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AQUATIC ECOLOGY REPORT





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*Underground Coal Gasification / Coal Seam Gas Investigations
Mineralogical, Geological, Petrographic and Soils Services
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BIG VEIN SOUTH GOLD PROJECT



AQUATIC ECOLOGY ASSESSMENT

REPORT PREPARED FOR:
Strategic Minerals Corporation Pty Ltd

Date:
November 2022

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Date: 30 November 2022

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SUMMARY OF RELEVANT INFORMATION

Project Title	Big Vein South Gold Project
Property Location	ML90238, ML2729, ML2739 and ML100236 North Queensland
Project Purpose	Aquatic Ecology Assessment for inclusion in a site specific Environmental Assessment Report (EAR)
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LIST OF ABBREVIATIONS

°C	– Degrees Celsius
µS/cm	– Micro-Siemens per centimetre
ANZECC	– Australian and New Zealand Environment and Conservation Council
AusRivAS	– Australian Rivers Assessment System
BOM	– Bureau of Meteorology
C&R	– C&R Consulting Pty Ltd
DEHP	– Department of Environment and Heritage Protection
DERM	– The former Department of Environment and Resource Management
DNRM	– The Department of Natural Resources and Mines
DES	– The Department of Environment and Science
DO	– Dissolved oxygen
DoEE	– Department of Environment and Energy
DSEWPaC	– Department of Sustainability, Environment, Water, Population and Communities
EC	– Electrical conductivity
EP Act	– <i>Environmental Protection Act (1994)</i>
EPBC Act	– <i>Environment Protection and Biodiversity Conservation Act (1999)</i>
EPP	– Environmental Protection Policy (2009)
HES wetland	– High Ecological Significance wetland
km	– Kilometre(s)
km ²	– Kilometres squared
mg/L	– Milligrams per litre
mm	– Millimetre(s)
NC Act	– <i>Nature Conservation Act (1992)</i>
NTU	– Nephelometric Turbidity Units
PET richness	– Number of Plecoptera, Ephemeroptera and Trichoptera (PET) families present at a site
QWQG	– Queensland Water Quality Guidelines (2009)
RE	– Regional Ecosystem
SIGNAL	– Stream Invertebrate Grade Number – Average Level
VM Act	– <i>Vegetation Management Act (2000)</i>
WMAs	– Wetland Management Areas
WPA	– Wetland protection area

1. INTRODUCTION

C&R Consulting Pty Ltd was commissioned by Strategic Minerals Corporation Pty Ltd to complete an aquatic ecology assessment as part of the Environmental Assessment Report (EAR) for the Big Vein South Gold Project (the project).

1.1 PROJECT OVERVIEW

The project involves the construction and operation of an open cut gold mine on a greenfield site in North Queensland. The project site covers an area of approximately 2,281 ha and is located approximately 100 km north of Richmond and 380 km west of Townsville (Figure 1).

Open cut mining will be conducted using excavators and trucks. Gold ore will be processed on site to produce gold doré (solid bars containing gold alloy). The mine's peak production rate will be up to 1.95 million tonnes per annum (Mtpa) of run of mine (ROM) gold ore, yielding up to approximately 100,000 ounces of gold doré per annum. The mine life will be approximately 11 years.

The following mining and ore processing activities will be undertaken as part of the project:

- Developing three open cut pits, as follows:
 - The main Big Vein South Pit (BVS Pit) located in the centre of the project site (Figure 2). Waste rock from this pit will be hauled by truck and stored in the Central and Southern Waste Rock Dumps (WRDs).
 - Two small satellite pits, BV1 Pit and BV2 Pit, located in the northern part of the project site (Figure 2). Waste rock from these pits will be stored in the Northern WRD.
- Transporting mined ore in haul trucks from the open cut pits to the ROM area ore stockpiles located near the mine processing facilities at the southern end of the project site (Figure 2).
- Processing ore from the BV1 and BV2 Pits in the first 2 years of mining using Heap Leach Pads and gold elution. Processing ore mined from the BVS Pit in an on-site Carbon In-Leach (CIL) Plant from Year 3 onwards. The heap leaching process will generate spent heap leach residues. These residues will be reprocessed in the CIL Plant over the life of the mine. The CIL Plant will generate wet tailings and dewatered tailings. Wet tailings will be pumped to a Tailings Storage Cell. Dewatered tailings will be stored with waste rock in the Central and Southern WRDs.
- Transporting doré bars from the site via plane to a refinery.

The majority of the mine infrastructure will be located at the southern end of the project site (Figure 2). Key mine infrastructure will include ore processing facilities, workshop, warehouse, administration buildings, haul roads and access roads, vehicle servicing, refuelling and wash down facilities, fuel storage facilities, diesel and solar power station, water supply and water management infrastructure. Workforce accommodation and a private airstrip will also be located at the southern end of the project site.

1.2 SCOPE

The purpose of the aquatic ecology impact assessment is to identify and quantify the aquatic ecology values within the study area and assess the potential project impacts on those ecology values.

The assessment has been guided by the *Queensland Aquatic Ecology – EIS Information Guideline* (Department of Environment and Science, 2021) and the *Aquatic Ecosystems*

Toolkit. The Aquatic Ecosystems Toolkit is the nationally agreed framework for mapping, classifying and assessing the condition of aquatic ecosystems.

The Aquatic Ecosystems Toolkit defines aquatic ecosystems as '*ecosystems that depend on flows, or periodic or sustained inundation/waterlogging for their ecological integrity*'. Aquatic ecosystems included in this definition are wetlands, rivers, karst and other groundwater dependent ecosystems (GDEs), saltmarshes, estuaries and certain shallow marine waters.

This assessment specifically addresses watercourses and drainage features, wetlands and groundwater springs within the study area. There are no karst systems, saltmarshes, estuaries or marine waters within the study area. An assessment of GDEs is presented in the main volume of the EAR.

This report also provides baseline stygofauna results. Impacts to stygofauna are assessed in the GDE section in the main volume of the EAR.

For the purposes of this assessment, the study area encompasses all watercourses and drainage lines that traverse the project site including their reaches 500 m upstream and/or downstream of the project site boundary. Additionally, the local catchment downstream (south-west) of the project was inspected to determine the status of the drainage features within it (refer to Figure 4).

1.3 REPORT STRUCTURE

This report is structured as follows:

- Section 1 provides an overview of the project, the assessment scope and report structure.
- Section 2 provides an overview of the relevant aspects of the project's regional environmental setting.
- Section 3 provides a description of relevant State and Federal legislation, regulations, policies and guidelines.
- Section 4 provides a detailed description of the methods used to determine the aquatic flora and fauna communities within the study area, including a literature review and field surveys.
- Section 5 presents the results of the aquatic ecology desktop study.
- Section 6 provides a baseline assessment of the aquatic habitats within the study area.
- Section 7 provides the baseline aquatic habitat assessment.
- Section 8 provides an assessment of the potential project impacts on aquatic ecology within the study area.
- Section 9 presents the key conclusions.

2. REGIONAL SETTING

This section provides an overview of the surface water setting, climate, groundwater regime within the study area, as far as it is relevant to the aquatic ecology assessment scope.

2.1 SURFACE WATERS

This section provides an overview of the catchment and drainage setting for the project. It is based on information presented in the EAR Surface Water Report.

2.1.1 WOOLGAR RIVER

The project site is located in the Woolgar River catchment, part of the Flinders River Sub-basin (Figure 3). The dominant land use in the Woolgar River catchment is cattle grazing. There are also historical gold mining activities in the vicinity of the project site. These activities have extensively modified and disturbed the Woolgar River catchment.

The Woolgar River commences approximately 46 km upstream of the project site. The Woolgar River traverses the northern and western boundaries of the project site, flowing in a south-westerly direction (Figure 2). The Woolgar River joins the Stawell River approximately 73 km downstream (i.e. along the river channel) of the project site. The Stawell River enters the Flinders River approximately 56 km downstream of the Woolgar River confluence. The Woolgar River is a watercourse, as defined under the *Water Act 2000* (Qld) (Water Act).

Near the project site, the Woolgar River has a well-defined channel that is set within a narrow, discontinuous floodplain. The river channel contains a braided low flow channel with sand sheet deposits, bars and islands that have been formed by the extensive suspended sediment deposition during flow events.

