites generally requires one or more sequential stages of investigation as follows:

- Stage 1 preliminary site investigation
- Stage 2 detailed site investigation
- Stage 3 health and environmental risk assessment and development of remediation action plan
- Stage 4 implementation of remediation action plan and preparation of validation report.

The various levels of investigation may be necessary to demonstrate that all allotments comprising a site and/or project area are suitable for the intended use, and to facilitate any approvals required for such a project.

It is an offence under the EP Act to remove soils from a site listed on the CLR or EMR without a permit. Under the *Sustainable Planning Act 2009* (Qld), applications for development approval (material change of use) involving land on the EMR or CLR must be referred to DEHP for assessment. This assessment will focus on whether contamination levels are inconsistent with the proposed land use.

5.4.2 Description of environmental values

5.4.2.1 Overview

Land use in the vicinity of the Project predominantly comprises land for cattle grazing with the historical potential of contamination resulting from the storage and use of hydrocarbons,

herbicides, pesticides and livestock dips. Potential contaminants of concern (currently in use and historically used) associated with livestock dips or spray races may include arsenic (trioxide), DDT, BHC, carbaryl, coumaphos, carbphenothion, bromophos-ethyl, dioxathion, ethion, chlordimeform, amitraz, promacyl, cypermethrin and chlorfenvinphos, flumethrin (Kimber et al. 2002; McDougall and Macoun 1996).

No potential areas of unexploded ordnance were identified within Project areas (Chapter 20 Hazard and risk).

Potential sensitive receptors within the Project areas comprise the waters of the Fitzroy, Mackenzie and Dawson Rivers and groundwater within nearby utilised aquifers.

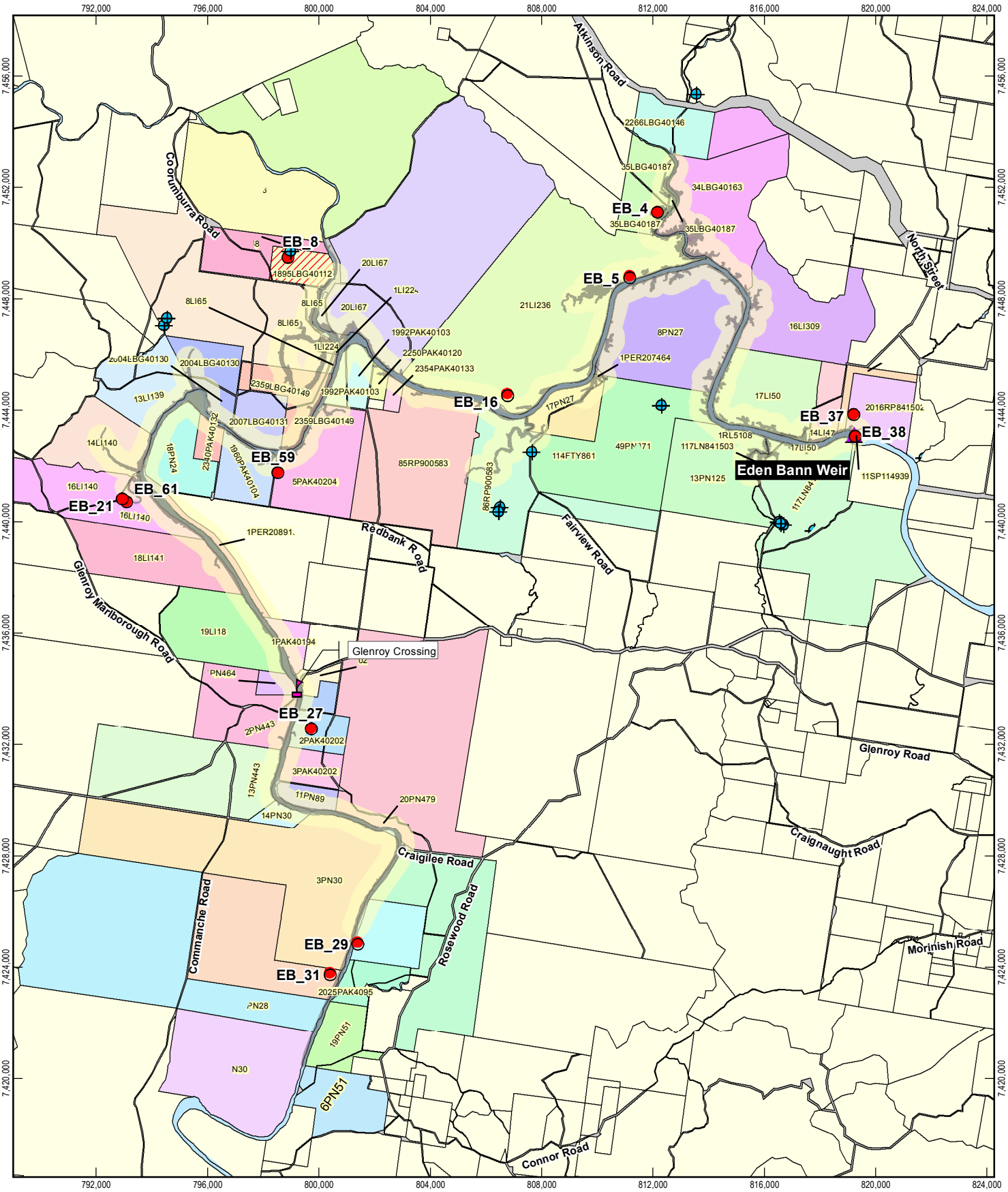
5.4.2.2 Eden Bann Weir

One subject lot within the Eden Bann Weir Project area is listed on the EMR for containing a livestock dip or spray race (Lot 1895 on LBG40112). However this site (EB-8 on Figure 5-15) is not located within the impoundment area or within the 500 m^2 of the full supply level and is not listed on the CLR. No other lots are listed on the EMR or the CLR.

From current and historical aerial photographs and information gathered through landholder surveys, 11 possible contamination sites and areas of interest were identified within the Eden Ban Weir impoundment area and within 500 m of the full supply level of the impoundment as shown on Figure 5-15. It is noted that these sites have only been identified as potentially being contaminated through historical land uses and have not yet been verified through a detailed site assessment or and soil and / or groundwater investigations.

Of these sites, nine are located within the 500 m impoundment buffer, one site is located within the impoundment (Eden Bann Weir Stage 3) and one site comprises the existing Eden Bann Weir. Table 5-11 provides details of the potential contamination sites within the Eden Bann Weir Project area.

Groundwater bores were identified within the subject lots of the Eden Bann Weir Project Area, however no groundwater bores are located within the Eden Bann impoundment area or 500 m impoundment buffer area (Figure 5-15).



LEGEND

- Weir Location
- River Crossing
- Impoundment Area
- 500 metre buffer zone
- Groundwater Bores
- Possible Contamination Site
- Parcel Boundary
- Road Easement
- Waterway
- Lot listed on the EMR

Note: Borehole locations sourced from a 5km radius around affected lots

1:185,000 (at A4)

0 1 2 3 4 5

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

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Gladstone Area Water Board SunWater Making Water Work

Gladstone Area Water Board, Sunwater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision F
Date 03 Nov 2014

Eden Bann Weir subject lots and potential contamination sites

Figure 5-15

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145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Sources: © Copyright Commonwealth of Australia (Geoscience Australia): Waterways (2007); Sunwater: Waterways, Weir Locations - 2008; DNRM: Roads - 2010, Cadastre -2013, Groundwater Bores -2013. Created by: MS

Table 5-11 Eden Bann Weir subject lots and potential contamination sites

Site ID*	Lot on Plan	Description of potential contamination	Location relative to Project areas
EB-4	Lot 35 LBG40187	Potential cattle pen, no associated structures observed (i.e. no cattle dip).	Impoundment
EB-5	Lot 21 LI236	Potential cattle pen, no associated structures observed (i.e. no cattle dip).	Impoundment buffer
EB-16	Lot 21 LI236	Area of interest - structure potentially associated with cattle activity.	Impoundment buffer
EB-21	Lot 16 LI140	Potential cattle pen, no associated structures observed (i.e. no cattle dip)	Impoundment buffer
EB-27	Lot 2 PAK40202	Cattle pen, with two associated structures (i.e. cattle dip / spray race) and two dams present.	Impoundment buffer
EB-29	Lot 1552 PN14	Area of interest - small structure (and possible cattle pen).	Impoundment buffer
EB-31	Lot 8 PN266	Small circular structures, not associated with a homestead or pen, may be potential cattle dip / above ground storage tanks.	Impoundment buffer
EB-37	Lot 2016 RP841502	Cattle pen and associated structure (i.e. cattle dip). The existing access to Eden Bann Weir is located within this subject lot. Construction activities will occur on part of this lot.	Impoundment buffer
EB-38	Lot 11 SP114939	The present Eden Bann Weir infrastructure is located within this subject lot, including a workshop, storeroom and hydraulic equipment. Construction activities will occur on part of this lot.	Eden Bann Weir / construction footprint
EB-59	Lot 5 PAK40204	Possible above ground storage tanks (up to three observed).	Impoundment buffer
EB-61	Lot 16 LI140	Potential cattle pen, no associated structures observed (i.e. no cattle dip).	Impoundment buffer

* Refer to Figure 5-15.

5.4.2.3 Rookwood Weir

Three subject lots within the Rookwood Weir Project area are listed on the EMR for containing a livestock dip or spray race (Lot 3 on PN106, Lot 7 on PAK40219 and Lot 1857 on PAK4091). However, these potentially contaminated sites are not located within the Rookwood Weir impoundment area or the 500 m impoundment buffer area. None of the subject lots are listed on the CLR.

A review of current and historical aerial photographs and information gathered through landholder surveys[2] identified six possible contamination sites and areas of interest within the 500 m Rookwood Weir impoundment buffers as shown on Figure 5-16. It is noted that these sites have only been identified as potentially being contaminated through historical land uses and have not yet been verified through a detailed site assessment or and soil and / or groundwater investigations.

Of these sites none of the identified potential contamination sites are within the Rookwood Weir impoundment. Four potential contamination sites are located within the 500 m impoundment buffer area. Two potential contaminated sites are located within the construction footprint (site RW 20 on lot 3 PN106 and RW-22 on Lot 1 SP136791). Table 5-12 provides details of the potential contamination sites within the Rookwood 500 m impoundment buffer area and the construction footprint area.

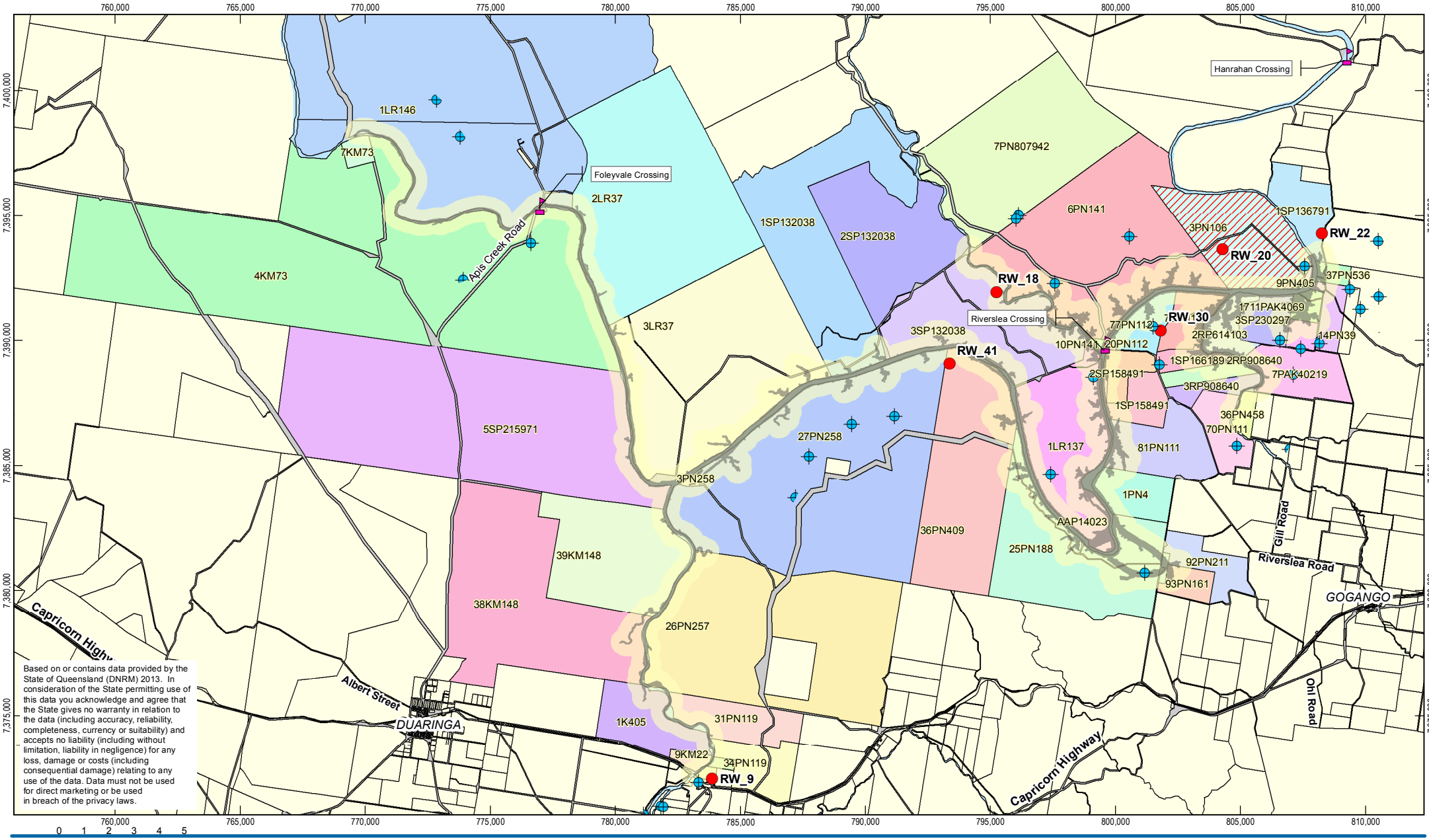
Groundwater bores were identified within the subject lots of the Rookwood Weir Project area, however only one groundwater bore (existing, water supply) is located within the Rookwood Weir impoundment area.

Table 5-12 Rookwood subject lots and potential contamination sites

Site ID*	Lot on Plan	Description of potential contamination	Location relative to Project areas
RW-9	Lot 20 RP843084	Potential historical cattle dip.	Impoundment buffer
RW-18	Lot 3 SP132038	Potential cattle pens, no associated structures observed (i.e.no cattle dip).	Impoundment buffer
RW-20	Lot 3 PN106	Homestead, cattle dip and associated infrastructure (i.e. cattle dip / spray race). Construction activities will occur on part of this lot. This lot is listed on the EMR for livestock dip or spray race activities.	Subject lot / construction footprint
RW-22	Lot 1 SP136791	Cattle pen and potential associated structure (i.e. cattle dip / spray race).Construction activities will occur on part of this lot.	Weir construction footprint
RW-30	Lot 77 PN112	Homestead and potential cattle pen, no associated structures observed (i.e. no cattle dip).	Impoundment buffer
RW-41	Lot 36 PN409	Potential cattle pen, no associated structures observed (i.e. cattle dip).	Impoundment buffer

* Refer to Figure 5-16.

[2] Five landholders (surveyed as part of the Social Impact Assessment) identified potentially contaminating activities on their land. Not all landholders returned survey questionnaires and not all landholders responded to questions in relation to potentially contaminating activities.



Based on or contains data provided by the State of Queensland (DNRM) 2013. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.

1:200,000 (at A4)

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

N

LEGEND

- Weir Location
- River Crossing
- Impoundment Area
- 500 metre buffer zone
- Groundwater Bores
- Possible Contamination Site
- Parcel Boundary
- Waterway
- Road Easement
- Lot listed on the EMR

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Gladstone Area Water Board

SunWater Making Water Work

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision F
Date 06 May 2014

Rookwood subject lots and potential contamination sites

Figure 5-16

G:\41\20736\GIS\Projects\MXD\210_Contaminated_Lands\4120736_216_Rev_F_Figure_2.mxd

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5.4.3 Potential impacts and mitigation measures

5.4.3.1 Overview

The potential impacts from land contamination may arise in two ways. Firstly, construction and inundation could disturb land containing contaminants deposited through previous land use activities and release these contaminants into the environment. Secondly, construction and operation activities may release new contaminants into the environment as a result of unintended spillages or accidents. Without appropriate management, the release of contaminants could impact on existing environmental qualities and human health.

5.4.3.2 Management of possible contamination sites

Sites and/or areas of interest identified as potential cattle pens only (that is no associated structures such as cattle dips and/or spray races are present) do not require further investigation. However those identified as cattle pens with associated structures (that is with cattle dips and/or spray races) and sites identified as having above ground storage tanks located within Project areas (weir construction footprints, impoundments and impoundment buffers and access road and river crossing areas) will require further investigation (site inspections and landholder interviews) as follows (with reference to Figure 5-15 and Figure 5-16 for Eden Bann Weir and the proposed Rookwood Weir, respectively):

- EB-16 (Lot 21 LI236): Structure associated with cattle activity located within the impoundment buffer.
- EB-27 (Lot 2 PAK40202): Cattle pen, with two associated structures located within the impoundment buffer
- EB-31 (Lot 8 PN266): Potential cattle dip / above ground storage tanks located within the impoundment buffer
- EB-37 (Lot 2016 RP841502): Cattle pen and associated structure within the impoundment buffer and within an area where construction activities will occur
- EB-59 (Lot 5 PAK40204): Above ground storage tanks within the impoundment buffer
- RW-9 (Lot 20 RP843084): Historical cattle dip within the impoundment buffer
- RW-22 (Lot 1 SP136791): Cattle pen and associated structure within the weir construction footprint.

Activities at these sites may include (or may have included) the use and/or storage of contaminants:

- Chemicals: arsenic (trioxide), DDT, BHC, carbaryl, coumaphos, carbphenothion, bromophos-ethyl, dioxathion, ethion, chlordimeform, amitraz, promacyl, cypermethrin and chlorfenvinphos, flumethrin
- Hydrocarbons (fuel and lubricants)
- Herbicides and pesticides.

The present Eden Bann Weir (EB-38 within Lot 11 SP114939) will require further investigation (site inspections and landholder interviews). The site is used for the control of water and ancillary, community and commercial purposes and activities include the use and storage of hydrocarbons (fuel and lubricants), herbicides and pesticides. The site has the potential to be disturbed during construction.

With regard to subject lots listed on the EMR (EB-8 on Lot 1895 LBG40112, RW-20 on Lot 3 PN106 and RW-23 on the boundary of Lot 1857 PAK4091 and Lot 7 PAK40219), although sites are not identified as being located within Project areas, it is proposed that further investigations (site inspections and landholder interviews) will be undertaken. The subject lots adjoin the impoundment or weir construction areas and the exact location of the listed livestock dip or spray race has yet to be determined.

At sites identified above, site investigations (including landholder interviews) will be undertaken in order to protect the quality of the water impounded by Eden Bann Weir and Rookwood Weir. Subsequent to the initial site investigation there may be a requirement for intrusive investigations at these sites depending on the findings of the site investigation. Sites found to be previously or currently used for notifiable activities (i.e. livestock dip or spray race), or found to be contaminated will be notified to DEHP and recorded in the EMR. It is unlikely that activities will require notification to the CLR. Remediation and validation would be completed if required before construction has proceeded to a stage where the site is likely to be impacted.

Further investigation stages and the need for the development of a Site Management Plan, Remediation Action Plan and a Contaminated Sites Construction Management Plan will be undertaken if future additional works as detailed above indicate potential or actual contamination. These activities will be undertaken (if required) prior to the construction phase for construction areas (and during construction for inundation areas).