The Woolgar River is ephemeral, exhibiting episodic, short duration, surface water flows that typically occur between January and March. Surface water flows typically occur during periods of heavy rainfall. Following the cessation of rainfall, surface water flows rapidly recede and cease. The Woolgar River is expected to flow for less than 8 weeks per year, on average. There is also significant variation in the volume and timing of surface water flow between years depending on annual rainfall patterns.

2.1.2 LOCAL DRAINAGE

The local topography transitions from elevated rocky plateaus and ridgelines to the flatter, low-lying Woolgar River. Several plateaus and ridgelines extend into the project site and form local catchment boundaries (as shown in Figure 4 and Figure 5). The local catchments within the project site are influenced by cattle grazing and land disturbance associated with mining exploration, access roads, and historic gold mining and timber acquisition, with each catchment summarised as follows:

- The northern catchment covers an area of approximately 4.2 km² and is drained by the unnamed Woolgar River tributaries of Drainage Feature 4 and Drainage Feature 5.
- The central catchment covers an area of approximately 19.4 km² and is drained by the unnamed Woolgar River tributaries of Drainage Feature 1, Drainage Feature 2 and Drainage Feature 3. There are two farm dams within this catchment area, with one located on Drainage Feature 1 and the other on Drainage Feature 3 (Figure 9).

- The southern catchment covers an area of approximately 53.7 km². Runoff from this catchment drains to the southwest as overland flow and enters the Woolgar River over 15 km downstream of the project site boundary. There are no defined drainage features within the project site or in the immediate downstream catchment area. A small channel forms in the lower part of this catchment area over a length of approximately 1 km, immediately upstream of the Woolgar River.
- Other small local catchment areas that drain directly to the Woolgar River channel.

The unnamed Woolgar River tributaries coalesce on the flatter ground that is located between the plateaus and ridgelines and drain towards the Woolgar River valley. The Queensland Department of Regional Development, Manufacturing and Water (DRDMW) have declared that the unnamed tributaries meet the Water Act definition of a 'drainage feature'.

Surface water flow duration, frequency and quality in the drainage features have similar characteristics as the Woolgar River, being highly ephemeral, with short duration flows that contain elevated suspended sediment loads. This is expected given the catchment features and geology setting.

2.2 CLIMATE

2.2.1 REGIONAL SETTING

Temperature data has been collected from the Bureau of Meteorology (BoM) weather station at Richmond Airport (BoM station number 030161) from March 1998 to February 2022. The highest daily maximum temperature recorded at the Richmond Airport weather station over this time period is 41.5°C, recorded in December 2019. The lowest daily minimum temperature is 6.2°C, recorded during July 2009.

During winter months, the mean recorded daily minimum temperatures range from 9.1°C to 10.2°C and the mean recorded daily maximum temperatures range from 26.7°C to 29.2°C. During summer months, the mean recorded daily minimum temperatures range from 22.9°C to 23.7°C and the mean recorded daily maximum temperatures range from 36.3°C to 38.5°C.

The climate of the region is dominated by intense rainfall events throughout the summer months of each year. More than 90% of the rain typically falls between November and April. Consequently, the region exhibits distinct wet and dry seasons.

The nearest BoM weather station with long-term rainfall monitoring data for both sampling seasons is the Gilberton Station (BoM weather station number 030019), located approximately 84.6 km from the project site, with data available from November 1917 to February 2022. Mean monthly rainfall recorded at the Gilberton weather station ranges from 4.0 mm in August to 199.4 mm in January, with a mean annual rainfall of 688.9 mm. Total average rainfall recorded during the wet season (November to April) is 641.8 mm. Total average rainfall recorded during the dry season (May to October) is 66 mm.

Winds at the project site are generally light to moderate with an average wind speed of 2.65 m/s. There is a variation in wind direction throughout the seasons of the year. On average, during the wet season, 60% of winds at the Richmond Airport weather station are from the south-east quartile. The winds are predominately moderate between 3 and 7 m/s, averaging 4.3 m/s, with a maximum 30-minute average of 16.6 m/s.

2.2.2 RAINFALL EXPERIENCED OVER SEASONAL FIELD SURVEY PERIODS

As discussed in Section 4.2.2, the field surveys were conducted in 22 – 27 April 2019, 27 – 30 April 2021, and 24 – 26 May 2022. The rainfall preceding these surveys is discussed below.

The period of June 2018 to May 2019 generally experienced close to average rainfall conditions each month (Figure 6). A notable exception was February 2019, reflecting the extraordinary weather conditions (slow-moving monsoonal low) impacting on most of North Queensland during January/February 2019. Gilberton received 377.4 mm of rainfall between 1-8 February, more than twice the long-term mean for the month of February (170.9 mm). The total rainfall from this monsoonal rainfall event totalled 495.4 mm. During the dry season, no rainfall was recorded at Gilberton with the exception of October 2018 (27 mm). The total rainfall from June 2018 to May 2019 (inclusive) was 852.3 mm at Gilberton, thus exceeding the long-term annual mean rainfall at both Gilberton (688.9 mm) and Burleigh Station (549.6 mm).

The above-average rainfall received in February and March 2019 is expected to have allowed ephemeral creeks within the region to flow for extended periods following the end of the wet season.

The 2020-2021 wet season started early with above average falls in both October and December (over 280 mm; Figure 6). These falls continued in February 2021 with over 250 mm recorded for the month (Figure 6). These above average falls recorded earlier in the wet season suggests that flows within watercourses across the project site may not have persisted as long as they did following the 2018-2019 wet season. Despite this, the yearly rainfall from June 2020 to May 2021 at Gilberton Station (754.4 mm) still exceeded the long-term average (688.9 mm).

The 2021-2022 wet season commenced in December 2021, although rainfall totals experienced over the wet season were well below average (Figure 6). Only May 2022 recorded rainfall totals above average (in 2022), with the entire month's total rainfall (100 mm) falling in one day (on the 10th of May). This May 2022 rainfall event created flows onsite. However, because of the below average rainfall experienced prior to this event, the flows in onsite drainages did not persist for an extended period (i.e. <2 weeks). Note: the Woolgar River flowed for a longer period aided by additional rainfall in the upper catchment area.

2.3 GROUNDWATER REGIME

The project site is located at the northern margin of the Eromanga Basin, a sedimentary basin that was deposited in the Mesozoic era. Locally, the Eromanga Basin overlies a Proterozoic basement. The Proterozoic basement is part of the North Australian Craton, one of Australia's major mineral provinces.

The Eromanga Basin and Proterozoic basement have been extensively modified by weathering and erosion. The weathered profile extends to depths of up to 40 m below ground level in the project site.

The local groundwater regime is described in the EAR Groundwater Report and comprises:

- Localised alluvium associated with the Woolgar River.
- The weathered in-situ rocks of the Eromanga Basin and Proterozoic basement (herein called the 'weathered profile'). The weathered profile exhibits low permeability and is typically dry.
- Fresh (i.e. unweathered) Jurassic sedimentary strata of the Eromanga Basin where the groundwater table is usually located.
- Fresh Proterozoic basement rocks that exhibit very low permeability and essentially functions as an aquiclude.



Regionally, the Jurassic strata are the main groundwater-bearing formation. However, the Jurassic strata are frequently dry in the vicinity of the project site. Where groundwater is present locally, the Jurassic strata are typically only partially saturated and yield low volumes of groundwater. Hence, the Jurassic sediments do not form a productive aquifer within the project site and its surrounds.

In the elevated plateau areas, shallow groundwater may also occur in thin permeable layers within the weathered profile. Where this occurs, the shallow groundwater is located above the regional groundwater table. Hence, the shallow groundwater and regional groundwater table are hydraulically disconnected. Outcrop springs fed by shallow groundwater occur in the elevated plateau areas to the east of the project site. The EAR Groundwater Report provides a detailed description of these springs.

3. RELEVANT LEGISLATION, GUIDELINES AND REGULATORY REQUIREMENTS

The legislation, policies and regulations relevant to the management of aquatic ecology in relation to the project are discussed in the following sections and include:

- The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- The Queensland *Nature Conservation Act 1992* (NC Act);
- The Queensland Water Act;
- The Queensland *Fisheries Act 1994* (Fisheries Act);
- Directory of Important Wetlands, Ramsar Wetlands;
- The Queensland Government's mapping of wetlands and watercourses;
- The Queensland *Environmental Protection Act 1994* (EP Act), the associated *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP) and the *Environmental Protection Regulation 2019*;
- The Commonwealth Environmental Offsets Policy; and
- The Queensland Environmental Offsets Framework.

3.1 COMMONWEALTH *ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999*

The EPBC Act is the Commonwealth government's principal piece of environmental legislation, and is administered by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW). It is designed to protect national environmental assets, known as Matters of National Environmental Significance (MNES), which include threatened species of flora and fauna, endangered ecological communities, and migratory species as well as other protected matters. Among other things, it defines the categories of threat for threatened species, identifies key threatening processes and provides for the preparation of recovery plans for threatened species and communities.

Any action (which includes a development, project or activity) that is considered likely to have a significant impact on MNES is termed a Controlled Action and is subject to assessment under the EPBC Act.

The project will be referred to the Commonwealth for assessment under the EPBC Act. Aquatic MNES are discussed in Section 6.1.1.

3.2 QUEENSLAND *NATURE CONSERVATION ACT 1992*

The NC Act is the key piece of legislation in Queensland relating to the protection and management of biodiversity and threatened species. It establishes a framework for the identification, gazettal and management of protected areas (such as National Parks) and the protection of native flora and fauna (protected wildlife) listed under the *Nature Conservation (Plants) Regulation 2020* (NC[P]R) and the *Nature Conservation (Animals) Regulation 2020* (NC[A]R). The NC Act is administered by the Queensland Department of Environment and Science (DES).

The NC Act classifies native flora and fauna species into categories of conservation significance in recognition of how threatened they are and what action needs to be taken to protect them including:

- Extinct in the wild;
- Endangered;
- Vulnerable;
- Near threatened; and
- Least concern.

3.3 QUEENSLAND *FISHERIES ACT 1994*

Under Section 125 of the Fisheries Act, all Queensland waters are protected against any potential impact that may directly or indirectly result in the degradation of the water body in question. This Act is administered by the Department of Agriculture and Fisheries (DAF).

Development permits under the *Planning Act 2016* (Planning Act) are required prior to constructing any waterway barrier works (i.e. structures such as culverts, road crossings, dams, etc.) that may inhibit fish passage.

The activities being assessed for the project are restricted to activities to be undertaken within the proposed mining lease boundary, and these activities will be undertaken in accordance with the Environmental Authority (EA) that will be obtained for the project. The Planning Act does not apply to activities undertaken within a mining lease, and there is consequently, no need to obtain separate approvals for waterway barrier works.

The Fisheries Act also contains provisions for the declaration of fish habitat. Significant residual impacts to areas of declared fish habitat are required to be offset in accordance with the Queensland Environmental Offsets Framework (Section 3.7).

3.4 RAMSAR WETLANDS AND NATIONALLY IMPORTANT WETLANDS

The Directory of Important Wetlands managed by DCCEEW is an online database that lists Internationally and Nationally Important Wetlands. The directory provides data and information about important wetlands on which to base management decisions. Although managed via the same database as MNES, Nationally Important Wetlands are not protected under the EPBC Act.

The directory includes Internationally Important Wetlands identified under the Ramsar Convention, an international cooperative designed to conserve wetlands. Ramsar wetlands are those that are representative, rare or unique wetlands, or are important for conserving biological diversity. Ramsar wetlands are protected under the EPBC Act.

There are no Internationally (i.e. Ramsar wetlands) or Nationally Important Wetlands within, or in the area surrounding, the project site.

3.5 GOVERNMENT MAPPING OF WETLANDS AND WATERCOURSES

3.5.1 MAP OF QUEENSLAND WETLAND ENVIRONMENTAL VALUES

The Map of Queensland wetland environmental values is a state wide statutory map of wetlands of General Ecological Significance (GES), High Ecological Significance (HES) and the wetland protection areas (WPAs) associated with HES wetlands. HES wetlands are wetlands of high conservation value and are considered matters of state environmental significance (MSES), while GES wetlands are areas that display attributes that comply with the definition of a wetland under Queensland legislation but there is no level of protection under the EPP (Water and Wetland Biodiversity) associated with this term (note: protections may still be associated with a GES system for riparian zones, etc., under other legislative

tools). The conservation value (i.e. GES or HES) of the wetland is determined using the DES Aquatic Biodiversity Assessment Mapping Methodology. WPAs include the HES wetland and the assumed extent of hydrological influence of the HES wetland (trigger area). Outside urban areas, including at the project site, the trigger area is 500 m from the edge of a HES wetland. Significant residual impact on WPAs and HES wetlands are required to be offset in accordance with the Queensland Environmental Offsets Policy's framework (Section 3.7).

3.5.2 VEGETATION MANAGEMENT WATERCOURSE MAP

The Vegetation Management Watercourse Map is produced under Section 20AB of the *Vegetation Management Act 1999* (VM Act). This map displays the combined extent of both watercourses and drainage features as defined under the Water Act (Figure 8). In addition, this map identifies the stream orders of the watercourses and drainage features. The stream orders combined with the relevant bioregion and sub-regions determines the relevant distance from the defining bank. Any regional ecosystem within the relevant distance from the defining bank is considered an MSES. Significant residual impacts to regional ecosystems within the relevant distance from the defining bank must be offset under the Queensland Environmental Offsets Policy. This issue is considered further in the EAR Terrestrial Ecology Report.

3.5.3 WATER ACT WATERCOURSE MAP

The Woolgar River is a mapped watercourse under the Water Act. As discussed in Section 2.1.2, the DRDMW has declared the various unnamed tributaries of the Woolgar River that are present in the study area as drainage features, as defined in the Water Act. Hence, the unnamed tributaries do not have the necessary characteristics to meet the Water Act definition of a watercourse.

The Water Act authorises the take or interference with surface water for mining activities. The impacts from the project on surface water are discussed in the EAR Surface Water Report.

3.6 EPBC ACT OFFSETS POLICY

The *EPBC Act Environmental Offsets Policy (2012)* discusses the role of offsets in impact assessments as well as outlining the consideration process undertaken by DCCEEW to determine the suitability of a proposed offset package. The policy defines an offset package as a "suite of actions that a proponent undertakes in order to compensate for the residual significant impact of a project" (DSEWPac 2012).

3.7 QUEENSLAND ENVIRONMENTAL OFFSETS FRAMEWORK

State environmental offset requirements are legislated within the *Environmental Offsets Act (2014)* (EO Act) and the *Environmental Offsets Regulation (2014)* (EO Regulation), with the *Environmental Offsets Policy (Version 1.9) (2020)* providing guidance on legislative requirements. These three documents comprise the Queensland Environmental Offsets framework. This framework is triggered when significant residual impacts are predicted to occur to a MSES.

MSES are described within the EO Regulation and encompass several aquatic habitats, including:

- Aquatic habitat mapped as essential habitat for protected wildlife, in accordance with the VM Act (Section 6.11);



- WPA or HES wetlands shown on the Map or Referable Wetlands (Section 6.11);
- A wetland or watercourse designated as HEV waters under the EPP (Section 6.11);
- Habitat for aquatic flora and fauna species listed as *Special Least Concern*, *Vulnerable* or *Endangered* under the NC Act (Section 3.2);
- Fish habitat areas and highly protected zones of State marine parks (Section 6.11); and/or
- Waterways providing fish passage (Section 6.11.2).

The *Significant Residual Impact Guideline* (DEHP, 2014) discusses the process to determine if a significant residual impact will occur from a proposed action and details the requirements of resultant offsets, if required.

4. METHODS

4.1 DESKTOP STUDY

4.1.1 LITERATURE REVIEW

A literature review was conducted of available previously published studies undertaken within the region which assessed the components targeted in the project field surveys (e.g. aquatic habitat, water and sediment quality, aquatic flora and aquatic fauna). However, few suitable aquatic ecology studies were identified within the region and even fewer are publicly available, with only one study found detailing aquatic ecology values within the region:

- Waltham, N., Burrows, D., Butler, B., Wallace, J., Thomas, C., James, C. and Brodie, J. (2013). Waterhole ecology in the Flinders and Gilbert catchments. A technical report to the Australian Government from the CSIRO Flinders and Gilbert Agricultural Resource Assessment, part of the North Queensland Irrigated Agriculture Strategy. CSIRO Water for a Healthy Country and Sustainable Agriculture flagships, Australia.

The background data from this study provided valuable insight when preparing to undertake the field surveys and assisted in the ability to target specific areas/habitats within each watercourse. An overview of the literature review is provided in Section 5, and specific information from the literature review is discussed in a regional and ecological context within each relevant sub-section in the results. This assists in determining the background (existing) aquatic ecological processes occurring across the project site as well as in upstream and downstream areas. This is an essential part of the study as the determination of these processes and the potential connectivity of the project site to other areas must be determined in order to assess the implications of any proposed activities on the regional aquatic environments.