5.4.3.3 Spill or leak prevention and management

It is not anticipated that the Project would lead to land contamination during construction or operation that would require registration on the CLR. It is unlikely that the Project will trigger notifiable activities or require notification for listing on the EMR.

The following preventative and responsive measures would be implemented to minimise the risk of accidental spills or leaks of environmentally hazardous substances:

- Design, construction and operations of the weirs would comply with AS 1940 - The storage and handling of flammable and combustible liquids
- A spill response plan would be developed
- Procedures for all fuel transport and unloading operations would be developed and personnel would be trained appropriately
- Personal protective equipment and spill response equipment would be available on site and personnel would be trained in appropriate use
- Any contaminated material would be collected, placed in secure containers and disposed of appropriately.

Further detail on the management of environmentally hazardous substances is provided in Chapter 20 Hazard and risk.

5.4.4 Summary

Existing land use in the Project area comprises predominantly land used for cattle grazing, with existing potential contamination resulting from the storage and use of hydrocarbons, herbicides, pesticides and livestock dips. Construction and inundation associated with the Project could disturb land containing contaminants from such land uses and release these contaminants into

the environment. New contaminants could also be released from construction and operation activities, as a result of unintended spillages or incidents.

Nine potential contamination sites are located within the 500 m impoundment buffer of Eden Bann Weir; one site is located within the impoundment and one site comprises the existing Eden Bann Weir. Four potential contamination sites are located within Rookwood Weir's 500 m impoundment buffer and two sites are located within the Rookwood Weir construction footprint. Four subject lots are listed on the EMR for containing a livestock dip or spray race. No sites are recorded on the CLR.

Initial site investigations will be undertaken for identified contamination sites prior to construction to prevent the release of existing contaminants to the environment and protect the quality of water in the reservoirs. Sites found to be used for notifiable activities (i.e. livestock dip or spray race), or found to be contaminated will be notified to DEHP and recorded in the EMR. It is unlikely that activities will require notification to the CLR. Remediation and validation would be completed if required before construction has proceeded, where the site is likely to be impacted.

Further investigation stages and the need for the development of a Site Management Plan, Remediation Action Plan and a Contaminated Sites Construction Management Plan will be undertaken if future additional works indicate potential or actual contamination. These activities will be undertaken prior to the construction phase for construction areas (and during construction for inundation areas.

An incident response plan and appropriate preventative measures would be implemented to minimise the risk of accidental spills and leaks of environmentally hazardous substances during construction and operation of the Project.

5.5 Land use and tenure

5.5.1 Introduction

5.5.1.1 Approach and methodology

The methodology for the identification of land use values and assessment of impacts includes the following:

- A review of primary data including:
  - Ownership and tenure information of directly affected properties
  - Native Title claim areas and determinations
  - Location of existing infrastructure
- Review of the relevant local government planning schemes:
  - Fitzroy Planning Scheme 2005 (for the former Fitzroy Shire amalgamated into the Rockhampton Regional Council (RRC))
  - Livingstone Planning Scheme 2005 (for the Livingstone Shire Council (LSC))
  - Duaringa Shire Planning Scheme 2007 (for the former Duaringa Shire amalgamated into the Central Highland Regional Council (CHRC))
  - Woorabinda Aboriginal Shire Council (WASC) Planning Scheme (Draft Version 3, August 2011 and Final 2014)
- A review of the Fitzroy River Weir Study (Keane 2004)

- Review of Project specific technical reports including consideration of potential land acquisition strategies
- Review of landowner consultations.

5.5.2 Description of environmental values

5.5.2.1 Land tenure

Of the land within the Fitzroy Basin, 70 per cent is owned by the State in a variety of tenures including National Parks, State Forests and Reserves, Unallocated State land (USL), road and railway reserves, and privately occupied Leasehold land (Christensen and Rodgers 2005). The remaining 30 per cent is under freehold tenure (FH). Linear easements accommodating existing and proposed roads, pipelines and power lines traverse the Project areas (Section 5.5.2.4 and Section 5.5.2.7).

SunWater own and operate Eden Bann Weir under a Perpetual Lease (Lot 11 SP114939). Land either side of the weir is held in FH. An easement accommodates the existing access road (Lot 2016 RP841502 (FH)). The Fitzroy River is USL. The Eden Bann Weir impoundment as part of the watercourse holds no specific tenure. Land adjacent to the watercourse within the Project's extent is largely held as FH tenure. Some Lands Lease (LL) and Reserve tenures exist. A State Forest area is identified (Section 5.5.2.3). Land tenure surrounding Eden Bann Weir and its impoundment is shown in Figure 5-17.

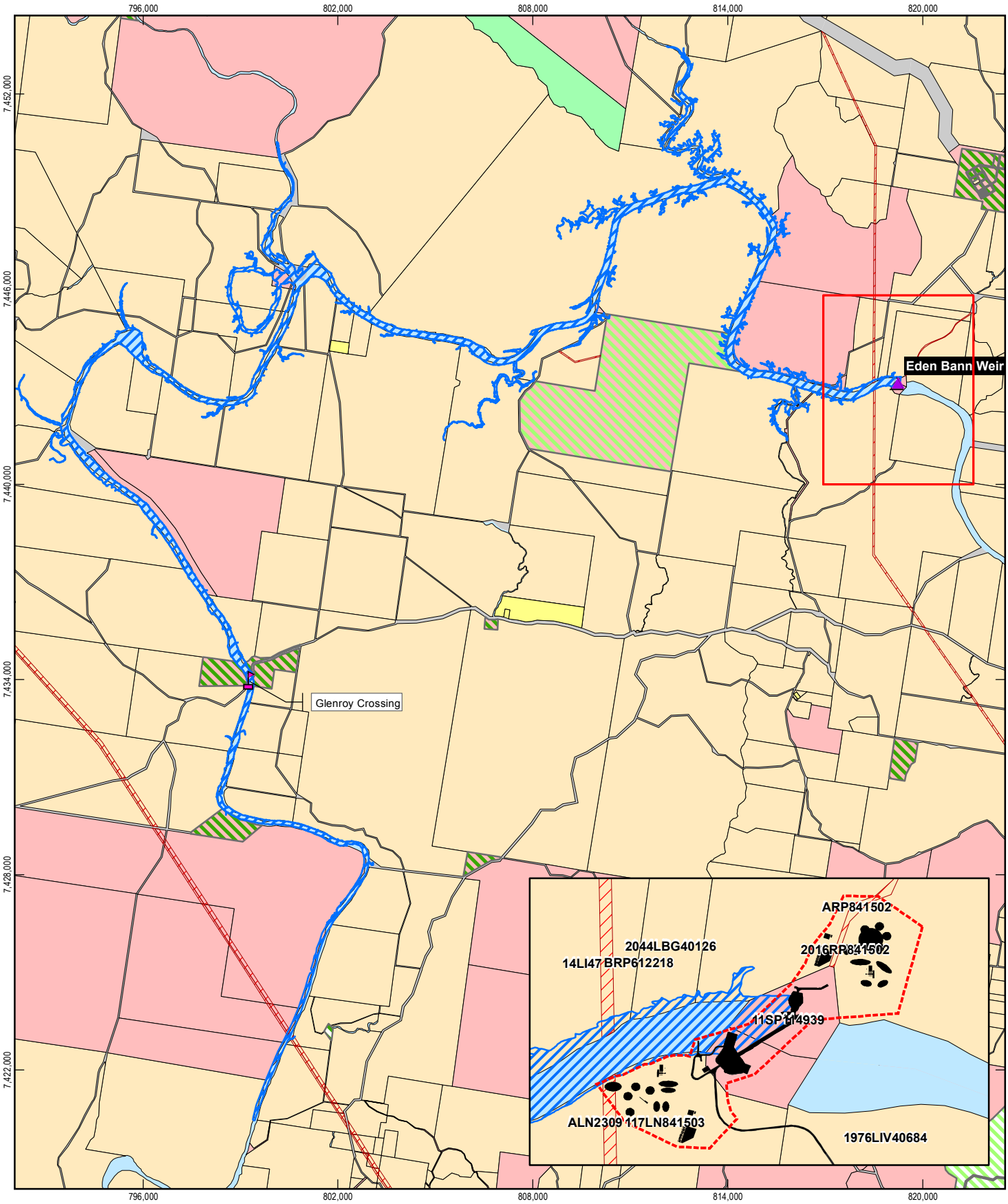
The Rookwood Weir site is located on the Fitzroy River. Land either side of the proposed weir is held as FH tenure. The Fitzroy, Mackenzie and Dawson Rivers are designated USL. Land adjacent to the watercourses within the Project's extent comprises largely FH tenure. Some LL and Reserve tenures exist. Figure 5-18 shows land tenure surrounding the proposed Rookwood Weir.

5.5.2.2 Land use

Eden Bann Weir is located on the Fitzroy River bounded by the RRC local government area (LGA) and the LSC LGA[3]. The Rookwood site is located on the Fitzroy River within the RRC LGA. The impoundment associated with development of a weir at Rookwood extends into the Mackenzie and Dawson rivers. The impoundment borders two parcels of WASC land and sections of CHRC land. Figure 5-19 shows the Project location relative to LGAs.

The Eden Bann Weir Project areas will be subject to assessment under both the Livingstone Planning Scheme 2005 and until the RRC planning scheme is finalised, the former Fitzroy Planning Scheme 2005. Rookwood Weir Project areas within the RRC LGA will be subject to assessment under the Fitzroy Planning Scheme 2005. Project areas within the CHRC LGA comprise land within the former Duaringa Shire Council area, including parcels of WASC land, and will be subject to assessment under the Duaringa Shire Planning Scheme 2007 and the WASC Planning Scheme 2014. Chapter 3 Legislation and project approvals provides information with regard to planning schemes and their relevance to the Project areas.

[3] On 10 March 2013 Livingstone residents voted to deamalgamate Livingstone Shire from the RRC. The new LSC came into effect on 1 January 2014 (Chapter 3 Legislation and project approvals).



LEGEND

- Weir Location
- River Crossing
- Impoundment Area
- Road Easement
- Waterway
- Tenure
- Easement
- National Park
- State Forest
- Reserve
- State Land
- Freehold
- Lands Lease

1:160,000 (at A4)

0 1 2 4 6

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Gladstone Area Water Board, Sunwater
Lower Fitzroy River Infrastructure Project

Job Number	41-20736
Revision	F
Date	28 Jul 2014

Eden Bann Weir land tenure

Figure 5-17

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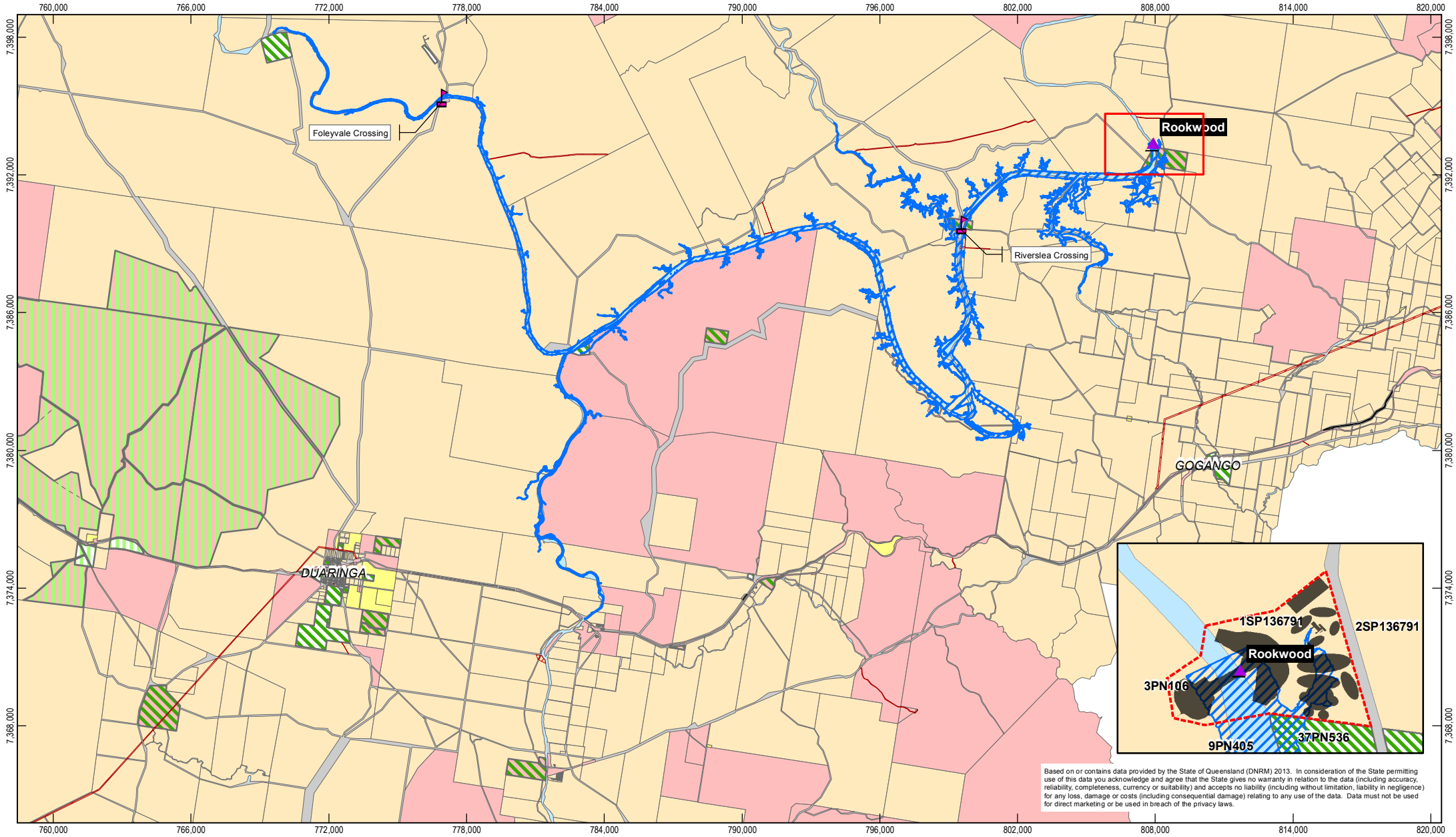

1:220,000 (at A4)

0 2 4 6

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
- River Crossing
- Impoundment Area
- Road Easement

Tenure

- Easement
- State Forest
- Reserve
- State Land
- Freehold
- Lands Lease
- Railway

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Revision E
Date 28 Jul 2014

Rookwood land tenure

Figure 5-18

G:\41\20736\GIS\Projects\MXD\600_Landowners\4120736_611_Rev_E.mxd

Level 9, 145 Ann St Brisbane QLD 4000 **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com.au **W** www.ghd.com.au

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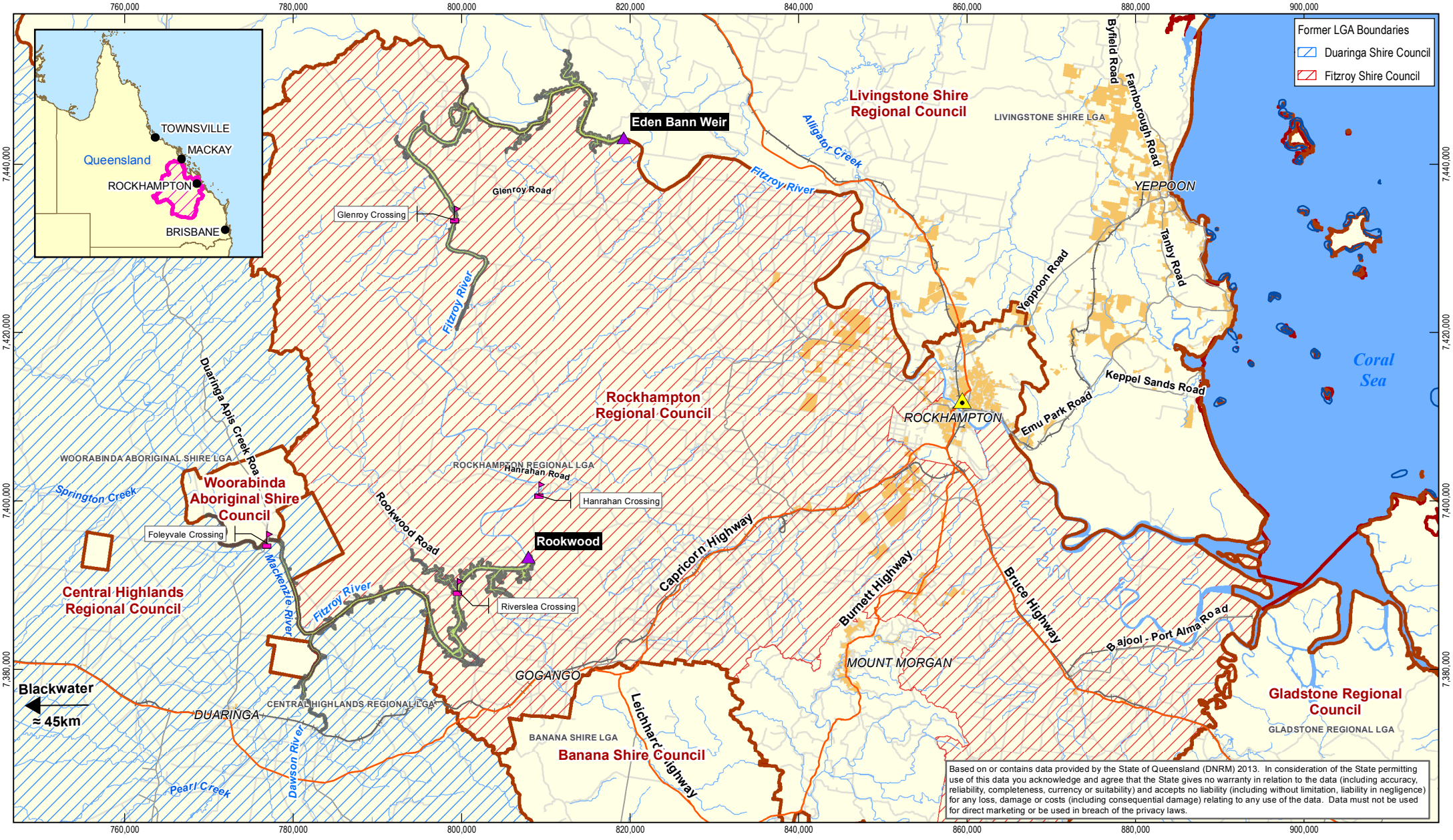

1:600,000 (at A4)

0 5 10 15 20

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
- River Crossing
- Fitzroy Barrage
- Highway
- Major Road
- Streets (Local)
- Local Government Boundary
- Railway
- Waterway
- Fitzroy Basin
- Urbanised Area
- Rookwood Impoundment Stage 1
- Rookwood Impoundment Stage 2
- Rookwood Impoundment Stage 3
- Eden Bann Impoundment Stage 2
- Eden Bann Impoundment Stage 3

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision C
Date 12 Feb 2015

Local government areas

Figure 5-19

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The RRC LGA encompasses a total land area of over 18,300 km^2 including national parks, state forests, coastline and islands. The main urban centre is Rockhampton, with a smaller centre at Yeppoon. There are numerous small towns and villages, both along the coast and in the rural hinterland. Rural land within the LGA is used mainly for raising cattle, pineapple growing, fruit growing, forestry and mining. Power generation and tourism are also important industries.

Within the CHRC LGA the largest town in the Project vicinity is Blackwater. Other towns are Duaringa, Dingo, Bluff and Bauhinia. Primary industries in the LGA include agriculture (cattle, wheat and grain production) and coal mining.

The WASC LGA comprise five parcels of land within the CHRC LGA. The WASC comprises the only Deed of Grant in Trust Aboriginal community within the Central Queensland region.