4.1.2 DATABASE SEARCHES

Database searches for this study targeted listed aquatic flora, fauna and communities previously documented in the area, as well as known wetlands. Databases searched included:

- the EPBC Protected Matters Tool (2019), which targets EPBC Act species and communities (including wetlands of national and international importance);
- WildNet (2019), which targets NC Act species;
- the Queensland Globe (2019) website, to search relevant MSES mapping, including (but not limited to) waterway barriers, protected aquatic habitat, HEV waters, map of referable wetlands and fish habitat areas; and
- Queensland subterranean aquatic fauna database (2022).

4.1.3 AERIAL PHOTOGRAPHY REVIEW

Historical aerial photographs of the region as well as the most up to date and finest scale Geoscience Australia map (Hampstead – 1:100,000) were reviewed for the purposes of determining and characterising potential aquatic habitats present.

4.2 AQUATIC ECOLOGY FIELD SURVEYS

All field surveys were undertaken in accordance with the appropriate permits from the Queensland Government to conduct research on the targeted fauna, including:

- A Scientific Purposes Permit (Permit Number: WA0006466);
- A General Fisheries Permit (Permit Number: 195672); and
- Animal Ethics Approval (Reference Number: CA2016/02/942 and CA2020/02/1354).

4.2.1 KEY PERSONNEL

Two C&R personnel undertook the key aquatic ecology surveys of the project site:

1. Matthew Knott (BSc(Hons); MEIANZ) – Senior Scientist/Project Manager

Matt has over 15 years post graduate experience undertaking aquatic ecology surveys throughout Queensland, the Northern Territory and New South Wales, with particular focus on Cape York Peninsula and the Gulf of Carpentaria. In a previous role, as a research scientist with the Australian Centre for Tropical Freshwater Research (ACTFR now referred to as TropWATER), Matt assisted with freshwater fish surveys throughout the Cape York Peninsula and the Gulf of Carpentaria as part of the Northern Australia Freshwater Fish Atlas Project (NAFF Project). Matt is also a committee member for the North Queensland Division of the Environmental Institute of Australia and New Zealand (EIANZ).

2. Dean Buchanan (MSc) – Scientist

Dean has been involved in environmental sampling and analysis (water, soil, rock as well as aquatic fauna and flora) for over 5 years. He has extensive field experience in a variety of regions ranging from the temperate Canada to the dry environments of western Queensland (e.g. Cloncurry and Mt Isa). Dean's specialty lies in water, soils and geology interactions with many of his projects involving the chemical and physical relationships of soils and rocks to hydrology.

4.2.2 TIMING

The majority of the aquatic ecology field work (including stygofauna sampling) was conducted at the end of the 2018-2019 wet season (22nd – 27th of April 2019), approximately five weeks after significant rain had fallen within the region in mid-March, in accordance with AusRivAS methodology. Section 2.2 describes the amount of rainfall received prior to the field survey. Difficulties accessing watercourses within the study area, made it difficult to assess all targeted parameters at each site. Despite this, all aquatic habitats, flora and fauna occurring within each system were appropriately characterised during the study.

A second post-wet season aquatic ecology survey was undertaken at the end of the 2020-2021 wet season (27th – 30th of April 2021), specifically targeting sampling location WR5 as well as a second round of stygofauna sampling.

A third field survey was undertaken at the end of May 2022 (24th – 26th of May) to ground-truth the unmapped watercourse associated with the southern catchment area.

A dry season (i.e. Spring) field survey was not undertaken for the project as all of the watercourses/drainage features within the project site are highly ephemeral and dry for the majority of the year.

4.2.3 SITE SELECTION

Aquatic ecology sampling sites were located based on different habitat types present within the Woolgar River and associated drainage features (e.g. pool, deep bend, backwater and/or rock bar), the proposed project layout and accessibility for sampling. Potential sampling sites were determined through an assessment of aerial photographs and project site boundaries. As field surveys were undertaken at the end of the wet season, accessibility was considered when determining the positioning of the sampling locations.

A total of eleven (11) sampling sites were assessed for aquatic ecology across (and/or immediately adjacent to) the project site, including:

- **Woolgar River** (Five sites – refer to Figure 9):
Sampling sites were relatively evenly spread out along the length of Woolgar River within the project survey area. All of the sites were situated within the main channel, with WR5 located at the proposed Woolgar River pump station. Full descriptions of each site as well as accompanying photographs are provided in Table 6, Section 5.
- **Other Drainage Features** (Six sites – refer Figure 9):
Drainage Feature 1, Drainage Feature 2, Drainage Feature 3 and the Drainage Feature 4 were also targeted for aquatic ecology sampling. These tributaries of the Woolgar River were targeted with sites TRIB1 to TRIB4 (Figure 9). Two farm dams within the lower catchment areas of Drainage Feature 1 and Drainage Feature 2 were also targeted (FD1 and FD2, respectively) (refer to Figure 9). Full descriptions of each site as well as accompanying photographs are provided in Table 6, Section 5.

Water availability limited the employment of all methods at all sites. Table 1 displays the methods utilised at each site as well as their locations. Drone surveys were also undertaken to ground-truth the variety of habitats present throughout much of the drainage lines present within, and upstream of the survey area (Figure 10).

Table 1: Sites targeted for surface water aquatic ecology and methods utilised

Site	Easting (GDA94)	Northing (GDA94)	Parameters sampled								
			Habitat Description	Large Crustaceans	Macroinvertebrates	Fish	Aquatic flora	Turtles	Sediment Quality	Water Quality	Hyporheic fauna
WR1	742053	7810609	X	X	X	X	X	X	X	X	X
WR2	739598	7810491	X	X	X	X	X	X	X	X	X
WR3	738567	7809342	X						X		X
WR4	737120	7807795	X	X	X	X	X	X	X	X	X
WR5	737828	7808378	X			X	X	X			X
FD1	738816	7808171	X	X	X	X	X	X	X	X	
FD2	738106	7807295	X	X	X	X	X	X	X	X	
TRIB 1	741071	7805109	X						X		
TRIB 2	739224	7806992	X						X		
TRIB 3	739697	7807861	X						X		
TRIB 4	740875	7808932	X						X		

Fourteen groundwater bores were targeted for stygofauna sampling during both the April 2019 and April 2021 surveys (Table 2). However, several of the shallower bores were dry and samples could not be collected. The full details of each bore are outlined in Table 2.

Table 2: Bore location and construction information

Site	Easting (GDA94)	Northing (GDA94)	Geological unit	Bore construction	Sampled	
				Bore depth (mbGL)	2019	2021
MB1A	738457	7807635	Proterozoic	6	No (Dry)	No (Dry)
MB1B	738457	7807635	Proterozoic	25	Yes	Yes
MB2A	739429	7810282	Jurassic strata	24	Yes	Yes
MB2B	739429	7810282	Proterozoic	70	Yes	Yes
MB3A	735824	7808079	Alluvium	5	No (Dry)	No (Dry)
MB3B	735824	7808079	Weathered profile	34	Yes	Yes
MB4A	740288	7805620	Weathered profile	13	No (Dry)	No (Dry)
MB4B	740288	7805620	Proterozoic	60	Yes	Yes
MB5A	738609	7805178	Jurassic strata	40	No (Dry)	No (Dry)
MB5B	738609	7805178	Proterozoic	90	Yes	Yes
MB6A	737645	7806506	Weathered profile	11	No (Dry)	No (Dry)
MB6B	737645	7806506	Proterozoic	84	Yes	Yes
MB7A	740129	7803932	Jurassic strata	33	Yes	Yes
MB7B	740129	7803932	Proterozoic	90	Yes	Yes

mbGL = metres below Ground Level.

4.2.4 AQUATIC HABITAT

Habitat Characteristics and Condition

Habitat condition was assessed at each sampling site in accordance with the methods outlined in the *Queensland AUSRIVAS Sampling and Processing Manual* (DNRM, 2001). Under this manual, the following nine key physical habitat characteristics were assessed:

- Bottom substrate/available cover;
- Embeddedness;
- Velocity/depth cover;
- Channel alteration;
- Bottom scouring and deposition;
- Pool/riffle, run/bend ratio;
- Bank stability;
- Bank vegetative stability; and

- Streamside cover.