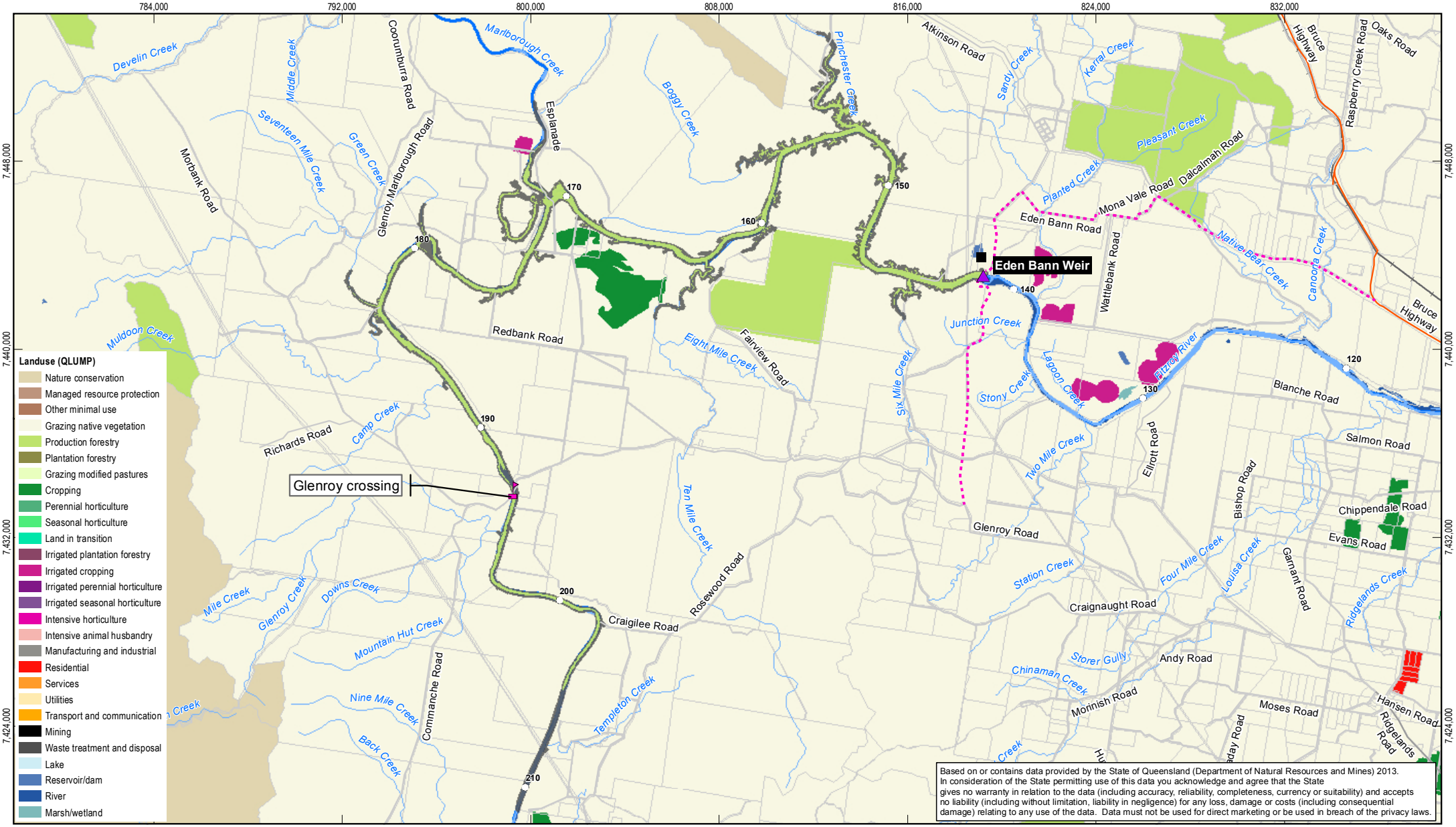
Areas of good soils that exist along the Fitzroy River form part of larger properties and largely remain undeveloped to intensive agriculture. The lack of development along the river can in part be explained by the formidable barrier the Fitzroy River forms to transport corridors, while the periodic large floods that inundate these properties have also hindered more intensive development of these better lands (Keane 2004).

With its wide channel, high flood flows and broad floodplain, only three high level bridges (two road and one rail) cross the Fitzroy River and these are located within one kilometre of each other in the centre of Rockhampton, where the land on both banks is high and flood free. The main north-south rail and road routes along the Queensland coast cross the Fitzroy River via these three bridges, while the transport routes to the inland centres further west are located well away from the Fitzroy River (Keane 2004).

As a result of the Fitzroy River being difficult to cross, access to properties along the Fitzroy River is largely by local gravel roads, which branch off from the main highways and road systems that service inland centres. These properties, located approximately an hour by road from Rockhampton, have largely remained beef cattle grazing properties since they were first settled well over a hundred years ago (Keane 2004).

The Project is located in a rural area. The main activity occurring on properties affected by the Project is cattle grazing, breeding and fattening as illustrated in Figure 5-20 and Figure 5-21, for Eden Bann Weir and the Rookwood site, respectively. There is some crop cultivation for grains and a small number of properties with irrigation licences. The most common use of the river is for stock watering with cattle generally accessing the water directly or via pump/trough systems. The large rural properties common to the Project areas are generally served by unsealed roads, often single lane, branching from the major arteries of the Bruce and Capricorn Highways.

Land suitability for irrigation within the Project areas as described in Forster and Sugars (2000), agricultural land, and strategic cropping land within the Project areas are is discussed in Section 5.3.2.3 and assessed in Section 5.3.3.3.



Landuse (QLUMP)

- Nature conservation
- Managed resource protection
- Other minimal use
- Grazing native vegetation
- Production forestry
- Plantation forestry
- Grazing modified pastures
- Cropping
- Perennial horticulture
- Seasonal horticulture
- Land in transition
- Irrigated plantation forestry
- Irrigated cropping
- Irrigated perennial horticulture
- Irrigated seasonal horticulture
- Intensive horticulture
- Intensive animal husbandry
- Manufacturing and industrial
- Residential
- Services
- Utilities
- Transport and communication
- Mining
- Waste treatment and disposal
- Lake
- Reservoir/dam
- River
- Marsh/wetland

1:215,000 (at A4)

0 2 4 6 8

Kilometres

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

N

LEGEND

- Homestead
- River Crossing
- Access Road
- AMTD (km)
- Weir Location
- Highway
- Major Road
- Streets (Local)
- Waterway
- Property Boundary
- Eden Bann Weir Stage 2 impoundment
- Eden Bann Weir Stage 3 impoundment

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision B
Date 09 Jan 2014

Eden Bann Weir Landuse

Figure 5-20

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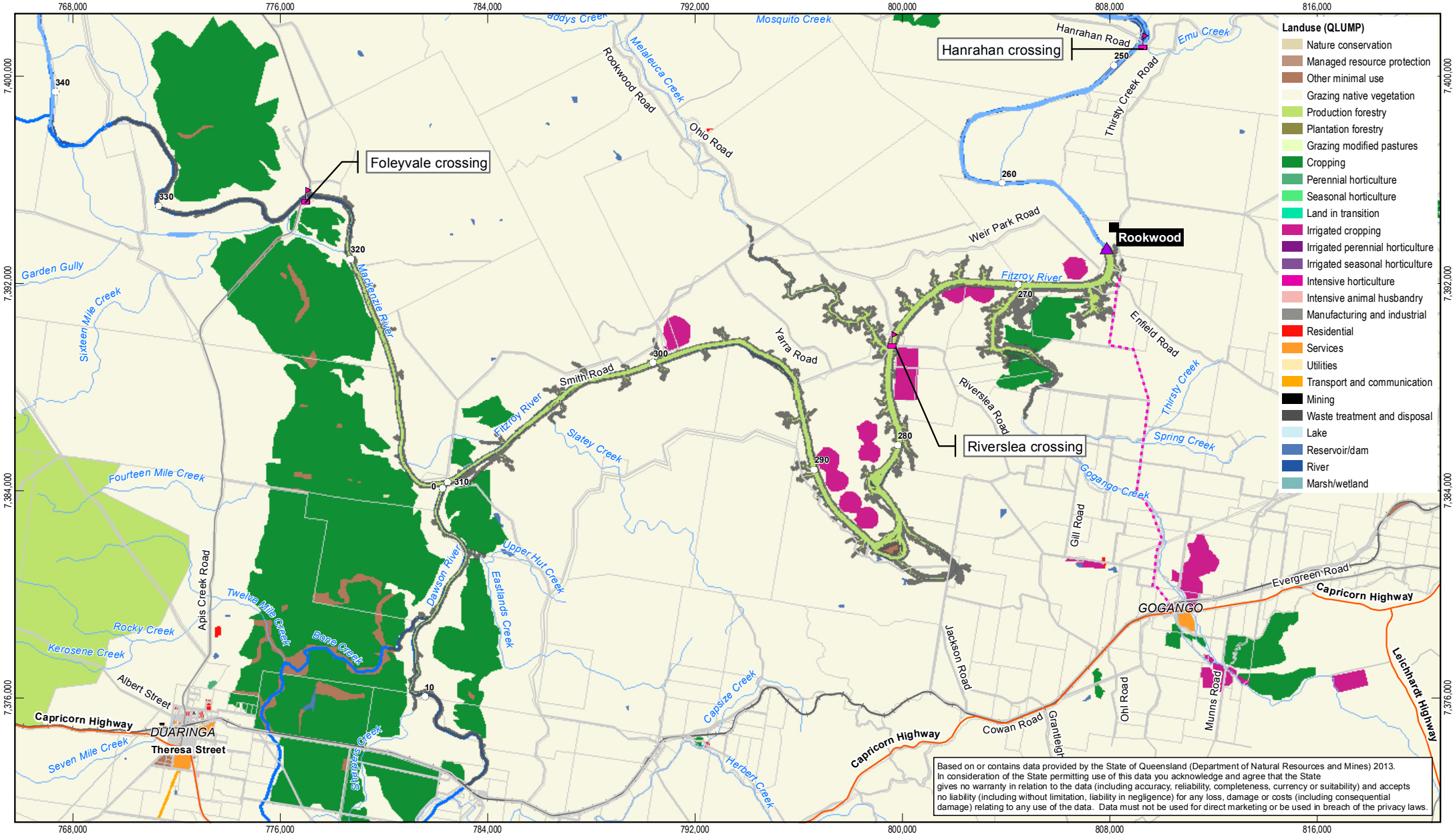

1:195,000 (at A4)

0 2 4 6 8

Kilometres

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

N

LEGEND

- Homestead
- River Crossing
- Access Road
- AMTD (km)
- Weir Location
- Highway
- Major Road
- Streets (Local)
- Railway
- Waterway
- Property Boundary
- Rookwood Weir Stage 1 impoundment
- Rookwood Weir Stage 2 impoundment

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision A
Date 09 Jan 2014

Rookwood Landuse

Figure 5-21

G:\41\20736\GIS\Projects\MXD\200_Report\4120736_321_rev_a.mxd

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5.5.2.3 Reserves, protected and 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) and within an approximate 20 km radius of the Project area are as follows(Figure 5-22):

- Goodedulla National Park
- Princhester Conservation Park
- Lake Learmouth State Forest
- Aricia State Forest
- Eugene State Forest
- Develin State Forest (adjoining the north-eastern corner of the Goodedulla National Park)
- Morinish State Forest
- Stuart Creek State Forest
- Duaringa State Forest.

Only the Aricia State Forest directly interacts with the Project. The north-eastern boundary (at approximately 147 km AMTD) and the north-western corner (at approximately 160 km AMTD) border the existing Eden Bann Weir impoundment.

Figure 5-22 also shows the locations of potentially sensitive environmental areas such as Great Barrier Reef Wetland Protection Areas of High Ecological Significance in the Project vicinity and the following sensitive environmental areas identified downstream of the Project areas:

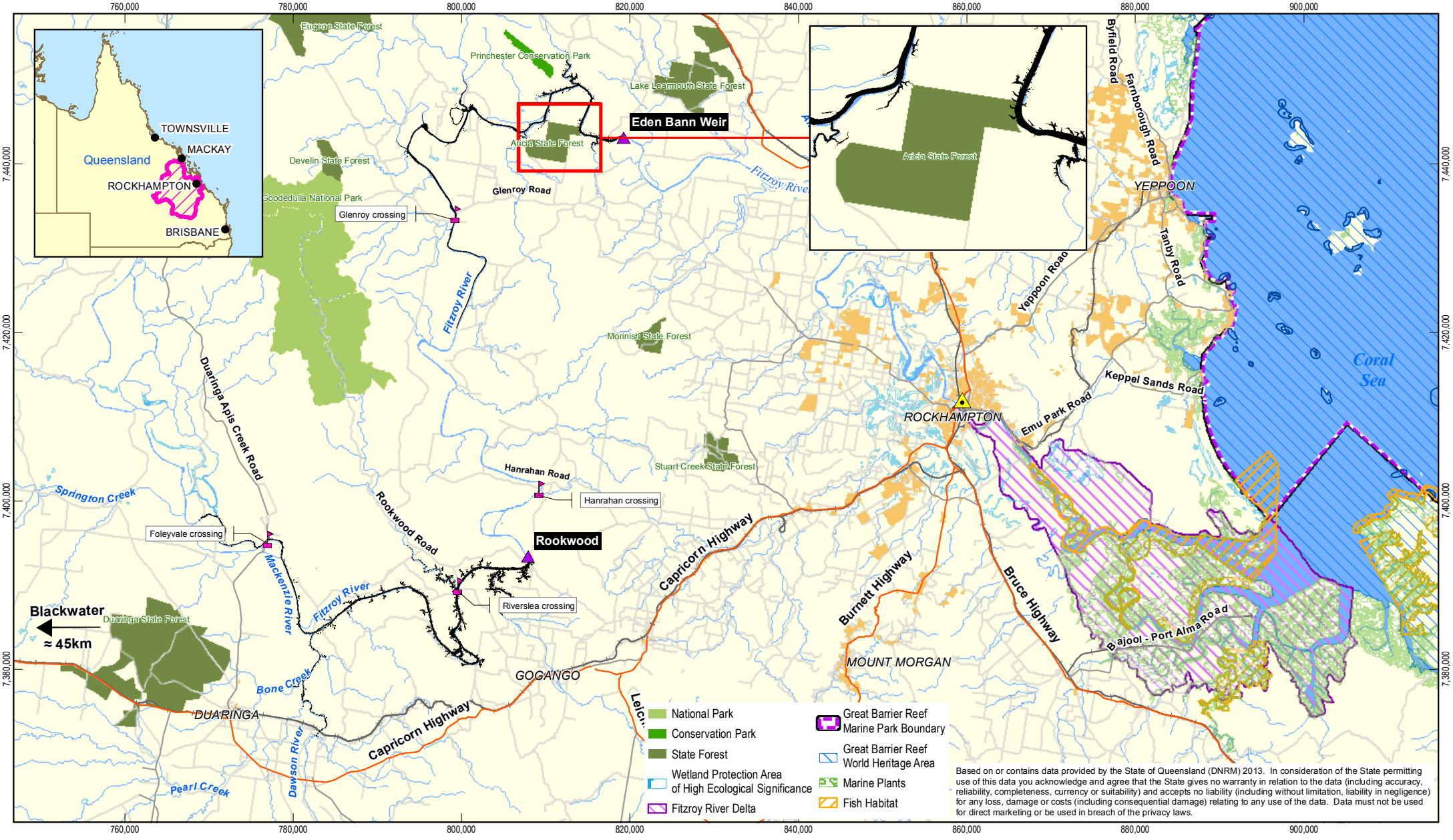
- Great Barrier Reef Marine Park
- Great Barrier Reef World Heritage Area (GBRWHA)
- Fitzroy River Floodplain (Directory of Important Wetlands)
- Fitzroy River Fish Habitat Area
- Marine plant location
- Great Barrier Reef Wetland Protection Areas of High Ecological Significance.

Further detail is provided in Chapter 7 Aquatic ecology and Chapter 11 Water quality.

A number of endangered, of concern and least concern Regional Ecosystems (REs) are situated in the Project area and discussed in Chapter 6 Flora.

5.5.2.4 Mining and petroleum tenure

As at 21 August 2013, mining and petroleum tenure (applied for and/or granted) in the vicinity of the Eden Bann Weir and the proposed Rookwood Weir Project areas comprised exploration permits for minerals (EPMs) (Figure 5-23 and Figure 5-24), exploration permits for petroleum (EPPs) and petroleum pipeline licences (PPLs) (Figure 5-25 and Figure 5-26), exploration permits for coal (EPCs) (Figure 5-27 and Figure 5-28) and mineral development licences (MDLs) and mining leases (MLs) (Figure 5-29 and Figure 5-30).



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1:600,000 (at A4)

0 5 10 15 20

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
- River Crossing
- Fitzroy Barrage
- Highway
- Major Road
- Streets (Local)
- Railway
- Waterway
- Fitzroy Basin
- Urbanised Area
- Impoundment Area

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision C
Date 09 Jan 2014

Reserves, protected areas and sensitive environmental areas

Figure 5-22

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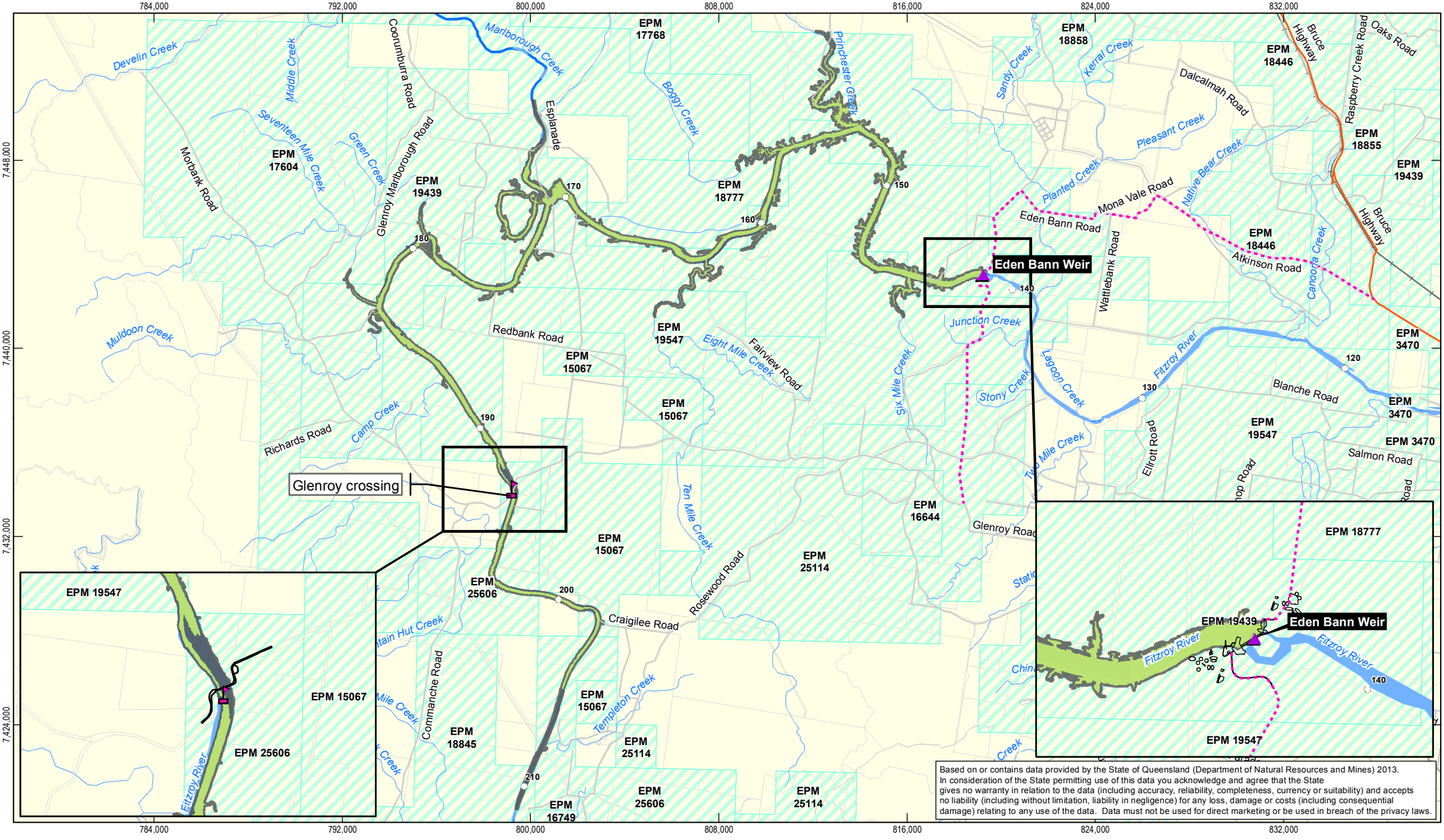