Habitat characteristics are given a rating based on their condition, with the overall habitat bioassessment score for a site (the sum of all the possible ratings) then allocated to one of four categories signifying habitat condition present at the site (Table 3). The four allocated categories are:

- Excellent (>110);
- Good (75 – 110);
- Fair / moderate (39 – 74); and
- Poor (≤38).

Table 3: Rating system used to determine Habitat Bioassessment Scores (DNRM, 2001)

Number	Habitat Variable	Habitat condition rating ranges			
		Poor	Fair / Moderate	Good	Excellent
1.	Bottom substrate / available cover	0 – 5	6 – 10	11 – 15	16 – 20
2.	Embeddedness	0 – 5	6 – 10	11 – 15	16 – 20
3.	Velocity / depth category	0 – 5	6 – 10	11 – 15	16 – 20
4.	Channel alteration	0 – 3	4 – 7	8 – 11	12 – 15
5.	Bottom scouring and deposition	0 – 3	4 – 7	8 – 11	12 – 15
6.	Pool / riffle, run / bend ratio	0 – 3	4 – 7	8 – 11	12 – 15
7.	Bank stability	0 – 2	3 – 5	6 – 8	9 & 10
8.	Bank vegetative stability	0 – 2	3 – 5	6 – 8	9 & 10
9.	Streamside cover	0 – 2	3 – 5	6 – 8	9 & 10
-	<u>Total Habitat Bioassessment Score</u>	<u>0 – 38</u>	<u>39 – 74</u>	<u>75 – 110</u>	<u>111 – 135</u>

The AusRivAS habitat condition assessment was determined for each sample site that contained water (as well as WR3) during the post-wet season survey.

Photos were taken to document habitat variability at each site. This habitat assessment provides a detailed overview of existing habitat condition at each sampling site.

4.2.5 SURFACE WATER QUALITY

Surface water quality monitoring was undertaken during the aquatic ecology surveys to assist in the interpretation of the biological data. Additional surface water quality monitoring has been undertaken by SMC for an ongoing baseline surface water monitoring program. The outcomes of this baseline monitoring are discussed within the EAR Surface Water Report. Hence, this section describes only the work undertaken as part of the aquatic ecology surveys.

The aquatic ecology surveys included the collection of water quality samples at each aquatic ecology survey site during aquatic ecology surveys. Water quality at each site was tested using an in-situ field meter. The following parameters were measured:

- Water temperature (°C);

- Electrical conductivity (EC; $\mu\text{S}/\text{cm}$);
- pH (Units); and
- Dissolved oxygen (DO; mg/L and %sat).

Grab water samples were also collected from each site and analysed at a NATA accredited laboratory for analysis of the following:

- pH (units);
- EC ($\mu\text{S}/\text{cm}$);
- Total dissolved solids (mg/L);
- Major anions and cations (mg/L);
- Alkalinity (full suite; mg/L);
- Turbidity (NTU);
- Total Suspended Solids (mg/L);
- Dissolved and Total Metals (including Al, As, Cd, Cr, Cu, Pb, Ni, Se, Zn, Fe, Ag, V, U and Hg; $\mu\text{g}/\text{L}$);
- Ammonia as N (mg/L);
- Nitrite + Nitrate as N (NO_x ; mg/L);
- Total Kjeldahl Nitrogen as N (mg/L);
- Total Nitrogen as N (mg/L);
- Total Phosphorus as P (mg/L); and
- Reactive Phosphorus as P (mg/L).

Data Analysis

Surface water quality data collected during the aquatic ecology surveys were analysed, tabulated and compared to published default guideline values, including ANZECC and ARMCANZ Water Quality Guidelines for Aquatic Ecosystems (2000); and QWQG (2009). These default guideline values are provided for context only. Section 6.3 presents the results of the surface water quality monitoring undertaken as part of the aquatic ecology surveys.

It should be noted that the EAR Surface Water Report provides an overarching analysis of the entire surface water quality monitoring dataset and the relevant water quality objectives.

4.2.6 SEDIMENT QUALITY

Sediment quality provides an assessment of the accumulation of quality characteristics within the highly ephemeral system over an extended period of time (e.g. years), specifically, the accumulation of metals and metalloids. Sediment quality analysis also provides an indication of the level of quality characteristics naturally available to organisms occurring within the substrate and/or ingesting fine sediments.

Sediment sampling was undertaken in accordance with the best-practice methods outlined in the Australian Standard AS5667.1 (*Guidance on Sampling of Bottom Sediments*) and the CSIRO published *Handbook for Sediment Quality Assessment* (Simpson *et al.* 2005).

Sediment samples were collected from each monitoring site. Approximately two kilograms of sediment was collected for each sample by placing nine randomly selected (across the stream channel) subsamples into a bucket and then mixing the subsamples within the bucket and taking the required sample.

Samples were sent to a NATA accredited laboratory for testing. Within the laboratory samples were sieved with particle size distribution analysed. The $<63\mu\text{m}$ and $63\mu\text{m} - 2\text{mm}$ fractions were then tested for the following total quality characteristics:

- Aluminium;
- Manganese;

- Boron;
- Arsenic;
- Cadmium;
- Chromium;
- Cobalt;
- Copper;
- Iron;
- Lead;
- Mercury;
- Molybdenum;
- Nickel;
- Selenium;
- Silver;
- Vanadium;
- Uranium; and
- Zinc.

Data analysis

Sediment quality data were analysed, tabulated and compared to the ANZG (2018) guidelines for sediment quality. Any analytes above the guideline values are discussed further and potential changes in sediment quality due to the project are also documented.

4.2.7 MACROINVERTEBRATE COMMUNITIES

Aquatic ecology field sites were selected primarily on the number of different habitats (pool, run or riffle) present within each waterway (e.g. different habitats were targeted in the same watercourse). Macroinvertebrate sampling methods followed the procedures set out in the Queensland AusRivAS Sampling Manual (DNRM, 2001). This involves the use of a standard triangular mouthed frame fitted with a 250µm mesh size net to collect all samples. Composite samples were taken by selecting the appropriate section (e.g. backwater with leaf litter, exposed tree roots and some trailing vegetation, if available) and vigorously sweeping the net in short upward movements perpendicular to the bank or kicking the bed habitat to ensure the substrate is disturbed and sweep through any suspended material. A maximum distance of 10m (x~40cm wide) was sampled.

Samples taken were live picked in the field for a minimum of 30 minutes using tweezers and pipettes. The first 5 minutes of picking targeted the common and most abundant taxa. After the first 5 minutes, the majority of the picking effort focused on the less common, conspicuous taxa. If at the end of the 30 minutes less than 200 animals had been found the samples were picked for a further 10 minutes. Picked specimens from each sample were stored in a vial of 70% alcohol and sent to a laboratory for detailed family identification. Organisms were counted and identified to the lowest practical taxonomic level (in most instances family) to comply with AusRivAS standards.

Data Analysis

Analysis of macroinvertebrate data was undertaken and compared against the one available regional study (Section 4.1.1 and Section 5.3) as QWQG (2009) values are not available for the study area. Four specific indicators considered best practice for assessing macroinvertebrate community health in freshwater systems were adopted.

The four indices employed included:

- **Taxonomic richness** – This represents the total number of different macroinvertebrate taxa collected at each site. This is to determine the diversity of the macroinvertebrate community present at each site. Healthier sites will have a greater diversity.
- **PET Taxa richness** – Indicates the number of families collected from three specific orders; Plecoptera (stoneflies), Ephemeroptera (mayflies) and Trichoptera (caddisflies). These macroinvertebrate orders are considered sensitive to changes within their environment. Therefore, a low number of families collected from these orders (compared to the guidelines values) may suggest habitat degradation.

- **SIGNAL Index Value** – The SIGNAL index (Stream Invertebrate Grade Number – Average Level) was developed by Chessman (1995) to assist in the bioassessment of water quality in Australia. Chessman (1995 & 2003) determined sensitivity grade numbers (between 1 and 10) for most freshwater macroinvertebrate families in Australia based on how sensitive each was to various pollutants and other physical and chemical factors. The SIGNAL Index Value is the average of the SIGNAL grade numbers of all aquatic macroinvertebrates collected in a sample. If a macroinvertebrate taxa does not have an allocated SIGNAL grade number then it is excluded from the calculation. The greater the SIGNAL Index Value the better condition of the site.
- **Shannon-Weiner Diversity Index** – This index provides an assessment of biodiversity of a community assemblage sampled at a site based on the diversity of the assemblage and the abundance of each family present. The index is calculated using the equation:

$$H' = -\sum p_i \ln p_i$$

Where p_i is the proportion of individuals found in family i , or $p_i = n_i/N$; where n_i is the number of individuals in species i and N is the total number of individuals within the sample. Evenness of the sample is then calculated by the equation:

$$\text{Evenness} = H'/\ln(N)$$

The Shannon-Weiner Diversity Index increases as both the richness and evenness of a community increase, although values are rarely recorded greater than 4. The higher the number the greater the biodiversity value of a site. Evenness is a measure of dominance of families within a community. The lower the evenness value the greater the propensity for a monoculture.