1:215,000 (at A4)

0 2 4 6 8

Kilometres

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

N

LEGEND

- River Crossing
- Access Road
- AMTD (km)
- Weir Location
- Highway
- Major Road
- Streets (Local)
- Waterway
- Property Boundary
- Eden Bann Weir Stage 2 impoundment
- Eden Bann Weir Stage 3 impoundment
- Mineral Exploration Permits
- Granted
- Construction Footprints

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Gladstone Area Water Board

SunWater Making Water Work

Gladstone Area Water Board, SunWater
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Eden Bann Weir exploration permits for minerals

Figure 5-23

G:\41\20736\GIS\Projects\MXD\200_Report\4120736_323_rev_c.mxd

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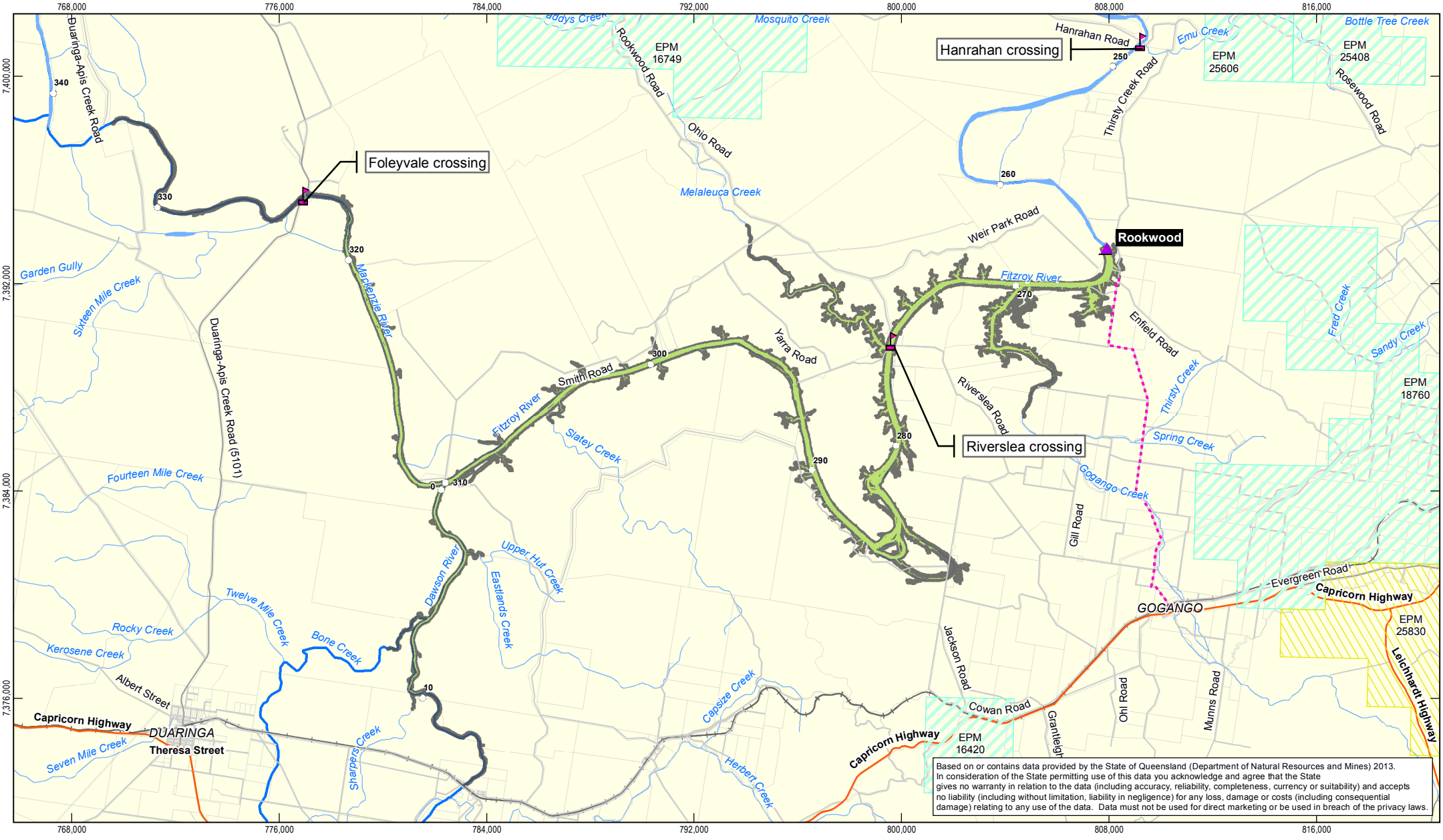

1:195,000 (at A4)

0 2 4 6 8

Kilometres

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

N

LEGEND

- River Crossing
- Access Road
- AMTD (km)
- Weir Location
- Highway
- Major Road
- Streets (Local)
- Railway
- Waterway
- Property Boundary
- Rookwood Weir Stage 1 impoundment
- Rookwood Weir Stage 2 impoundment
- Mineral Exploaration Permits
- Granted
- Application
- Construction Footprints

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Gladstone Area Water Board

SunWater Making Water Work

Gladstone Area Water Board, SunWater
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Job Number 41-20736
Revision C
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Rookwood exploration permits for minerals

Figure 5-24

G:\41\20736\GIS\Projects\MXD\200_Report\4120736_324_rev_c.mxd

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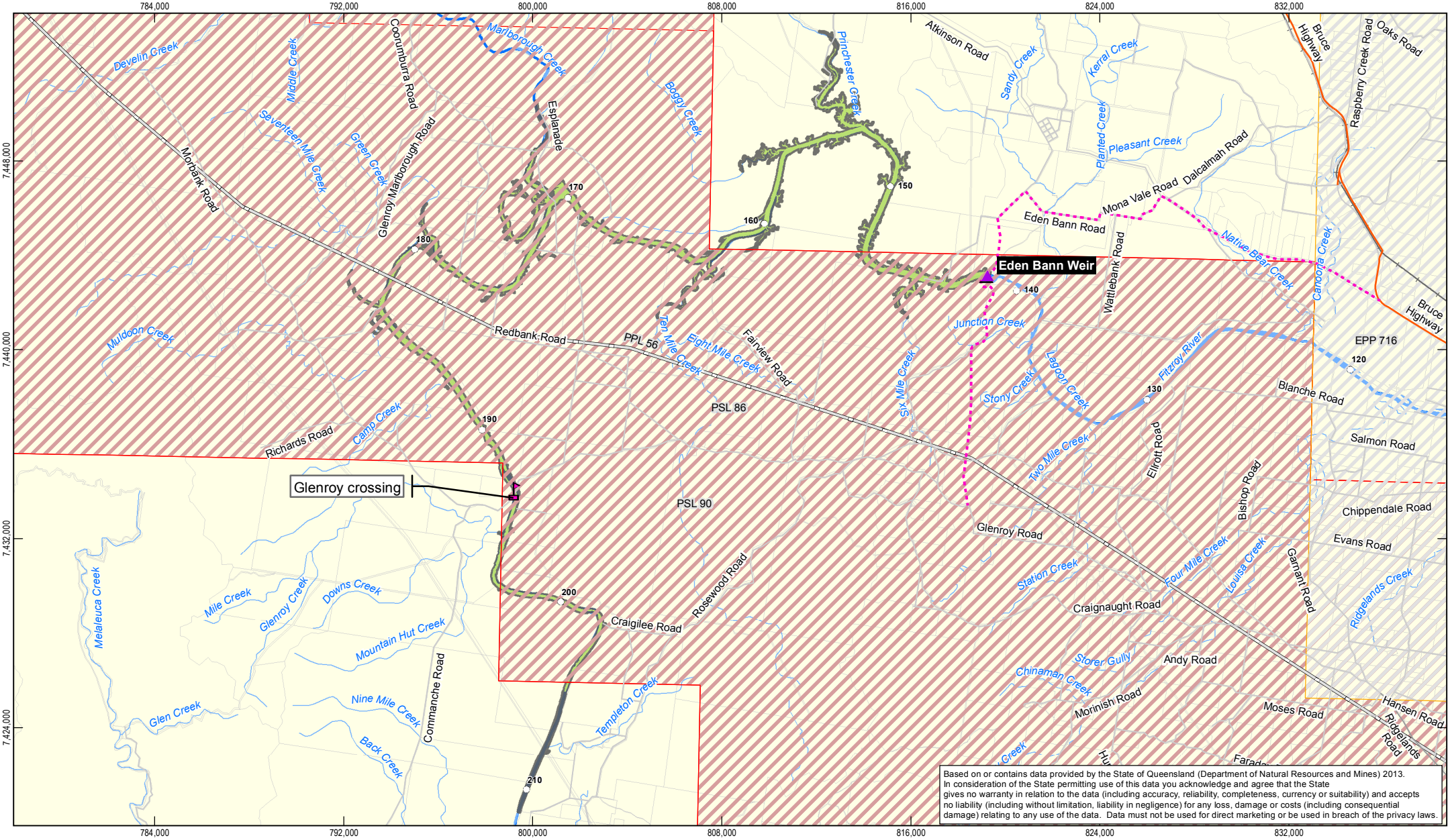

1:215,000 (at A4)

0 2 4 6 8

Kilometres

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

N

LEGEND

- River Crossing
- Access Road
- AMTD (km)
- Weir Location
- Highway
- Major Road
- Streets (Local)
- Waterway
- Property Boundary
- Eden Bann Weir Stage 2 impoundment
- Eden Bann Weir Stage 3 impoundment
- Petroleum Exploration Permits: Granted
- Petroleum Survey Licence: Granted
- Petroleum Pipeline Licence: Non-Current

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Date 09 Apr 2015

Eden Bann Weir exploration permits for petroleum, petroleum pipeline and petroleum survey licences

Figure 5-25

G:\41\20736\GIS\Projects\MXD\200_Report\4120736_325_rev_c.mxd

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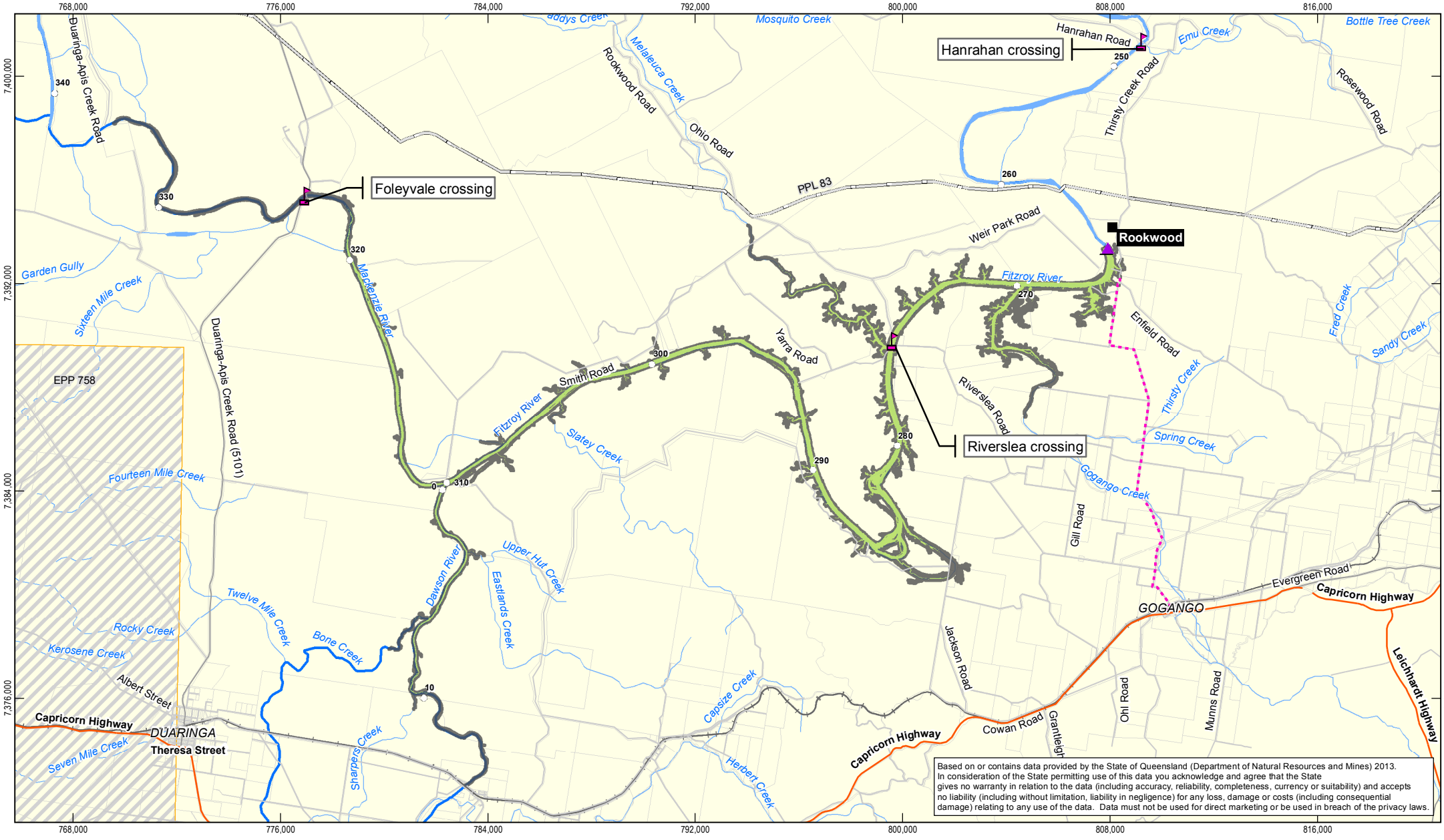

1:195,000 (at A4)

0 2 4 6 8

Kilometres

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

N

LEGEND

- River Crossing
- Access Road
- AMTD (km)
- Weir Location
- Highway
- Major Road
- Streets (Local)
- Railway
- Waterway
- Property Boundary
- Rookwood Weir Stage 1 impoundment
- Rookwood Weir Stage 2 impoundment
- Petroleum Pipeline
- Non-Current
- Petroleum
- Granted

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
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Rookwood exploration permits for petroleum and petroleum pipeline licences

Figure 5-26

G:\41\20736\GIS\Projects\MXD\200_Report\4120736_326_rev_c.mxd

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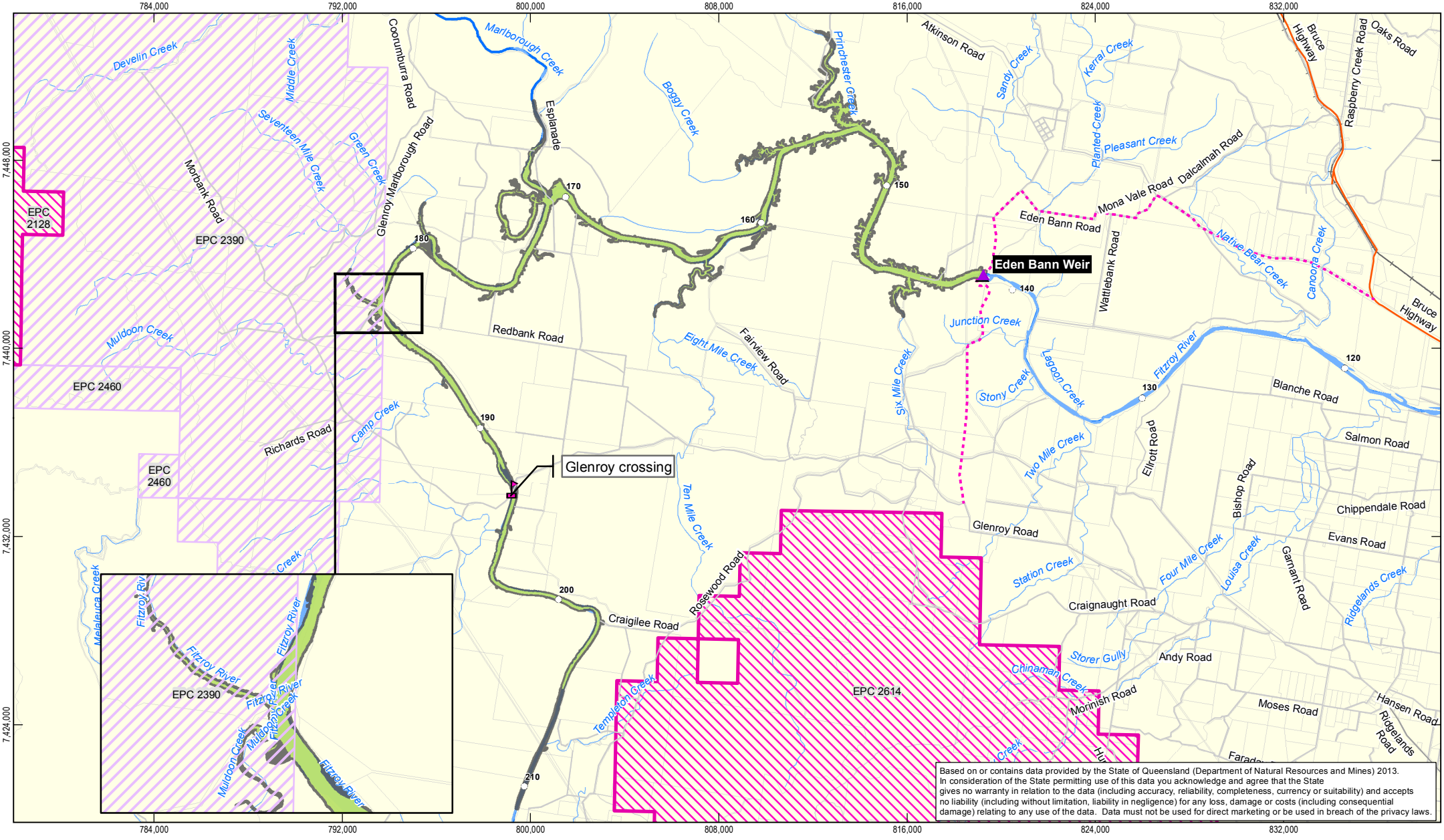

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1:215,000 (at A4)

0 2 4 6 8

Kilometres

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

N

LEGEND

- River Crossing
- Access Road
- AMTD (km)
- Weir Location
- Highway
- Major Road
- Streets (Local)
- Waterway
- Construction Footprints
- Property Boundary
- Eden Bann Weir Stage 2 impoundment
- Eden Bann Weir Stage 3 impoundment
- Exploration Permits (Coal)
- Granted
- Application

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Gladstone Area Water Board

SunWater Making Water Work

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision D
Date 09 Apr 2015

Eden Bann Weir exploration permits for coal

Figure 5-27

G:\41\20736\GIS\Projects\MXD\200_Report\4120736_327_rev_d.mxd

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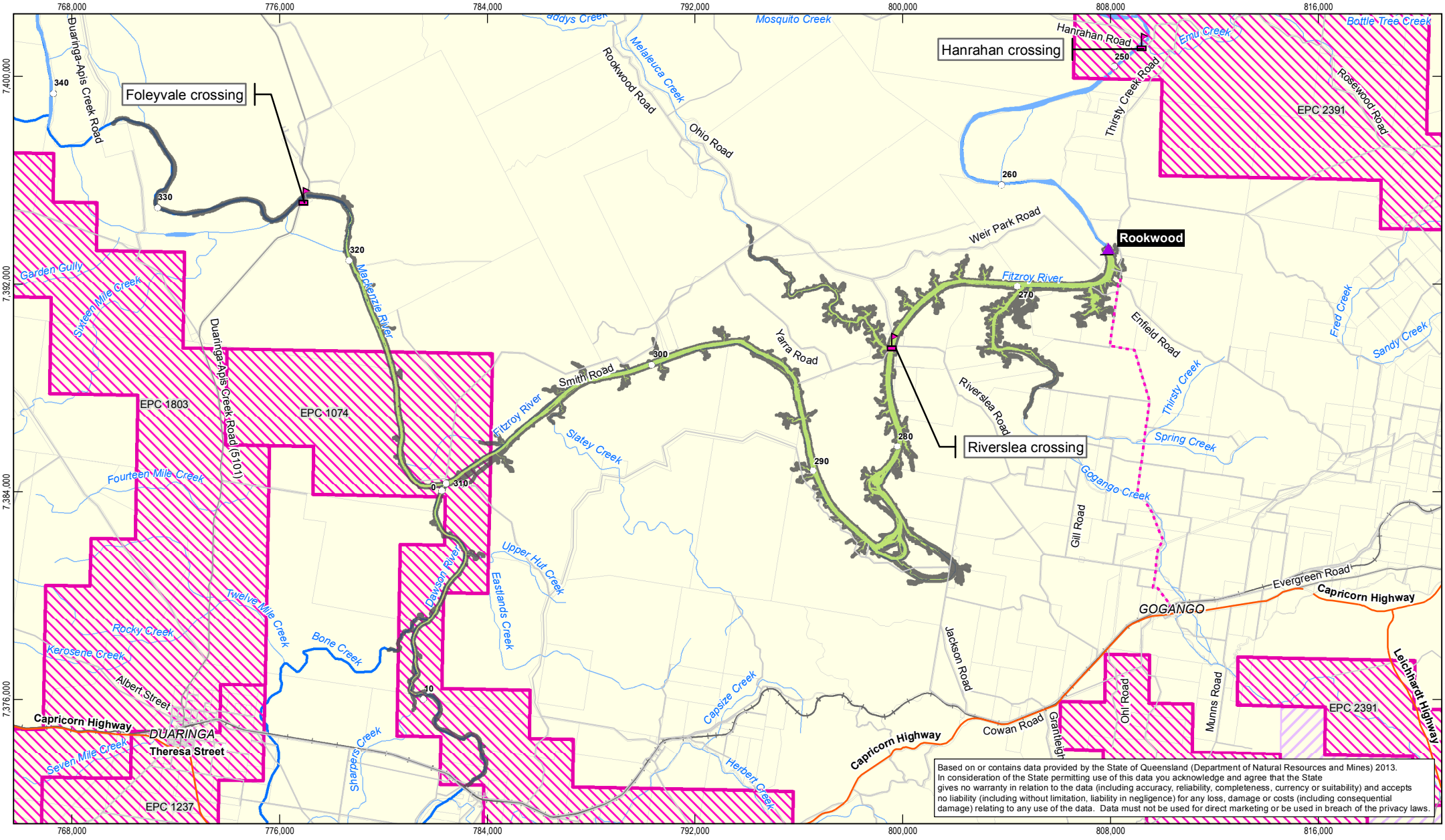

1:195,000 (at A4)

0 2 4 6 8

Kilometres

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

N

LEGEND

- River Crossing
- Access Road
- AMTD (km)
- Weir Location
- Highway
- Major Road
- Streets (Local)
- Railway
- Waterway
- Property Boundary
- Rookwood Weir Stage 1 impoundment
- Rookwood Weir Stage 2 impoundment
- Exploration Permits (Coal)
- Granted
- Application

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SunWater Making Water Work

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number	41-20736
Revision	C
Date	09 Apr 2015

Rookwood exploration permits for coal

Figure 5-28

G:\41\20736\GIS\Projects\MXD\200_Report\4120736_328_rev_c.mxd

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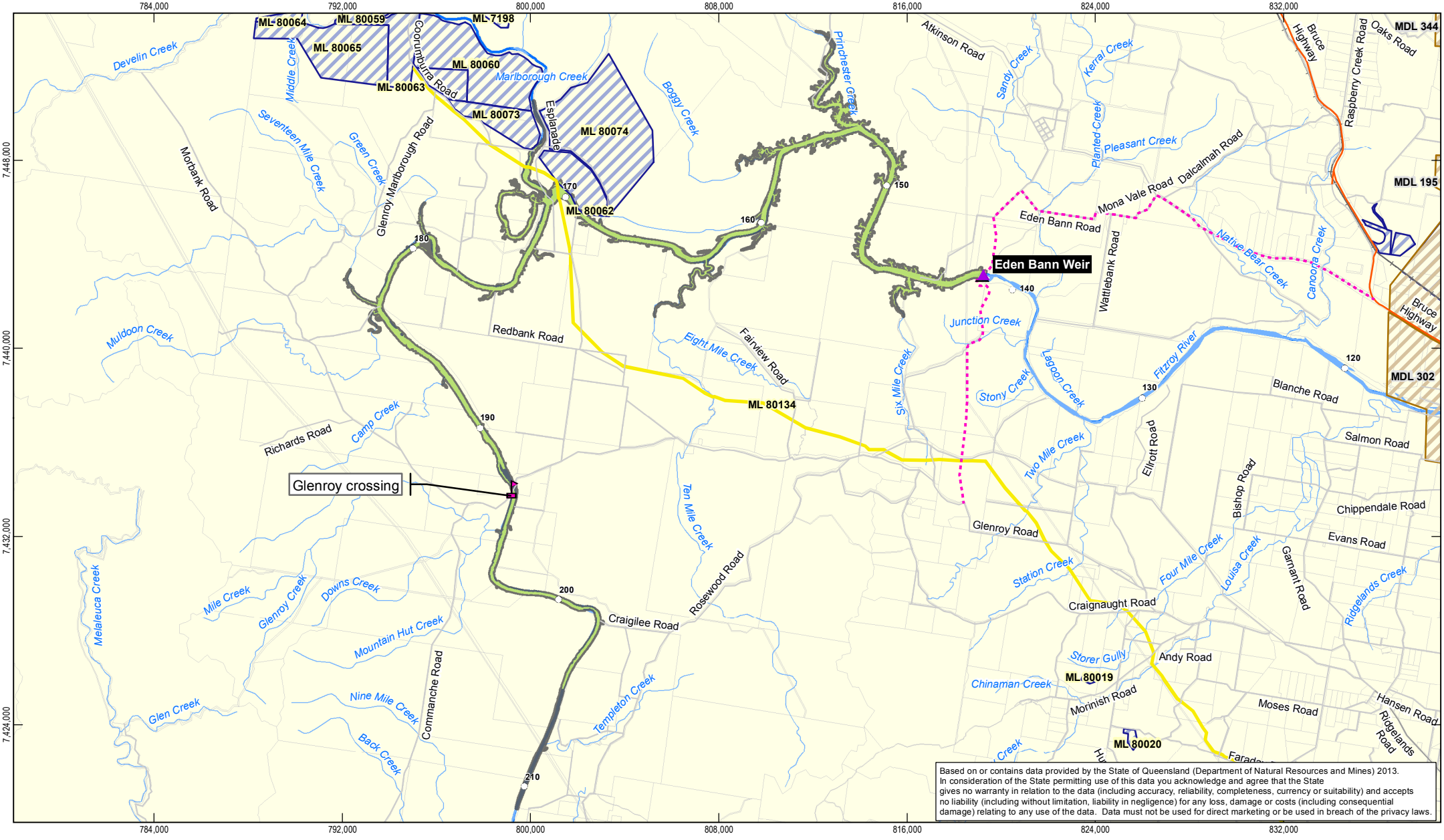

1:215,000 (at A4)

0 2 4 6 8

Kilometres

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

N

LEGEND

- River Crossing
- Access Road
- AMTD (km)
- Weir Location
- Highway
- Major Road
- Streets (Local)
- Waterway
- Property Boundary
- Eden Bann Weir Stage 2 impoundment
- Eden Bann Weir Stage 3 impoundment
- Mineral Development Licence: Granted
- Mining Leases: Granted
- Mining Leases: Application

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision C
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Eden Bann Weir mineral development licences and mining leases

Figure 5-29

G:\41\20736\GIS\Projects\MXD\200_Report\4120736_329_rev_c.mxd

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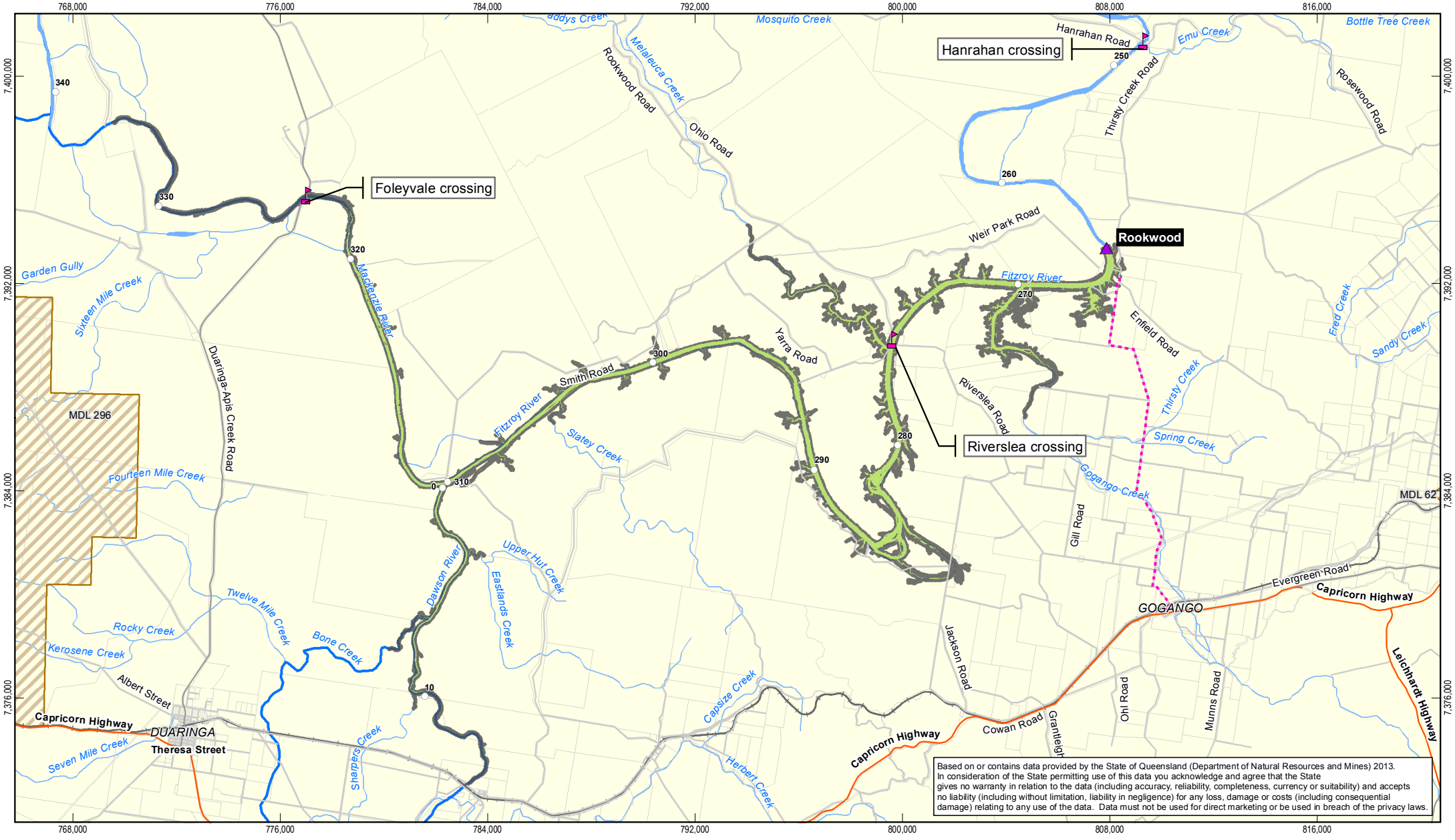

1:195,000 (at A4)

0 2 4 6 8

Kilometres

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

N

LEGEND

- River Crossing
- Access Road
- AMTD (km)
- Weir Location
- Highway
- Major Road
- Streets (Local)
- Railway
- Waterway
- Property Boundary
- Rookwood Weir Stage 1 impoundment
- Rookwood Weir Stage 2 impoundment
- Mineral Development
- Granted Mining Lease
- Application

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision B
Date 05 Sep 2014

Rookwood mineral development licences and mining leases

Figure 5-30

G:\41\20736\GIS\Projects\MXD\200_Report\4120736_330_rev_b.mxd

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In relation to Eden Bann Weir Project areas the following tenures apply:

- The Project inundation areas overlie a number of applications (and granted) for EPMs (Figure 5-23). The Eden Bann Weir site is within EPM19439/EPM11195 (Marlborough Nickel Pty Ltd), EPM25606 and EPM15067 (Signature Gold Ltd), EMP18777 (GWM resources NL) and EMP17604 and EPM18845 (Kalicoal Pty Ltd). The new southern access road traverses EPM19439 and EPM19547 applied for by Marlborough Nickel Pty Ltd and EPM25114 applied for by Signature Gold Ltd
- No applications (or granted) for permits for EPPs exist in the Project areas (Figure 5-25)
- EPC2390 (applied for by Civil and Mining Resources Pty Ltd) overlies a limited inundation area as shown on Figure 5-27
- No MDLs cover Project areas (Figure 5-29)
- ML80062 and ML80074 are granted to Marlborough Nickel Pty Ltd on land adjacent to the existing Eden Bann Weir impoundment (Figure 5-29). Mining has not commenced and the land is grazed. ML80134 has been applied for in relation to a pipeline that proposes to traverse the Fitzroy River (existing and proposed Eden Bann Weir impoundment) to support Marlborough Nickel
- A non-current PPL56 for gas, held by AGL Pipelines Investments (QLD) Pty Limited, traverses the present Eden Bann Weir impoundment on the Fitzroy River (at 182 km AMTD, Figure 5-25). However, PPL56 is non-current
- Petroleum Survey Licences (PSLs) for the Arrow Bowen Pipeline (PSL 86 and PSL 90) underlie parts of the existing and proposed raised Eden Bann Weir inundation area.

In relation to the proposed Rookwood Weir Project areas the following tenures apply:

- No applications (or granted) for EPMs exist in the proposed Rookwood Weir Project area (Figure 5-24)
- No applications (or granted) for permits for EPPs exist in the Project areas (Figure 5-26)
- The Project inundation areas are subject to a number of applications (and granted) EPCs (Figure 5-28). EPC1581 (granted to Peabody Energy Australia Coal Pty Limited underlies Riverslea Crossing; EPC1473 (applied for by Conarco Minerals Pty Ltd) underlies Foleyvale Crossing, EPC2391 (granted to Metroof Industries Pty Limited) underlies Hanrahan Crossing and EPC1074 (granted to Fairway Coal Pty Ltd) underlies the Dawson River and part of the Mackenzie River inundation areas
- No MDLs or MLs underlie the Project areas (Figure 5-30)
- PPL121 (for gas) (granted to Central Queensland Pipeline Pty Ltd) traverses Melaleuca Creek and the Mackenzie River at 320 km AMTD (Figure 5-26).

5.5.2.5 Key resource areas

Key resource areas (KRAs) are defined as locations that contain important extractive materials of State or regional significance (DME 2007). KRAs generally encompass extractive resource and onsite processing areas, an associated transport route and separation areas around the resource (DME 2011). There are no KRAs within the Project area.

Figure 5-31 shows the location of KRAs within the region as described below:

- Benedict Road KRA (KRA 18) is the closest key resource area to the Project, located approximately 28 km east of the proposed Rookwood Weir site and approximately 32 km west of Rockhampton along Benedict Road. The extractive resource at this location is quarry rock (basalt) with the potential to provide aggregate and other construction materials for the proposed expansion of industrial facilities and other development in the eastern part of the central Queensland region (Department of Mines and Energy (DME) 2007)
- Pink Lily KRA (KRA 22) is located approximately 8 km west of Rockhampton off the Ridgelands Road and provides fine to coarse-grained sand and gravel from off-stream deposits in the Pink Lily and Lilymere Lagoons areas. These resources are the major source of fine concrete aggregate and other construction sands for the Rockhampton region (DME 2007)
- Nerimbera KRA (KRA 21) is located in the foothills of the Berserker Range approximately 8 km east of Rockhampton comprising hardened argillite and greywacke. The northern part of the site comprises a quarry supplying high quality crushed rock products for the Rockhampton and wider central Queensland region (DME 2007)
- Peak Hill KRA (KRA 98) is located 8 km north of Rockhampton on the Rockhampton to Yeppoon road and provides quarry rock. The existing operation (quarry) produces a considerable proportion of the hard rock consumed in the former Rockhampton City and Livingstone Shire. The resource is sufficient to continue for over twenty years at its present rate of production (DME 2007).

5.5.2.6 Existing and proposed infrastructure

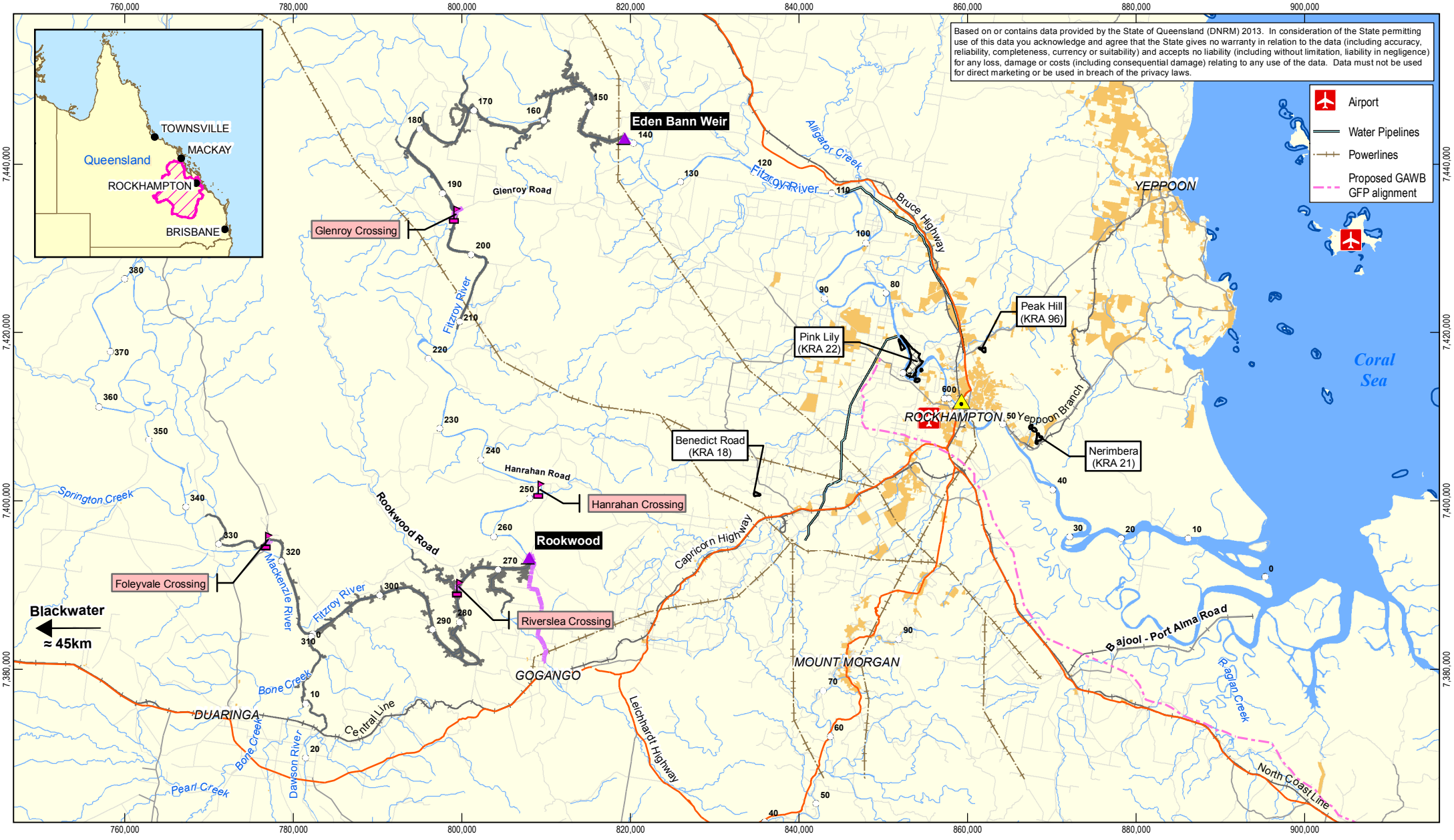
Figure 5-31 shows the location of existing roads and infrastructure within the region. Transport infrastructure (road, rail, air and port) is discussed further in Chapter 16 Transport. Other infrastructure associated with the Project is detailed in Chapter 2 Project description.