Further assessment of the data was also undertaken using the AusRivAS modelling programme to compare collected data against the AusRivAS reference sites within the region and provide a level of macroinvertebrate community condition for each site. Data were analysed using the AusRivAS Queensland-Autumn-Western Regional-Pool model. For a full description of how this model functions please refer to the *AusRivAS Predictive Modelling Software Version 3.1 Users Manual (2004)* and the *AusRivAS Macroinvertebrate Bioassessment Predictive Modelling Manual (2000)*. The results of the modelling provide an indication of the level of biological impairment experienced at the targeted sites. The Observed/Expected (O/E) score (50%) provides a measure of biological impairment for each habitat sampled. The O/E score (50%) indicates the number of collected taxa that were predicted (expected) to occur with equal to or greater than 50% probability. Each O/E score (50%) occurs within the range of one of five Bands (X, A, B, C or D). The Band provides the description of biological impairment. The habitat that provides the lowest O/E score (50%) (e.g. the most biologically impaired) for a site provides the level of biological impairment for that particular site. This provides a conservative approach to management.

The levels of biological impairment a site can be categorised as include:

- **Band X:** Indicates the site is richer than reference sites within the region. This means that more families were found than expected and can suggest that the site is either a potential biodiversity “hotspot” or has mild organic enrichment.
- **Band A:** Infers the site is similar to reference sites. Suggesting that the site is similar to the determined natural state of creeks in the region.
- **Band B:** Indicates the site is significantly impacted. Fewer families were collected than were predicted to occur. This suggests there is potential mild impact to water quality and/or sampled habitat.
- **Band C:** Indicates the site is severely impacted. Many families were not collected that were predicted to occur. Severely impacted water quality and/or habitat are present that has resulted in a loss of families.
- **Band D:** Indicates the site is impoverished. This infers that very few families were collected, indicating that the site is highly degraded with very poor water and/or habitat quality.

4.2.8 FISH AND LARGE MACROINVERTEBRATE COMMUNITIES

Fish communities were surveyed using a combination of backpack electrofishing, baited traps and dip nets, dependent on habitat type present (e.g. deep pool, shallow pools, etc.).

Backpack electrofishing (using a Smith-Root LR-24) was the preferred sampling technique and was primarily used across all sampling sites (where appropriate). Baited traps were employed at deeper sites to target both fish and crustaceans. This included replicate samples of collapsible box traps (2mm mesh) and opera house traps (1.5" mesh) at each site. Table 4 outlines the fishing techniques utilised at each particular site during the field assessment.

Fish collected were enumerated, identified, measured (to determine life history stage) and photographed. A general assessment of fish health was also noted for each surveyed site. Any specimens unable to be identified within the field were euthanised or photographed and sent to qualified taxonomist for identification.

Freshwater fish surveys were conducted in accordance the methods developed for the Northern Australian Freshwater Fish Atlas project (NAFF, 2007; a collaboration between the National Centre for Tropical Wetland Research and Griffith University) and in accordance with the *Australian Code of Electrofishing Practice 1997*.

Data Analysis

Species richness, total abundance, abundance of listed aquatic species, abundance of exotic species, abundance of each life history stage present (e.g. juvenile, intermediate or adult) and mean fork length of each collected species were determined for each assessed site.

Table 4: Fishing settings and effort employed at each site

Site	Date	Habitat sampled	Average Depth	Method	Fishing Settings			Total Effort
WR1	24/04/2019	Series of small shallow pools with an undercut banks and woody debris	0.6m	Backpack Electrofisher	300V	60Hz	25% Duty	146 secs
WR2	24/04/2019	Small shallow pool with an undercut bank	0.8m	Backpack Electrofisher	300V	60Hz	25% Duty	146 secs
WR4	25/04/2019	Small shallow pool with a rock bar and undercut banks	~1m	Backpack Electrofisher	320V	60Hz	25% Duty	140 secs
WR5	30/04/2021	Shallow run habitat along an undercut bank	0.6m	Backpack Electrofisher	540V	60Hz	25% Duty	290 secs
FD1	25/04/2019	Shallow and deep waters with a high degree of turbidity, muddy bed	1m	Baited box traps	2 deployed		2mm mesh	32 hrs
				Baited opera traps	2 deployed		1" mesh	32 hrs
				Backpack Electrofisher	320V	60Hz	25% Duty	138 hrs
FD2	25/04/2019	Deep turbid waters restricting access to much of the dam	>1.5m	Baited box traps	3 deployed		2mm mesh	48 hrs
				Baited opera traps	3 deployed		1" mesh	48 hrs
				Backpack Electrofisher	500V	60Hz	25% Duty	139 secs

4.2.9 TURTLE COMMUNITIES

Freshwater turtle surveys were conducted to identify any turtle species that may be present within the survey area. Turtle communities at each targeted site were assessed via visual surveys and/or baited cathedral traps. Table 5 outlines the turtle surveying techniques employed at each site during the field assessment. Snorkelling was not conducted because of adverse habitat conditions (e.g. deep, turbid water in dams) and shallow clear water in river sites. Therefore, walk through visual surveys (while electrofishing) combined with Cathedral Traps were employed to target all species of freshwater turtles potentially inhabiting the area.

Turtles are regularly seen during electrofishing surveys for fish communities. If noticed, the electrofisher is shut down to prevent injury to the animal. The turtle is then caught for identification purposes, and subsequently released.

All captured turtles are measured, identified to a species level and photographed. If species are not able to be identified in the field, additional photographs of key morphological features are taken, as well as specific measurements of these features. Details are then forwarded to a herpetological specialist to assist with identification.

All results are tabulated for species presence and abundance at each sampling site.

Data Analysis

Species richness, total abundance, abundance of listed aquatic species, abundance of exotic species, and abundance of each life history stage present (e.g. juvenile, intermediate or adult) are determined.

4.2.10 OTHER AQUATIC VERTEBRATES

The potential presence of other aquatic vertebrates in the region was assessed through the completion of a literature review and database searches, specifically the Commonwealth's *Protected Matters Search Tool* and the Queensland Government's *WildNet* database. The database searches indicated that the Freshwater Crocodile (listed as Marine Migratory under EPBC Act) inhabited within the greater catchment area. No other aquatic vertebrates with statutory protection were revealed from database searches.

A literature review, together with a habitat assessment, was undertaken to determine the potential for freshwater crocodiles to be present. The results are provided in Section 6.8.

Table 5: Turtle survey techniques and effort employed at each site

Site	Date	Method	Fishing settings		Effort	Notes
WR1	24/04/2019	Visual census during fish and macroinvertebrate surveys.				The shallower sections of the site were heavily sampled for fish and macroinvertebrates, with the waters very clear for a visual survey.
WR2	24/04/2019	Visual census during fish and macroinvertebrate surveys.				The shallower sections of the site were heavily sampled for fish and macroinvertebrates, with the waters very clear for a visual survey.
WR4	25/04/2019	Visual census during fish and macroinvertebrate surveys.				The shallower sections of the site were heavily sampled for fish and macroinvertebrates, with the waters very clear for a visual survey.
WR5	30/04/2021	Visual census during fish and macroinvertebrate surveys.				The shallower sections of the site were heavily sampled for fish and macroinvertebrates, with the waters very clear for a visual survey.
FD1	25/04/2019	Visual census during fish and macroinvertebrate surveys.				The shallower sections of the site were heavily sampled for fish and macroinvertebrates. However, the highly turbid waters limited the effectiveness of visual surveys. Too shallow for traps.
FD2	19/05/2018	Visual census during fish and macroinvertebrate surveys.				The shallower sections of the site were heavily sampled for fish and macroinvertebrates. However, the highly turbid waters limited the effectiveness of visual surveys.
		Cathedral traps	2 deployed	3/4" mesh	32 hrs	

4.2.11 AQUATIC FLORA

Aquatic flora can have many different forms, including:

- Submerged macrophytes: Growth is predominantly beneath the water surface although flowers and/or leaves of some species protruding above the surface of the water;
- Floating macrophytes: Can be either attached or free floating (Sainty & Jacobs, 2003). For example, the introduced water hyacinth floats freely around waterways, being moved across the surface by wind or currents. Waterlilies, however, are rooted to the substrate but the mature leaves float on the surface;
- Emergent macrophytes: Generally grow in the shallower waters and are rooted to the substrate with the majority of the plant (stems, flowers and leaves) protruding above the surface of the water (Sainty & Jacobs, 2003); and,
- Algae: Generally need to be fully submerged to survive.