Rail infrastructure

Aurizon Network Pty Ltd (Aurizon) operates the rail network in the vicinity of the Project area, specifically the Blackwater system (Chapter 16 Transport). An active (boomed) level crossing traverses Third Street/Riverslea Road at Gogango on route to Rookwood Weir. The crossing has a height clearance of 5.2 m. A high level rail crossing traverses the Dawson River at Boolburra (15.9 km AMTD) outside of the Rookwood Weir impoundment and flood impact area.

Gas, water, power and telecommunications infrastructure

There are a number of water pipelines (Figure 5-31), gas pipelines (Figure 5-25 and Figure 5-26) and power lines (Figure 5-31) (in place and proposed) traversing the region. There are no water pipelines within close proximity to the Project. The offtake to the Stanwell Power Station and the proposed Gladstone-Fitzroy Pipeline (GFP) Project pipeline are located downstream of Eden Bann Weir (approximately 75 km AMTD). Petroleum pipeline licences are discussed in Section 5.5.2.4. Two power lines cross the Eden Bann Weir impoundment, one immediately upstream of the weir (at approximately 142 km AMTD) and one at approximately 208 km AMTD. Ergon currently supply power to Eden Bann Weir via a 12.7 kV Single Wire Earth Return 22 km long overhead power line. There is no current supply to the proposed Rookwood Weir site. No power lines traverse the Rookwood Weir impoundment. The nearest major power line is located approximately 12 km south of the weir site at the Capricorn Highway.



1:600,000 (at A4)

0 5 10 15 20

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
- Fitzroy Barrage
- Highway
- Major Road
- Streets (Local)
- Railway
- Waterway
- Fitzroy Basin
- Urbanised Area
- Impoundment Area
- Proposed Road Upgrade
- Key Resource Area

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Revision C
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Key resource areas, existing and proposed infrastructure

Figure 5-31

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Data Source: GHD: Proposed Bridge and Road Relignment (2012); © Copyright Commonwealth of Australia (Geoscience Australia): Places, Waterways, Utilities, Airport (2007); Sunwater: Waterways, Weir Locations - 2008; DNRM: Railways, Roads - 2010;
DME: Key Resource Area - 2007: GAWB: GFP alignment (2014). Created by: MS *See Appendix for disclaimers and copyrights.

Two water supply pipelines transfer water from the Fitzroy Barrage impoundment (at 108 km AMTD and 75 km AMTD) to supply North Rockhampton and Stanwell Power Station, respectively. The Rockhampton to Yeppoon Water Pipeline provides potable water from the RRC Glenmore Water Treatment Plant to Yeppoon. These water supply pipelines do not traverse Project areas.

5.5.2.7 Stock routes

Figure 5-32 shows the location of stock routes identified within the vicinity of the Project:

- Stock Route M420DUAR02 crosses the Mackenzie River at approximately 335 km ATMD
- Stock Route U413DUAR01 crosses the Dawson River at approximately 15 km ATMD.

Stock routes also comprise corridors on roads, reserves, pastoral leases and USL along which stock are driven on foot. A stock route can be a road that is declared to be a stock route under Queensland legislation, or it may simply be any route that has customarily been used for walking stock. Stock routes have no separate title or tenure from the underlying road reserve, and the same roads are used for walking and agisting stock and vehicular transport. Reserves for travelling stock are areas designated for travelling stock purposes under the *Land Act 1994* (Qld). They can include camping and water reserves, pasture reserves and trucking reserves (State of Queensland 2012). Land tenure within the Project area is described in Section 5.5.2.1 above.

5.5.2.8 Native title

Native title searches (Chapter 17 Cultural heritage) revealed that a number of claims exist (or did exist) over the Project area including the following:

- Eden Bann Weir: Darumbal People QC2012/008, QUD6131/1998 combined claims QC1997/021, QUD6131/1998 and QC1999/001, QUD6001/1999)
- Rookwood: Darumbal People (former uncombined claim QC1997/021, QUD6131/1998); Gangulu People (former claim QC97/36; QUD6144/1998); Kangoulu People (former claim QC98/25; QUD6195/1998); and Ghungalu People (former claim QC99/16; QUD6226/1998).

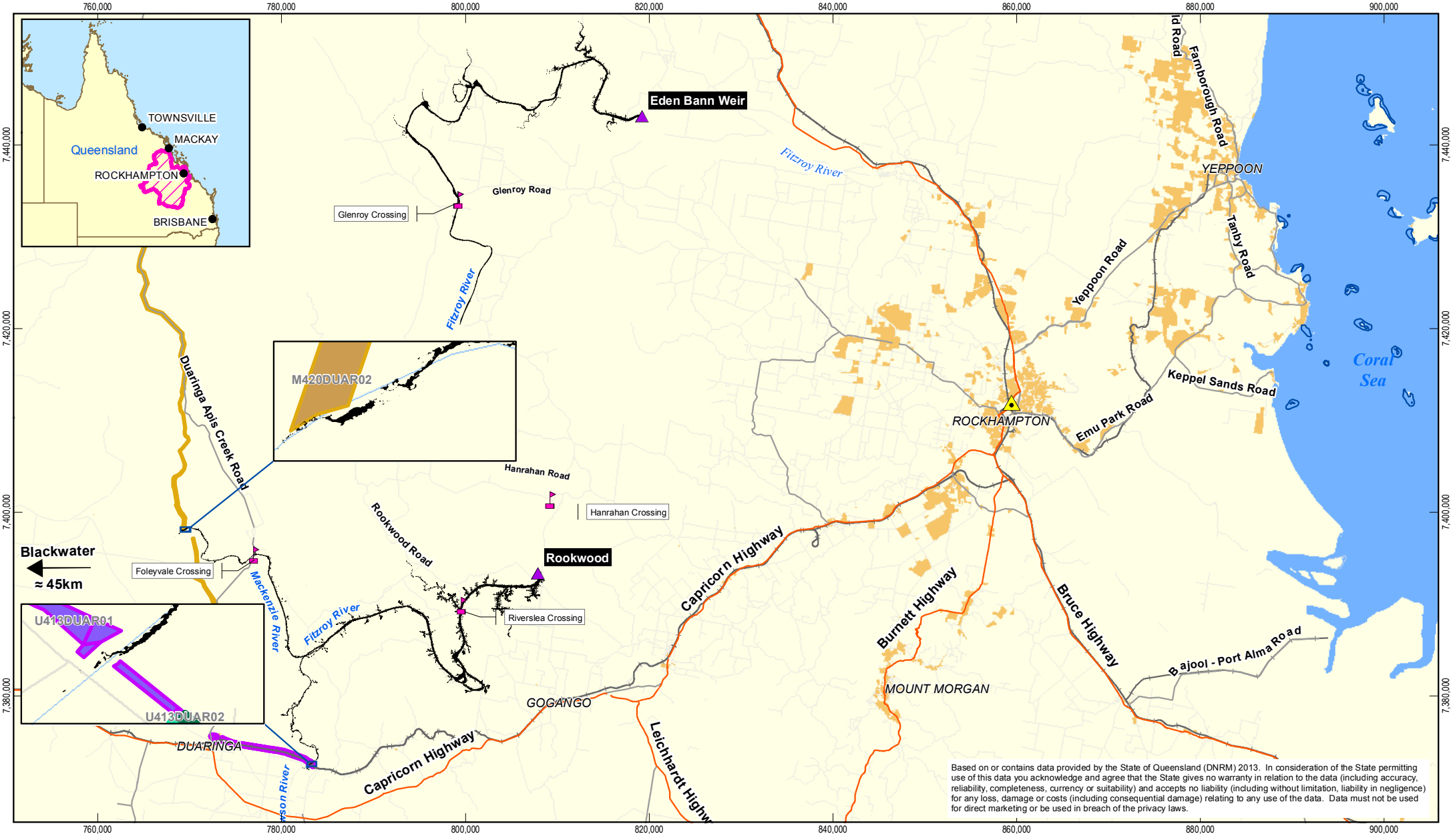
A portion of the proposed Rookwood Weir Project area was not the subject of a claim. Following public notification and discussion with the aforementioned parties, the Jetimarala People were identified as custodians.

5.5.2.9 Residential and recreational use areas

The Fitzroy River is used for recreational activities but boating (motorised and non-motorised) is largely restricted to the downstream reaches near Rockhampton and the Fitzroy River estuary. These recreational users represent a significant stakeholder group for the Project and have been engaged in the EIS community consultation process (Chapter 1 Introduction (Consultation)).

Recreational use at the existing Eden Bann Weir is not facilitated. Access to the weir itself is restricted to authorised personnel and the impoundment is largely bordered by private landholdings, restricting access to the river. Opportunities to access the Fitzroy River may exist at river crossings however there are no formal facilities to facilitate recreation.

The Project area consists predominantly of large, rural agricultural land holdings with sparse and scattered settlement. An existing occupier rural homestead is confirmed present approximately 750 m north, north-east of Eden Bann Weir. Access to the proposed Rookwood Weir site is via the town of Gogango, 14 km from the proposed weir site. Chapter 12 Air quality and Chapter 14 Noise and vibration discuss sensitive receptors further.



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0 5 10 15 20

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
- Fitzroy Barrage
- River Crossing
- Highway
- Major Road
- Streets (Local)
- Railway
- Waterway
- Fitzroy Basin
- Urbanised Area
- Impoundment Area
- **Stock Routes**
  - M420DUAR02
  - U413DUAR01

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Stock route network

Figure 5-32

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5.5.3 Potential impacts and mitigation measures

5.5.3.1 Land tenure

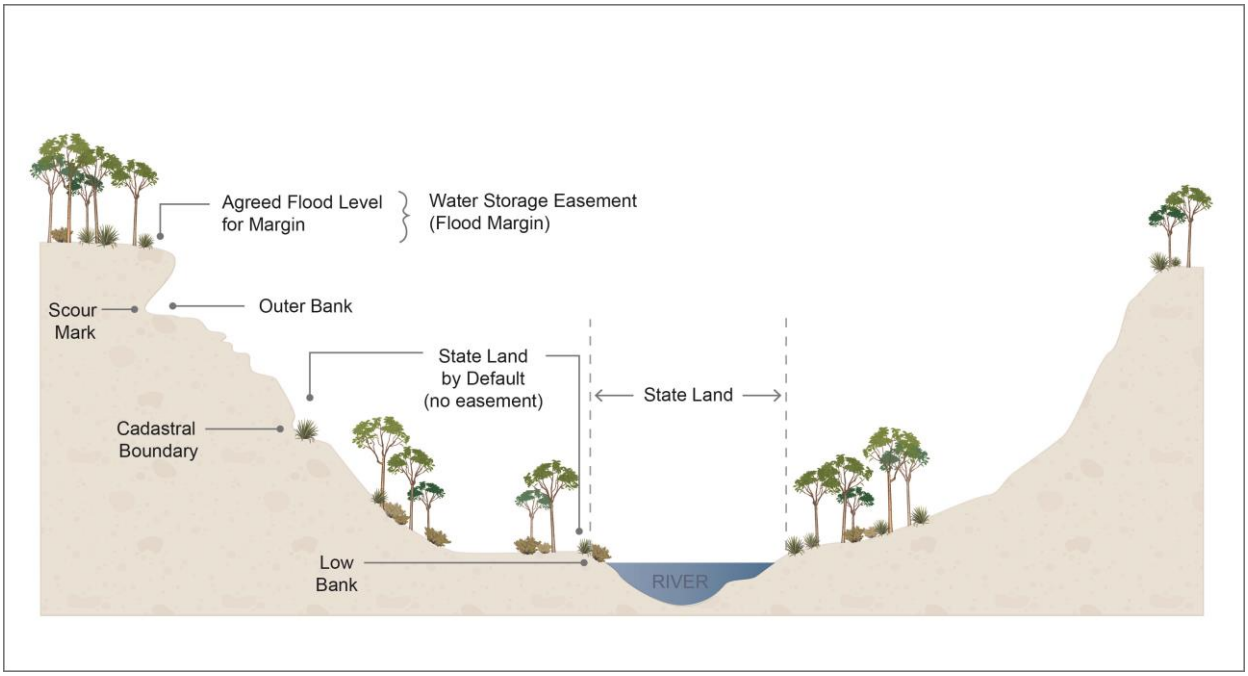
The Perpetual lease at Eden Bann Weir is appropriate for the Project. Raising the weir to a Stage 2 build will extend into Lot 2016 RP841502 on the northern bank. The right (southern) embankment is contained within Lot 11 SP114939. It is expected that the Perpetual Lease will persist over lots impacted directly by weir infrastructure and associated ancillary work areas retained for operations. The proposed southern bank access road will traverse three FH lots (namely: Lot 1976 LIV40684; Lot 117 LN841503; and Lot 26 LN200) (Figure 5-17). Easements will be negotiated over these lots to secure tenure of the private access road. Raising Eden Bann Weir to Stage 3 will not further impact this footprint or require additional tenures to be negotiated.

For Rookwood, the majority of the weir itself is within the Fitzroy River on USL. The right (eastern) embankment will extend into FH land on Lot 1 SP136791. The left (western) embankment extends into FH land on Lot 3 PN106. Three saddle dams will be located within Lot 3 PN106 upstream of the weir (Figure 5-18). Similar to Eden Bann Weir a long-term lease will be acquired over Rookwood Weir and the associated infrastructure. An easement will be negotiated over FH Lot 1 SP136791 to accommodate a new access road. Thirsty Creek Road will be upgraded to accommodate construction traffic. Raising Rookwood Weir to Stage 2 will not further impact on this footprint and will not require additional tenure negotiations.

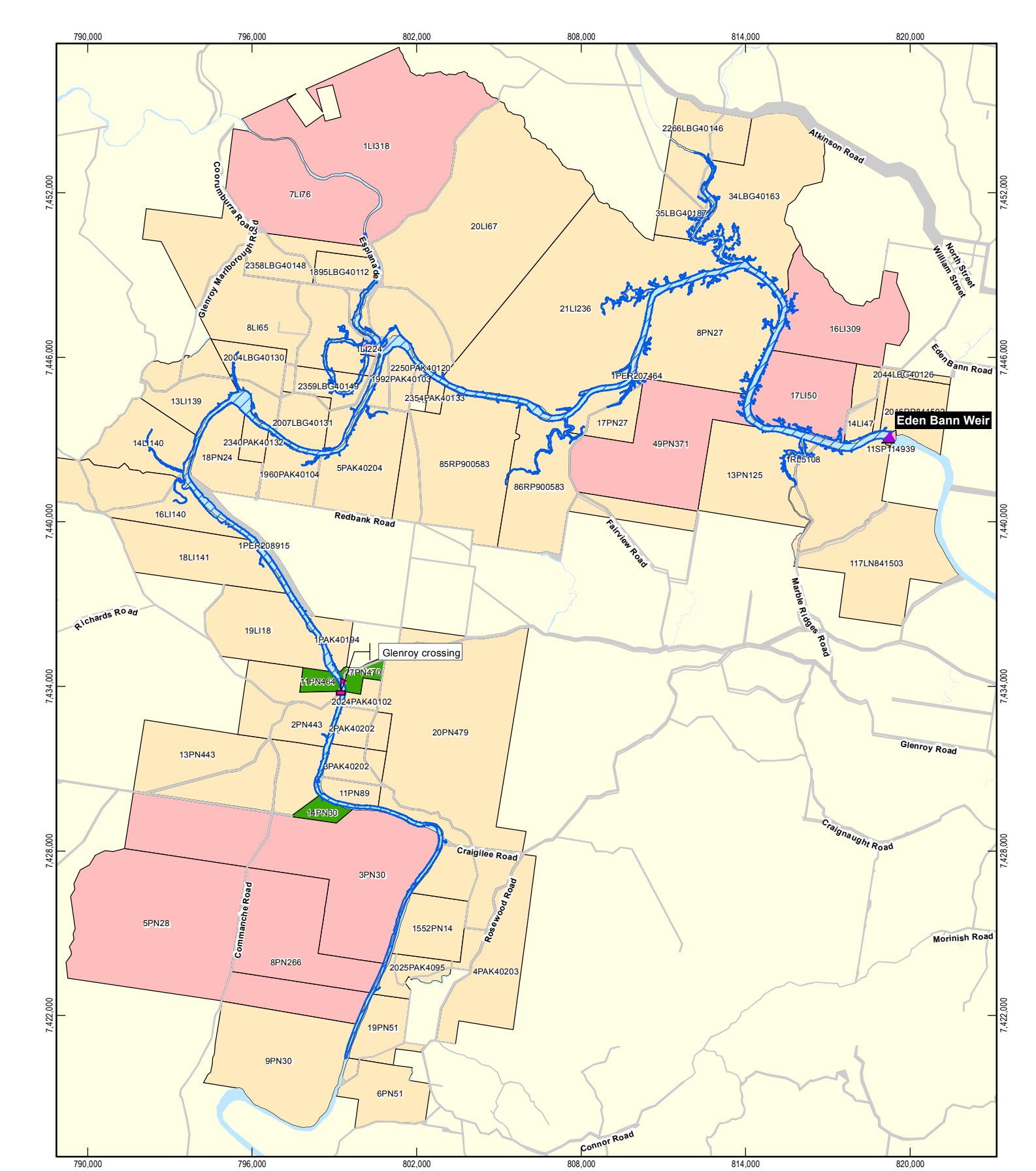
With regard to future proposed tenure of the Eden Bann Weir and Rookwood Weir impoundments it is not possible for the State Government to grant land interests in State land that is also part of the watercourse and as such it is considered that areas can be inundated without the need for specific tenure or licence. A water storage easement (or similar) will be negotiated for riparian land within the impoundment but outside of the watercourse. The water storage easement will consider the need for a flood buffer zone on a lot-by-lot basis to account for potential flood impacts as a result of operation of the Project. This is discussed in more detail in Chapter 2 Project description and Chapter 3 Legislation and project approvals.

The impoundments do not extend outside of the banks of the Fitzroy, Mackenzie or Dawson Rivers. For the purposes of the EIS, cadastral boundaries have been used to define the extent of the watercourse areas and adjacent landholdings (FH or other). As illustrated in Figure 5-33 cadastral boundaries may lie between the low bank and the outer bank of a river. Weir design allows for inundation at full supply level to extend up to the outer bank level. As such, riparian land (as defined in terms of the cadastral boundary) within these adjacent landholdings is likely to be impacted by the impoundment even though inundation is retained within the river banks.

Figure 5-33 Extent of land interest and ownership illustrated



The existing Eden Bann Weir (Stage 1) impoundment impacts 11 landholders across 33 lots. Raising the weir to Stage 2 will impact on an additional nine landholders and 19 lots. Adding gates as at Stage 3 will impact an additional five landholders and seven lots. The tenure status of land adjacent to the inundation area comprises mainly FH lots, some leasehold and a few Reserves. One lot is listed as state forest, namely Aricia State Forest (leased for grazing purposes). Properties affected by the raising of Eden Bann Weir are shown in Figure 5-34. Table 5-13 lists the subject lots and tenures potentially impacted by the Project as a result of the construction and operation of Eden Bann Weir.



LEGEND

- Weir Location
- River Crossing
- Secondary Roads
- Minor Road/Road Easement
- Proposed Eden Bann Upper Impoundment Limit

Tenure

- Freehold
- Lands Lease
- Reserve
- Road Easement
- Waterway

1:180,000 (at A4)

0 1.5 3 6

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Lower Fitzroy River Infrastructure Project

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Revision D
Date 28 Jul 2014

Eden Bann Weir Potentially Affected Properties

Figure 5-34

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Data Source: © Copyright Commonwealth of Australia (Geoscience Australia): Waterways (2007); Sunwater: Waterways, Weir Locations - 2008; DNRM: Roads - 2010, DCDB - 2013.
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Table 5-13 Eden Bann Weir subject lots and tenure status

Subject lots	Tenure*	Impoundment for Stage			Project impact^	Potential tenure implications
		1	2	3		
11 SP114939	LL	Y	Y	Y	• Eden Bann Weir construction and operation • Inundation	• Perpetual lease retained or similar long-term lease negotiated
2016 RP841502	FH	Y	Y	Y	• Inundation of riparian land on the left bank • Raise will extend left embankment into this lot • Existing left bank access retained for raise	• Water storage easement over riparian land • Extension of Perpetual/long-term lease • Easement retained for access road
Fitzroy River	USL	Y	Y	Y	• Raise will extend right embankment into this area	• Perpetual lease or similar long-term lease negotiated
1976 LIV40684	FH		Y	Y	• Right bank access road will traverse this lot	• Easement required for access road
117 LN841503	FH	Y	Y	Y	• Inundation of riparian land on right bank and along Six Mile Creek • Right bank access road will traverse this lot and follows the powerline easement from Junction Creek	• Water storage easement over riparian land • Easement required for access road
26 LN200	FH		Y	Y	• Right bank access road will traverse this lot • Access road crosses an unnamed local road within this lot. No road closure required. • Access road terminates at Glenroy Road bordering this lot in the south	• Easement required for access road • No road closure required
2044 LBG40126	FH	Y	Y	Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
14 LI47	FH	Y	Y	Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
17 LI50	LL	Y	Y	Y	• Inundation of riparian land on the left bank • Inundation of road reserve	• Water storage easement over riparian land • Road closure
1 RL5108	RE	Y	Y	Y	• Inundation right bank • Temporarily closed road on the right bank	• Temporary road closure retained

Subject lots	Tenure*	Impoundment for Stage			Project impact^	Potential tenure implications
		1	2	3		
13 PN125	FH	Y	Y	Y	• Inundation of riparian land on right bank and along Six Mile Creek	• Water storage easement over riparian land
114 FTY861 49 PN371	SF LL	Y	Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
16 LI309	LL	Y	Y	Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
34 LBG40163	FH	Y	Y	Y	• Inundation of riparian land on the left bank and along Princhester Creek	• Water storage easement over riparian land
35 LBG40187	FH	Y	Y	Y	• Inundation of riparian land on the left bank and along Princhester Creek • Inundation of road reserve area	• Water storage easement over riparian land • Road closure
226 LBG40146	FH			Y	• Inundation of riparian land on the left bank, along Princhester Creek and Boggy Creek • Inundation of road reserve area	• Water storage easement over riparian land • Road closure
21 LI236	FH	Y	Y	Y	• Inundation of riparian land on the left bank and along Princhester Creek	• Water storage easement over riparian land
8 PN27	FH	Y	Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
1 PER207464	RE / LL	Y	Y	Y	• Inundation of road reserve	• Road closure
17 PN27	FH	Y	Y	Y	• Inundation of riparian land on the right bank and along Ten Mile Creek • Inundation of road reserve	• Water storage easement over riparian land • Road closure
86 RP900583	FH	Y	Y	Y	• Inundation of riparian land on the right bank and along Ten Mile Creek	• Water storage easement over riparian land
85 RP900583	FH	Y	Y	Y	• Inundation of riparian land on the right bank and along Ten Mile Creek	• Water storage easement over riparian land

Subject lots	Tenure*	Impoundment for Stage			Project impact^	Potential tenure implications
		1	2	3		
2354 PAK40133	FH	Y	Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
2250 PAK40120	FH	Y	Y	Y	• Inundation of riparian land on the right bank • Inundation of road reserve	• Water storage easement over riparian land • Road closure
20 LI67	FH	Y	Y	Y	• Inundation of riparian land on the left bank and along Marlborough Creek • Inundation of road reserve areas	• Water storage easement over riparian land • Road closure
1895 LBG40112	FH		Y	Y	• Inundation of riparian land on the left bank and along Marlborough Creek	• Water storage easement over riparian land
2358 LBG 40148	FH			Y	• Inundation of riparian land on the left bank and along Marlborough Creek	• Water storage easement over riparian land
7 LI76	LL			Y	• Inundation of riparian land on the left bank and along Marlborough Creek	• Water storage easement over riparian land
1 LI318	LL			Y	• Inundation of riparian land on the left bank and along Marlborough Creek	• Water storage easement over riparian land
1992 PAK40103	FH	Y	Y	Y	• Inundation of riparian land on the right bank • Inundation of road reserve	• Water storage easement over riparian land • Road closure
8 LI65	FH	Y	Y	Y	• Inundation of riparian land on the left bank and along Marlborough Creek • Inundation of road reserve areas	• Water storage easement over riparian land • Road closure
1 LI224	LL	Y	Y	Y	• Inundation of riparian land on the left bank and along Marlborough Creek	• Water storage easement over riparian land

Subject lots	Tenure*	Impoundment for Stage			Project impact^	Potential tenure implications
		1	2	3		
2359 LBG40149	FH	Y	Y	Y	• Inundation of riparian land on the left bank and land area known as Horseshoe Lagoon • Inundation of road reserve areas	• Water storage easement over riparian land • Negotiate tenure over Horseshoe Lagoon
5 PAK40204	FH	Y	Y	Y	• Inundation of riparian land on the right bank • Inundation of road reserve	• Water storage easement over riparian land • No road closure
1960 PAK40104	FH	Y	Y	Y	• Inundation of riparian land on the right bank • Inundation of road reserve	• Water storage easement over riparian land • No road closure
2007 LBG40131	FH	Y	Y	Y	• Inundation of riparian land on the left bank • Inundation of road reserve	• Water storage easement over riparian land • No road closure
2004 LBG40130	FH	Y	Y	Y	• Inundation of riparian land on the left bank and along Marlborough Creek • Inundation of road reserve areas	• Water storage easement over riparian land • Road closure
2340 PAK40132	FH	Y	Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
18 PN24	FH	Y	Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
13 LI139	FH	Y	Y	Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
14 LI140	FH	Y	Y	Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
16 LI140	FH		Y	Y	• Inundation of riparian land on the left bank and along Muldoon Creek • Inundation of road reserve	• Water storage easement over riparian land • No road closure
8 CP899147 1PER208915	RE / LL		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
18 LI141	FH		Y	Y	• Inundation of riparian land on the right bank and along Camp Creek	• Water storage easement over riparian land

Subject lots	Tenure*	Impoundment for Stage			Project impact^	Potential tenure implications
		1	2	3		
19 LI18	FH		Y	Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
1 PAK40194	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
11 PN464	RE / LL		Y	Y	• Inundation of riparian land on the left bank • Upgrade of Glenroy Crossing / Road within the road reserve	• Road access and road reserve retained
27 PN470	RE / LL		Y	Y	• Inundation of riparian land on the right bank • Upgrade of Glenroy Crossing / Road within the road reserve	• Road access and road reserve retained
2 PN443	FH		Y	Y	• Inundation of riparian land on the right bank and along Glenroy Creek • Upgrade of Glenroy Crossing / Road within the road reserve	• Road access and road reserve retained
2024 PAK40102	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
2 PAK40202	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
13 PN443	FH		Y	Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
3 PAK40202	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
11 PN89	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
14 PN30	RE / LL		Y	Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
3 PN30	LL		Y	Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
20 PN479	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
4 PAK40203	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
1552 PN14	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land

Subject lots	Tenure*	Impoundment for Stage			Project impact^	Potential tenure implications
		1	2	3		
2025 PAK4095	FH			Y	• Inundation of riparian land on the right bank • Powerline easement	• Water storage easement over riparian land
8 PN266	LL			Y	• Inundation of riparian land on the right bank • Powerline easement	• Water storage easement over riparian land
5 PN28	LL			Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
19 PN51	FH			Y	• Inundation of riparian land on the right bank • Powerline easement	• Water storage easement over riparian land
9 PN30	FH			Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
6 PN51	FH			Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land

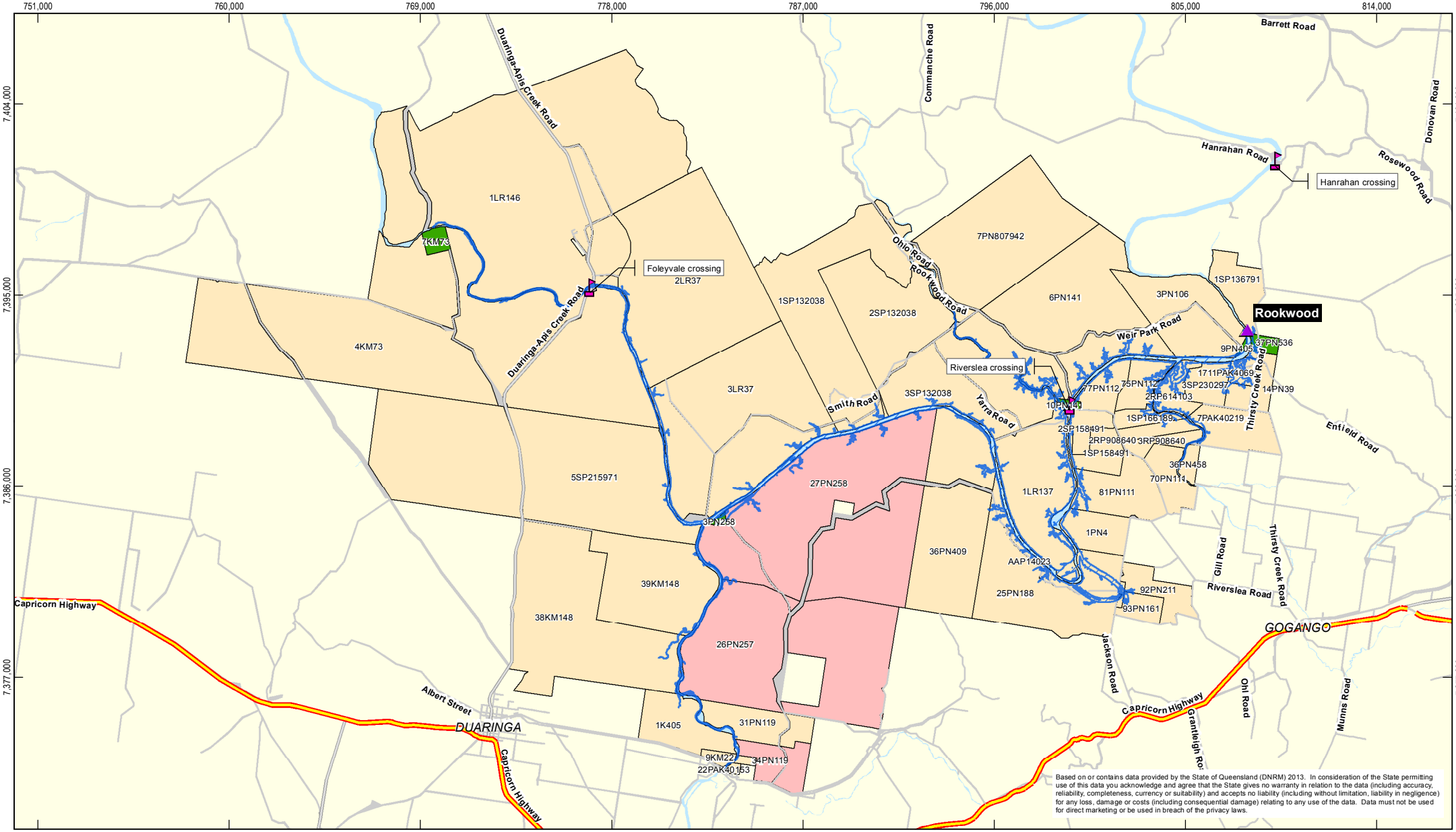
* Key: LL Leasehold; FH Freehold; USL Unallocated State Land; RE Reserve; SF State Forest

^ Right bank = southern bank; left bank = northern bank; Inundation reflects impoundment within bed and banks

Inundation associated with Rookwood Stage 1 impacts 26 landholders across 38 lots. Raising the weir to Stage 2 will impact on an additional seven landholders across an additional 12 lots. The tenure status of land adjacent to the inundation area comprises mainly FH, some LL and a few Reserves. Properties affected by the construction and operation of Rookwood Weir are shown in Figure 5-35. Table 5-14 lists the subject lots and tenures potentially impacted by the Project as a result of the construction and operation of Rookwood Weir.

As discussed in Chapter 2 Project description and Chapter 16 Transport, three river crossings will be upgraded through the construction of bridges as a result of the Project. Some realignment of road reserve areas will be required to accommodate the upgrades, in particular the approaches. Further discussions will be held with the Department of Transport and Main Roads (DTMR), RRC and CHRC in this regard during detailed design. Thirsty Creek Road and the Third Street/Capricorn Highway intersection will be upgraded to accommodate construction traffic. Some realignment of road reserves may be required and further discussion with RRC and DTMR, respectively, will be held during detailed design. A number of road reserves terminate at the river margin and no crossings are provided. There are a number of roads and road reserves that enable traversing of the river opportunistically when water levels are sufficiently low to accommodate passage. Local roads subject to inundation (Table 5-13 and Table 5-14) will be closed in consultation with RRC. Opportunistic crossings will not be reinstated. It is considered that provision of bridge infrastructure at Glenroy, Riverslea and Foleyvale Crossings will benefit the local road network and mitigate impacts associated the loss of some opportunistic crossings. Individual negotiations with landholders will address further land use issues arising as a result of these opportunistic crossings (Chapter 18 Social impact).

Construction materials such as clay/silt, sand and rock are proposed to be extracted from FH Lots 1976 LIV40684, 117 LN841503 and 2016 RP841502 adjacent to the Eden Bann Weir site and Lots 3 PN106, 3 SP230297, 1711 PAK4069, 14 PN34 and 2 SP136791 adjacent to the Rookwood site. In addition, sand, gravel and rock are proposed to be extracted from within the Fitzroy River immediately upstream and downstream of the weirs within USL. It is proposed that these activities will be subject to separate environmental assessment and approvals. Further detail is provided in Chapter 2 Project description and Chapter 16 Transport.



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

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LEGEND

- Weir Location
- River Crossing
- Major Road
- Secondary Roads
- Minor Road/Road Easement
- Proposed Rookwood Upper Impoundment Limit
- Tenure
- Freehold
- Lands Lease
- Reserve
- Road Easement
- Waterway

Gladstone Area Water Board

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SunWater Making Water Work

Gladstone Area Water Board, SunWater
Lower Fitzroy River Infrastructure Project

Job Number 41-20736
Revision B
Date 28 Jul 2014

Rookwood potentially affected properties

Figure 5-35

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Data Source: © Copyright Commonwealth of Australia (Geoscience Australia): Waterways (2007); Sunwater: Waterways, Weir Locations - 2008; DNRM: Roads - 2010, DCDB - 2013. Created by: MG *See Appendix for disclaimers and copyrights.

Table 5-14 Rookwood subject lots and tenure status

Subject lots	Tenure*	Weir	Impoundment Stage		Project impact^	Potential tenure implications
			1	2		
1 SP136791	FH	Y	Y	Y	• Right embankment and inundation of riparian land • Access road traverses this lot	• Long-term lease for weir infrastructure • Water storage easement over riparian land • Easement required for access road
Fitzroy River	USL	Y	Y	Y	• Weir infrastructure extends across the Fitzroy River • Inundation	• Long-term lease for weir infrastructure • No tenure for impoundment within watercourse
3 PM106	FH	Y	Y	Y	• Left embankment and inundation of riparian land • Saddle dam	• Long-term lease for weir infrastructure • Water storage easement over riparian land • Saddle dam
37 PN536	RE LL		Y	Y	• Inundation of riparian land on the right bank • Upgrade of unnamed local road for access	• Water storage easement over riparian land • Road reserve retained, possible realignment
14 PN39	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
9 PN405	RE		Y	Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
1711 PAK4069	FH		Y	Y	• Inundation of riparian land on the right bank • Upgrade of local road (Thirsty Creek Road) for access	• Water storage easement over riparian land • Road reserve retained, possible realignment in sections
185 PAK4091	FH		Y	Y	• Inundation of riparian land on the right bank • Upgrade of local road (Thirsty Creek Road) for access	• Water storage easement over riparian land • Road reserve retained, possible realignment in sections
3 SP230297	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
2 RP614103	FH		Y	Y	• Inundation of riparian land on the right bank and along Gogango Creek	• Water storage easement over riparian land

Subject lots	Tenure*	Weir	Impoundment Stage		Project impact^	Potential tenure implications
			1	2		
6 PN141	FH		Y	Y	• Inundation of riparian land on the left bank • Upgrade of local roads at Riverslea Crossing	• Water storage easement over riparian land • Possible realignment of road reserve
75 PN112	FH		Y	Y	• Inundation of riparian land on the right bank and along Gogango Creek	• Water storage easement over riparian land
1 SP166189	FH		Y	Y	• Inundation of riparian land on the right bank and along Gogango Creek	• Water storage easement over riparian land
2 RP908640	FH		Y	Y	• Inundation of riparian land on the right bank and along Gogango Creek	• Water storage easement over riparian land
3 RP908640	FH		Y	Y	• Inundation of riparian land on the right bank and along Gogango Creek	• Water storage easement over riparian land
70 PN111	FH			Y	• Inundation of riparian land on the right bank and along Gogango Creek	• Water storage easement over riparian land
7 PAK40219	FH		Y	Y	• Inundation of riparian land on the right bank and along Gogango Creek	• Water storage easement over riparian land
36 PN458	FH			Y	• Inundation of riparian land on the right bank and along Gogango Creek	• Water storage easement over riparian land
77 PN112	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
20 PN112	RE		Y	Y	• Inundation of riparian land on the right bank • Upgrade of local roads at Riverslea Crossing	• Water storage easement over riparian land • Possible realignment of road reserve
10 PN141	RE		Y	Y	• Inundation of riparian land on the left bank and along Melaleuca Creek	• Water storage easement over riparian land
3 SP132038	FH		Y	Y	• Inundation of riparian land on the left bank and along Melaleuca Creek	• Water storage easement over riparian land