Aquatic flora surveys were conducted at each site along a 100m reach. This assessment detailed the presence/absence of all native and exotic aquatic flora and their form (from the four categories listed above) as well as the percent cover of each species at each site. Transects could not be effectively surveyed in high tannin waters and/or deep habitats, therefore transects generally targeted shallower waters.

Photographs of different macrophyte species present at each site were taken. Specimens of any species that could not be identified in the field were photographed for identification purposes within the C&R laboratory or sent to a taxonomic specialist for further assessment.

The data collected provide an understanding of the existing condition of aquatic macrophyte communities present within each of the water bodies across the survey area.

4.2.12 BASELINE STYGOFAUNA COMMUNITIES

Hyporheic Zone

While there are numerous techniques that can target stygofauna within the hyporheic zone, the Karaman-Chappius Pits method was employed. Pits were dug to the hyporheic zone and allowed to flood. Twenty litres of the water from within the pit was then filtered through a 50µm mesh size sieve. Samples were collected from each aquatic ecology site where water remained in the alluvial (i.e. only Woolgar River sites) and placed in 95% ethanol for transported to a suitably qualified taxonomist for further sorting and identification to the lowest possible taxonomic level. Sampling was not conducted in the bed of the ephemeral drainage features traversing the project site as they were dry at the time of the surveys. However, any stygofauna present in the reaches of these drainage features associated with the project site would be unlikely to be endemic to the project area due to the uniform geology and the connection and proximity to the Woolgar River.

Bore Sampling

Bore sampling was undertaken using a method that complies with the Queensland DES guidelines of sampling stygofauna from bores (*Environmental Protection (Water) Policy 2009 – Monitoring and Sampling Manual, Biological Assessment: Sampling bores for stygofauna 2018*). The method involved two parts:

1. Netting – This technique involved a custom made, weighted, haul net (50µm mesh) making six hauls (i.e. sub-samples) after agitating the substrate for each haul. The nets have an opening of approximately 45mm diameter (designed to fit down a 50mm bore hole). At the end of each haul the entire content of the net was emptied into a 50µm mesh sieve.

2. Bailing – Following the completion of the six hauls, a stainless-steel bailer was sent down the bore at speed to penetrate the substrate. The bailer aimed to capture the first few centimetres of substrate at the base of the bore as well as any organisms residing within that substrate. The bailer was then retrieved and its contents poured into the 50µm mesh sieve, combining with the contents of the haul nets to provide the overall sample for the site.

In accordance with guidelines bores were not purged prior to sampling. This method provides additional surety that any organisms present will be collected during sampling.

The resultant samples collected using the above method were placed in separate sample jars containing at least 90% ethanol for transportation prior to sorting and identification. All stygofauna samples collected via the bore monitoring were sent to a suitably qualified taxonomist for further sorting and identification to the lowest possible taxonomic level. Refer to Section 4.2.2 for timing of sampling and Section 4.2.3 for details of the bores sampled.

Data Analysis

Species richness and total abundance of any stygofauna present were determined for each bore. Impacts to stygofauna are assessed in the main volume of the EAR.

5. DESKTOP OUTCOMES

5.1 INTRODUCTION

The desktop component of the study entailed three different methods (refer to Section 4.1):

- Database searches for the occurrence of protected species and communities;
- Literature review to identify the results of previous studies undertaken in the area/region and determine the relevance of these findings to the proposed project; and
- Aerial imagery review.

The results of the aerial imagery review guided the positioning of field sites. The review included determining the presence of different habitat types within a watercourses/study area (if able to) and the access constraints associated with sampling these habitat types. Because the results of this component of the desktop review are for identifying field efficiencies only, they are not discussed any further in this assessment.

The results of the database searches and literature review are detailed further throughout Sections 5.2 and 5.3, respectively.

5.2 DATABASE SEARCHES

Database searches targeted protected aquatic fauna and flora species as well as ecological communities. The full results of the database searches are provided in Appendix 4.

In summary, the key findings of the database search are as follows:

- No EPBC Act listed threatened or migratory aquatic fauna species were identified as potentially occurring within the study area.
- No EPBC Act listed aquatic flora species were identified as potentially occurring within the study area.
- No other protected aquatic ecological communities under the EPBC Act occur within the region.
- No NC Act listed aquatic flora or fauna were identified as potentially occurring within the study area and, therefore, no essential habitat for listed aquatic flora or fauna was identified within the study area.
- No national or internationally important wetlands occur in the region (i.e. within the 20 km buffer).
- No HES wetlands or associated WPAs occur within the region.
- No HEV waters are mapped within the region.
- No fish habitat areas are mapped within the region.
- Waterways are mapped within the system with risk to fish passage from waterway barrier works ranging from major in the Woolgar River, and from low to high within the unnamed drainage features (Figure 7).
- No stygofauna have been documented within the area on the Queensland subterranean aquatic fauna database.

There are mapped General Ecological Significance (GES) wetlands within the project site which align with the Woolgar River and associated riparian corridor. GES wetlands are mapped for the purpose of establishing environmental values and are not MSES. Therefore, this is not discussed further in this report.

5.3 LITERATURE REVIEW

The literature review targeted all aspects of aquatic ecology generally assessed within an environmental impact study – including (but not limited to) water quality, macroinvertebrate communities, fish communities, turtle communities and aquatic flora. Although information/data/studies were found on some of these subjects within the area, no information / previous studies could be found (i.e. was publicly available) on freshwater turtle and aquatic flora communities.

The only technical report from the region, Waltham *et al.* (2013), forms part of the Flinders and Gilbert Agricultural Resource Assessment (FGARA). Specifically, it summarises the existing knowledge on the status and condition of ecological communities and natural assets within both the Flinders and Gilbert catchments by:

- examining water quality, limnology, habitat suitability and thermal regimes of refugial waterholes;
- examining the fish and aquatic invertebrate communities of these same waterholes; and
- evaluating the potential sediment, nutrient and pesticide export from farms to aquatic environments.

With respect to the aquatic faunal assemblages in the Flinders River catchment, replicate sampling was undertaken within a single season at a total of ten sites; three in the mid reaches of the Flinders River and seven sites located in the upper reaches (the closest site is located immediately downstream of Stawell River-Flinders River confluence, approximately 185 km downstream of the project site). The study identified 38 fish species within the Flinders River catchment area, although this included literature review and anecdotal accounts from in the downstream catchment areas, to the estuarine margins (i.e. not all relevant to the project site). None of the fauna identified in the study are listed species. The study concluded that the overall fish community appears to be consistent with the expected species for the Gulf and western Cape York catchments for the level of effort expended. The main driver of differences between assemblages found in the Flinders (turbid waterholes) and Gilbert catchment (clear waterholes) were turbidity and related water quality variables such as euphotic depth and water light climate. Water clarity is a main driver of fish community assemblage and any changes in water clarity due to catchment development can be expected to alter the fish community assemblage.

6. RESULTS

6.1 INTRODUCTION

This section presents the results of the field survey and desktop study, and is structured as follows:

- Section 6.2 describes the aquatic habitat characteristics at each of the survey sites
- Section 6.3 presents the surface water quality data collected from the study area;
- Section 6.4 presents the sediment quality data collected from the study area;
- Section 6.5 describes the macroinvertebrate communities identified in the study area;
- Section 6.6 describes the fish communities identified in the study area;
- Section 6.7 details the turtle communities identified in the study area;
- Section 6.8 details the occurrence of other aquatic vertebrates (i.e. except fish) in the study area;
- Section 6.9 details the aquatic flora communities present in the study area;
- Section 6.10 details the stygofauna identified within the study area; and
- Section 6.11 details the MSES identified within the study area.