Subject lots	Tenure*	Weir	Impoundment Stage		Project impact^	Potential tenure implications
			1	2		
2 SP132038	FH			Y	• Inundation of riparian land on the left bank and along Melaleuca Creek • Smith Road traverses the lot	• Water storage easement over riparian land • Potential road closure
7 PN807942	FH			Y	• Inundation of riparian land on the left bank and along Melaleuca Creek • Smith Road traverses the lot	• Water storage easement over riparian land • Potential road closure
1 LR134	FH		Y	Y	• Inundation of riparian land on the left bank and along Melaleuca Creek	• Water storage easement over riparian land
2 SP158491	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
1 SP158491	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
81 PN111	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
1 PN4	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
92 PN211	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
25 PN188	FH		Y	Y	• Inundation of riparian land on the right bank • Inundation of temporarily closed road (AAP14023)	• Water storage easement over riparian land • Road closure retained
93 PN166	FH			Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
36 PN409	FH		Y	Y	• Inundation of riparian land on the right bank	• Water storage easement over riparian land
27 PN258	LL		Y	Y	• Inundation of riparian land on the right bank and along Slatey Creek	• Water storage easement over riparian land
1 SP23038	FH		Y	Y	• Inundation of riparian land on the left bank	• Water storage easement over riparian land
3 LR37	FH		Y	Y	• Inundation of riparian land on the left bank (Mackenzie and Dawson Rivers confluence)	• Water storage easement over riparian land

Subject lots	Tenure*	Weir	Impoundment Stage		Project impact^	Potential tenure implications
			1	2		
3 PN258	RE		Y	Y	• Inundation of riparian land on the right bank (Mackenzie and Dawson Rivers confluence)	• Water storage easement over riparian land
5 SP215971	FH		Y	Y	• Inundation of riparian land on the right bank (Mackenzie River)	• Water storage easement over riparian land
4 KM73	FH		Y	Y	• Inundation of riparian land on the right bank (Mackenzie River) • Upgrade of State controlled road at Foleyvale Crossing	• Water storage easement over riparian land • Possible realignment of road reserve
2 LR37	FH		Y	Y	• Inundation of riparian land on the left bank (Mackenzie River)	• Water storage easement over riparian land
1 LR146	FH			Y	• Inundation of riparian land on the left bank (Mackenzie River) • Upgrade of State controlled road at Foleyvale Crossing	• Water storage easement over riparian land • Possible realignment of road reserve
7 KM73	RE			Y	• Inundation of riparian land on the right bank (Mackenzie River)	• Water storage easement over riparian land
39 KM148	FH		Y	Y	• Inundation of riparian land on the left bank (Dawson River) and along Bone Creek	• Water storage easement over riparian land
26 PN257	LL		Y	Y	• Inundation of riparian land on the right bank (Dawson River)	• Water storage easement over riparian land
38 KM148	FH		Y	Y	• Inundation of riparian land on the left bank (Dawson River) and along Bone Creek	• Water storage easement over riparian land
31 PN119	FH			Y	• Inundation of riparian land on the right bank (Dawson River)	• Water storage easement over riparian land
1 K405	FH		Y	Y	• Inundation of riparian land on the left bank (Dawson River) and along Sharpers Creek	• Water storage easement over riparian land

Subject lots	Tenure*	Weir	Impoundment Stage		Project impact^	Potential tenure implications
			1	2		
9 KM22	FH			Y	• Inundation of riparian land on the left bank (Dawson River)	• Water storage easement over riparian land
22 PAK40153	FH			Y	• Inundation of riparian land on the right bank (Dawson River)	• Water storage easement over riparian land
34 PN119	LL			Y	• Inundation of riparian land on the right bank (Dawson River)	• Water storage easement over riparian land
20 RP843084	FH			Y	• Inundation of riparian land on the right bank (Dawson River)	• Water storage easement over riparian land

* Key: LL Leasehold; FH Freehold; USL Unallocated State Land; RE Reserve; SF State Forest

^ Right bank = eastern bank; left bank = western bank; Inundation reflects impoundment within bed and banks

5.5.3.2 Land use

As discussed in Section 5.3.3, the Project is not considered to adversely impact on the intended use of rural land for rural purposes. In accordance with local government planning scheme provisions the Project is considered compatible with existing and future land uses in the rural zone.

As described in detail in Chapter 18 Social impact, the Project footprints will result in a relatively small loss of riparian land. Land potentially impacted by the impoundment while located physically within the bed and banks of the Fitzroy, Dawson and Mackenzie rivers will inundate cleared grazing and/or green grazing land as defined on property titles and reflected in the cadastral property data available. Further loss of access to land and loss of access within properties and between properties may impact the ability of some landholders to productively manage their operations.

Upgrades proposed to river crossings will improve flood immunity and facilitate connectivity in the region thereby enhancing rural activities (Chapter 16 Transport).

Landholders have rights to graze livestock over the area between the high and low bank outside their legal riparian boundary, to ingress and egress the river, to invite other people and remove trespassers, and to access water for livestock. The Project has the potential to affect the ability of landholders to undertake such activities.

In order to address impacts on landholders' loss of land, loss of access to land, impacts to productivity and ability to access the river, the following factors will be taken into consideration when determining appropriate landholder compensation:

- The area of riparian land inundated and determined to be non-river
- The loss of stock watering points
- The increased need for fencing to prevent stock losses
- The increased risk of stock losses due to the provision of more potential nesting places for crocodiles
- The cost of relocation of irrigation pumps due to higher standing water levels
- Changed weed and pest control management requirements.

The following mitigation measures would be implemented to reduce potential impacts on landholders:

- Adequate, timely and regular communication with the stakeholders based on a Stakeholder Engagement Plan prepared for the Project. Communication with stakeholders would include information on Project status, water allocations and management of key project impacts
- Implementation of a Project Land Access and Acquisition Strategy to manage land access, loss of land, compensation and potential impacts on existing and future water allocations (Chapter 9 Surface water resources). The emphasis of the strategy will be to secure land by agreement.

Further detail on potential landholder impacts and mitigation measures are discussed in Chapter 18 Social Impact.

5.5.3.3 Reserves, protected and sensitive environmental areas

Inundation associated with raising Eden Bann Weir potentially affects three parcels (lot on plan) of reserve tenure as shown in Table 5-15 and a 4 ha section of the Aricia State Forest adjacent to the Fitzroy River. Inundation associated with Rookwood Weir potentially impacts on six reserve tenure parcels (lot on plan). Table 5-15 provides a description of these parcels and the locations are shown on Figure 5-17, Figure 5-18 and Figure 5-22. No land use related changes or impacts are anticipated for other protected areas identified in the Project vicinity (such as Princhester Conservation Park, Goodedulla National Park and the Duaringa State Forest) as these areas are located outside the development footprints and inundation areas.

Table 5-15 Reserves and protected areas directly impacted by the Project

Eden Bann Weir				Rookwood			
Lot on plan	Tenure	Project component	Area (ha)	Lot on plan	Tenure	Project component	Area (ha)
11PN464	Reserve	Glenroy Crossing	0.9	20PN112	Reserve	Riverslea Crossing	0.1
		Impoundment	0.1			Impoundment	2.5
14PN30	Reserve	Impoundment	0.3	10PN141	Reserve	Riverslea Crossing	1.5
27PN470	Reserve	Glenroy Crossing	1.3			Impoundment	10.1
		Impoundment	0.6	9PN405	Reserve	Impoundment	3.2
114FTY861	State Forest	Impoundment	4.0	37PN536	Reserve	Impoundment	13.6
				3PN106	Reserve	Impoundment	1.1

Impacts on sensitive environmental areas are discussed in Chapter 6 Flora and Chapter 7 Aquatic ecology and not repeated here.

5.5.3.4 Mining and petroleum tenure

Construction activities will not adversely impact on mining and petroleum tenures within the Project area. Inundation during operation is retained within the river bed and banks and will not adversely impact the potential for land under mining and petroleum tenures to be developed.

ML80074 granted to, and ML80134 applied for by, Marlborough Nickel Pty Ltd is associated with land adjacent to the existing Eden Bann Weir impoundment and proposes to traverse the Fitzroy River across the existing and proposed Eden Bann Weir impoundment, respectively. It is not expected that the Project will adversely impact these tenures.

Key public access routes impacted by inundation will be retained, and improved flood immunity infrastructure installed at Glenroy, Riverslea and Foleyvale crossings (within impoundments) and at Hanrahan Crossing (downstream of the proposed Rookwood Weir).

5.5.3.5 Key resource areas

Key resource areas are not located within the Project footprints or inundation areas and will not be impacted as a result of the Project.

Potential borrow and quarry areas on land adjacent to the development sites have been identified and will be assessed further during detailed design as discussed in Chapter 2 Project description. These sites will be subject to separate environmental approvals.

5.5.3.6 Existing and future infrastructure

Roads and river crossings

Upgrades or new access roads are required for the Project as described in Chapter 2 Project description and Chapter 16 Transport. The Project is not expected to impact on the potential for future road upgrades. Upgrading and/or construction of Project related infrastructure will facilitate and enhance existing and future road network upgrades.

Rail

No rail infrastructure traverses the Project footprints or associated impoundments. No impacts on existing or future rail infrastructure are expected as a result of the Project.

Gas, water, power and telecommunications infrastructure

Existing power lines traversing the Eden Bann Weir impoundment will not be impacted by the Project as pylons are not located within the banks of the river. Further, the Project is expected to have limited impacts on flooding pre- and post-development at the lower flood levels and has no impact on the 1 in 20 year Annual Exceedance Probability (and higher) flood events (Chapter 9 Surface water resources). Similarly it is not expected that future power lines would be impacted by the Project.

Stanwell Power Station's water supply pipeline will not be impacted by the Project. Development of the GFP Project will be facilitated by the Project (Chapter 1 Introduction).

Future gas, water and telecommunications infrastructure (subject to appropriate design) will not be impacted by the Project.

5.5.3.7 Stock routes

No adverse impacts are expected on the dedicated stock routes identified in the vicinity of the Project. Neither of the dedicated stock routes are located within the impoundment and both stock routes already traverse the Mackenzie and Dawson rivers, respectively.

No adverse impacts are expected to roads declared as stock routes as the Project will retain access across the Fitzroy and Mackenzie rivers at these locations (Glenroy Crossing, Riverslea Crossing and Foleyvale Crossing) (Chapter 2 Project description).

Minor impacts to stock routes on reserve tenure (reserves for camping and water) may occur. Riparian fringe areas associated with the reserve tenures will be subject to inundation with the majority of the reserve area remaining available for use.

5.5.3.8 Native title

In relation to Native Title:

- The Project will interact with lands and/or waters where Native Title has not been dealt with, including the bed and banks of the Fitzroy, Dawson and Mackenzie Rivers

- The Project will include actions involving taking of surface water and living aquatic resources. Notification to registered Native Title claimants[4] will be required in relation to the granting of permits by the State, which authorise the taking of any surface waters or living aquatic resources
- The Project involves the management of water and certain facilities for service to the public
- FH tenure will not be granted over the river bed and banks. It is envisaged that a perpetual or term lease (or similar) will be granted over the weir infrastructure and a water storage easement (or similar) will be granted over lands within the inundation zone.

A Native Title assessment was undertaken for non-FH tenure within the Project areas as follows:

- Eden Bann Weir – approximately seven lots were identified for which Native Title status is not able to be determined. These comprise land under term leases, on State Forests, within reserves with special lease tenures and where permits to occupy exist
- Rookwood Weir – approximately 12 lots were identified for which Native Title status is not able to be determined, for example, reserve with special lease or term lease tenures, permits to occupy and estate in perpetuity tenures.

Project activities within each of the lots where Native Title is not able to be determined have been identified and the impacts on Native Title considered as follows:

- The 24KA process is applicable to the weir sites and inundation areas. Discussions with Native Title Services and State Land and Asset Management have indicated that the 24KA process can be utilised by the Project. That is Native Title suppression can be achieved through issuing notices under Section 24KA of the *Native Title Act 1993* (Cth). Consideration will also be given to the use of Section 24HA (management or regulation of water and airspace) of the *Native Title Act 1993* (Cth) whereby notification is required prior to the issuing of permits, approvals or leases involving or associated with the taking of surface water, groundwater, living aquatic resources or airspace. In the event that 24KA does not apply, it is considered that Section 24MB(1)(b)(ii) (freehold test in relation to waters) may also be used
- Access roads to the weir sites identified to date are located on lands with FH tenure and Native Title is considered extinguished
- River crossings at Glenroy, Riverslea, Foleyvale and Hanrahan can be constructed under State Government and Council provisions given they are operated for the general public. The Department of Transport and Main Roads and Council will have their own provisions for dealing with Native Title and suppression or extinguishment powers. Public roads can be dealt with in the same manner
- Works on private roads located on FH land will consider Native Title to have been previously extinguished. Works on private roads not located on FH, or lands where Native Title has not been previously extinguished, should be avoided. Based on current mapping, no instances have been identified
- Borrow areas on FH land will consider Native Title to have been previously extinguished. Borrow areas on non-FH land, or lands where Native Title has not been previously extinguished, should be avoided otherwise Native Title notification will be required.

[4] At the present time only the Darumbal People have registered claims within the Project area associated with both Eden Bann Weir and Rookwood.

5.5.3.9 Residential and recreational and industrial use

The Project area currently has limited access for recreational use opportunities. It is not intended to increase or further facilitate recreational use of the Fitzroy, Dawson and Mackenzie Rivers as a result of the Project. Access to the impoundments would be restricted as there are few public access points. Recreational use of the impoundments would not be encouraged and no public access to the river would be provided as part of the Project. The weir sites will be fenced and visitor access to the weir would be restricted.

The homestead in close proximity to Eden Bann Weir and residences at Gogango may experience some impacts, particularly as they relate to noise and dust, as a result of construction activities. Management and mitigation of such impacts are addressed in Chapter 23 Environmental management plan.

During operations the Project will not directly impact on homesteads or residential use of land. Upgrades of river crossings will mitigate potential impacts arising from inundation and will positively impact homesteads through the provision of infrastructure with improved flood immunity such that access routes are maintained. Land within the Project area is not currently used for industrial purposes and is zoned as rural.

5.5.4 Summary

SunWater own and operate Eden Bann Weir under a Perpetual Lease. Land either side of the weir is held in FH. An easement accommodates the existing access road. The Fitzroy River is USL. The Eden Bann Weir impoundment as part of the watercourse holds no specific tenure. Land adjacent to the watercourse within the Project's extent is largely held as FH. Some LL and Reserve tenures exist. A State Forest area is located adjacent to the existing Eden Bann Weir impoundment.

The Perpetual lease at Eden Bann Weir is appropriate for the Project and is expected to extend to include raised embankments and ancillary work areas retained for operations. The proposed southern bank access road will traverse three FH lots easements will be negotiated.

The Rookwood Weir site is located on the Fitzroy River as USL. Land either side of the proposed weir is held as FH. The Fitzroy, Mackenzie and Dawson Rivers are designated USL. Land adjacent to the watercourses within the Project's extent comprises largely FH. Some LL and reserves exist.

Similar to Eden Bann Weir a long-term lease will be acquired over Rookwood Weir and the associated infrastructure. An easement will be negotiated to accommodate a new access road. Thirsty Creek Road will be upgraded to accommodate construction traffic.

With regard to future proposed tenure of the Eden Bann Weir and Rookwood Weir impoundments, it is not possible for the State Government to grant land interests in State land that is also part of the watercourse and as such it is considered that areas can be inundated without the need for specific tenure or licence. A water storage easement (or similar) (including a flood buffer zone) will be negotiated for riparian land within the impoundment but outside of the watercourse.

Eden Bann Weir is located on the Fitzroy River bounded by the RRC LGA and the LSC LGA. The proposed Rookwood Weir site is located on the Fitzroy River within the RRC LGA. The impoundment associated with development of a weir at Rookwood extends into the Mackenzie

and Dawson rivers. The impoundment borders two parcels of WASC land and sections of CHRC land.

The Project is located in a rural area. The main activity occurring on properties affected by the Project is cattle grazing, breeding and fattening. There is some crop cultivation for grains and a small number of properties with irrigation licences. The most common use of the river is for stock watering with cattle generally accessing the water directly or via pump/trough systems. The large rural properties common to the Project areas are generally served by unsealed roads, often single lane, branching from the major arteries of the Bruce and Capricorn Highways.

As described in detail in Chapter 18 Social impact, the Project footprints will result in a relatively small loss of riparian land. Land potentially impacted by the impoundment while located physically within the bed and banks of the Fitzroy, Dawson and Mackenzie rivers will inundate cleared grazing and/or green grazing land as defined on property titles and reflected in the cadastral property data available. Further loss of access to land and loss of access within properties and between properties may impact the ability of some landholders to productively manage their operations.

The Project has the potential to affect the ability of landholders to graze livestock over the area between the high and low bank outside their legal riparian boundary, to ingress and egress the river, to invite other people and remove trespassers, and to access water for livestock. In order to address these impacts on loss of land, loss of access to land, impacts to productivity and ability to access the river will be taken into consideration when determining appropriate landholder compensation.

Reserves (primarily for the purposes of camping, water, roads and stock) are locally impact by the Project: in the order of 2.2 ha is impacted as a result of upgrades to Glenroy Crossing; approximately 5 ha is impacted by Eden Bann Weir impoundment; 1.6 ha is estimated to be impacted as a result of upgrades at Riverslea Crossing and in the order of 30.5 ha is associated with impoundment areas for Rookwood Weir. In the order of 4 ha of the Aricia State Forest will be impacted as a result of Eden Bann Weir impoundment.

Construction activities will not adversely impact mining and petroleum tenures within the Project area. Inundation during operation is retained within the river bed and banks and will not adversely impact the potential for land under mining and petroleum tenures to be developed.

Key resource areas are not located within the Project footprints or inundation areas and will not be impacted as a result of the Project.

Upgrades or new access roads are required for the Project. The Project is not expected to impact on the potential for future road upgrades. Upgrades and construction of new Project related infrastructure will facilitate and enhance existing and future road network capacity.

No rail infrastructure traverses the Project footprints or associated impoundments. No impacts on existing or future rail infrastructure are expected as a result of the Project.

Existing power lines traversing the Eden Bann Weir impoundment will not be impacted by the Project. Similarly it is not expected that future power lines would be impacted by the Project. Future gas, water and telecommunications infrastructure (subject to appropriate design) will not be impacted by the Project.

No adverse impacts on the stock routes are expected as a result of the Project.

With regard to Native Title the 24KA process is applicable to the weir sites and inundation areas.

The Project area currently has limited access and recreational use opportunities. It is not intended to increase or further facilitate recreational use of the Fitzroy, Dawson and Mackenzie Rivers as a result of the Project. Access to the impoundments would be restricted as there are few public access points. Recreational use of the impoundments would not be encouraged and no public access to the river would be provided as part of the Project. The weir sites will be fenced and visitor access to the weir would be restricted.

The Project is not considered to impact significantly on the intended use of rural land for rural purposes. The Project footprint will cause only a minor loss of land used for rural production, based on land as mapped within the banks of the Fitzroy, Dawson and Mackenzie rivers. As a result, only minimal impacts on land productivity are expected as a result of the Project.

The Project has the potential to affect the ability of landholders to undertake certain activities on their properties. The extent of these impacts would be determined through consultation with landholders and would be taken into consideration when determining appropriate landholder compensation. Impacts on landholders would be managed through the development and implementation of a number of plans, strategies and management processes in line with a Project Land Access and Acquisition Strategy.

Given the nature of activities to be undertaken as part of the Project, notifications to registered Native Title claimants will be required in relation to the granting of permits by the State, which authorise those activities, including the taking of any surface waters or living aquatic resources within those claim areas. Works conducted on private roads, borrow areas and access roads on FH land will consider Native Title to have been previously extinguished within lots where Native Title is not able to be determined.