6.2 AQUATIC HABITAT CHARACTERISTICS OF SURVEY SITES

Table 6 provides photographs and a detailed description of the aquatic habitat characteristics of monitoring sites in the Woolgar River and the two farm dams, as well as presenting the results of the AusRivAS habitat condition assessment (employing the habitat bioassessment score method detailed in section 4.2.4) for each monitoring site. The habitat bioassessment score allocates values (based on condition) to the various habitat features present at each site, including the bottom substrate/available cover, embeddedness, velocity/depth cover, channel alteration, bottom scouring and deposition, pool/riffle run/bend ratio, bank stability, bank vegetative stability and riparian cover. The results of the habitat bioassessment provide an indication of the condition of aquatic habitats available to flora and fauna communities at the time of sampling (i.e. this condition is also dependent on natural flows observed) and aids in the interpretation of macroinvertebrate results (section 6.5). As such, bioassessment scores were not determined for any monitoring sites that lacked water at the time of sampling.

To summarise the results of the bioassessment scores shown in Table 6, the aquatic habitats at:

- Sites WR1, WR2, WR3, WR4 and WR5 were categorised as 'fair / moderate' condition;
- Sites FD1 and FD2 were categorised as 'poor' condition; and
- Sites TRIB1, TRIB2, TRIB3 and TRIB4 were dry at the time of sampling.

This is a direct result of the ephemeral nature of the watercourses combined with the relatively uniform habitats observed in-channel. WR4 scored the highest of any of the watercourse sites because of the rock bar increasing the diversity of habitats present (Table 6). Stable, structurally complex/diverse habitats are generally considered better habitats (i.e. in better condition) for macroinvertebrate communities to inhabit. Therefore, systems that display an increased structural complexity/diversity of habitats, generally score a high bioassessment score.

The farm dam sites recorded poor condition due to their anthropogenic origins and the high level of disturbance by cattle (Table 6). These results are not unexpected for the region with grazing practices the main anthropogenic disturbance to note. The lack of complex edge habitats observed at the farm dam sites can influence macroinvertebrate communities inhabiting a site (Gleason *et al.*, 2003; Gray & Ward 1982; Wood & Armitage 1997).

Table 6: Site descriptions, sampling limitations, site pictures and habitat bioassessment score

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
WR1			WR1 incorporated a wide (~50m), sandy channel with several in-channel sand bars creating small vegetated islands. The water during the post-wet season survey was clear and restricted to a series of small remnant pools, generally associated with deeper undercut banks. Moderate amounts of leaf litter and woody debris were observed at the site. Cattle activity was observed within the area. The riparian vegetation can be described as a Weeping Tea Tree (<i>Melaleuca leucadendra</i>)/River Red Gum (<i>Eucalyptus camaldulensis</i>) woodland. The understory is dominated by tussock grasses which is generally a monoculture of the invasive Buffel Grass (<i>Cenchrus ciliaris</i>). The presence of forbs and sedges was limited at the time of sampling. Exposed roots, sedges and trailing vegetation provided structurally complex habitat along the banks, while the substrate was dominated by sand and gravel sediment. Limitations – Full surveys were conducted during post wet season survey although low water levels restricted trapping for fish, crustaceans and turtles. Turtle surveys were limited to a visual assessment.	Total score: 71 (fair/moderate) Scores for each habitat variable: 1. Bottom substrate: 9/20 2. Embeddedness: 11/20 3. Velocity/depth: 4/20 4. Channel alteration: 10/15 5. Bottom scouring: 9/15 6. Pool/riffle, run/bend ratio: 4/15 7. Bank stability: 6/10 8. Bank vegetative stability: 8/10 9. Streamside cover: 10/10

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
WR2			WR2 consisted of a wide (>50m), straight, sandy channel with a deep (~1m) pool along an undercut bank. It is the site of a road crossing with large cobble being placed within the river as a causeway. Minimal macrophytes were observed at the site. Instead, exposed tree roots, undercut banks and trailing terrestrial vegetation provide structural complexity within the edge habitat. The substrate was dominated by sand with some cobble from the road. The riparian vegetation can be described as a Weeping Tea Tree/River Red Gum woodland. The understory is dominated by tussock grasses which is generally a monoculture of the invasive Buffel Grass. The presence of forbs and sedges was limited at the time of sampling. The water was clear during post wet season surveys, but the site would entirely dry out in the following months. Limitations – Full surveys were conducted although low water levels restricted trapping for fish, crustaceans and turtles. Turtle surveys were limited to a visual assessment.	Total score: 68 (fair/moderate) Scores for each habitat variable: 1. Bottom substrate: 6/20 2. Embeddedness: 12/20 3. Velocity/depth: 3/20 4. Channel alteration: 11/15 5. Bottom scouring: 9/15 6. Pool/riffle, run/bend ratio: 6/15 7. Bank stability: 4/10 8. Bank vegetative stability: 8/10 9. Streamside cover: 9/10

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
WR3			Only a small remnant pool was present during the field surveys, although the alluvial aquifer was still flowing just below the surface with hyporheic sampling able to undertaken. WR3 is located in the main arm of an anabranch section of the river. Both channels of the anabranch are ~40m wide with a large vegetated sand island dividing the two channels The high banks on both sides of the river are ~10m high. Low-flow channels were observed throughout the sandy bed with recent sediment movement noted. The riparian vegetation can be described as a Weeping Tea Tree/River Red Gum woodland. The understory is dominated by tussock grasses which is generally a monoculture of the invasive Buffel Grass. The presence of forbs and sedges was limited at the time of sampling. The substrate was dominated by sand with some gravel. Limitations – The small remnant pool present was too small to sample during the survey therefore limiting the parameters targeted.	Total score: 66 (fair/moderate) Scores for each habitat variable: 1. Bottom substrate: 8/20 2. Embeddedness: 12/20 3. Velocity/depth: 1/20 4. Channel alteration: 11/15 5. Bottom scouring: 9/15 6. Pool/riffle, run/bend ratio: 2/15 7. Bank stability: 5/10 8. Bank vegetative stability: 8/10 9. Streamside cover: 10/10

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
WR4			WR4 has a broad (~50m wide), sandy channel with an exposed rock bar stretching across the width of the channel. There is a deep (>1.2m) pool downstream of one end of the rock bar that has previously be washed out by flows but acts as a refuge at times of low/no flow. Small <i>Melaleuca</i> saplings grow along the rock bar with other emergent macrophytes observed along the bank adjacent to the pool. The substrate was dominated by sand with some gravel and exposed bedrock also present. The riparian vegetation can be described as a Weeping Tea Tree/River Red Gum woodland. The understory is dominated by tussock grasses which is generally a monoculture of the invasive Buffel Grass. The presence of forbs and sedges was limited at the time of sampling. Limitations – Full surveys were conducted although low water levels restricted trapping for fish, crustaceans and turtles. Turtle surveys were limited to a visual assessment.	Total score: 73 (fair/moderate) Scores for each habitat variable: 1. Bottom substrate: 8/20 2. Embeddedness: 11/20 3. Velocity/depth: 4/20 4. Channel alteration: 10/15 5. Bottom scouring: 10/15 6. Pool/riffle, run/bend ratio: 5/15 7. Bank stability: 6/10 8. Bank vegetative stability: 9/10 9. Streamside cover: 10/10

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
WR5			Similar to other Woolgar River sites, WR5 has a broad (~50m wide), sandy channel. The high banks on both sides of the river are ~10m high. Shallow runs utilised low-flow channels throughout the sandy bed with recent sediment movement noted. The runs encroached on the undercut bank at various points along the 100m stretch creating greater structural complexity within the available habitats. The substrate was dominated by sand with some gravel. The recent deposition of sediments was noted via the sinking of samplers while traversing the site. The riparian vegetation can be described as a Weeping Tea Tree/River Red Gum woodland. The understory is dominated by tussock grasses which is generally a monoculture of the invasive Buffel Grass. The presence of forbs and sedges was limited at the time of sampling. Limitations – Full surveys were conducted although low water levels restricted trapping for fish, crustaceans and turtles. Turtle surveys were limited to a visual assessment.	Total score: 72 (fair/moderate) Scores for each habitat variable: 1. Bottom substrate: 9/20 2. Embeddedness: 11/20 3. Velocity/depth: 4/20 4. Channel alteration: 10/15 5. Bottom scouring: 9/15 6. Pool/riffle, run/bend ratio: 5/15 7. Bank stability: 6/10 8. Bank vegetative stability: 8/10 9. Streamside cover: 10/10

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
TRIB1			TRIB1 is located on the upper reaches of Drainage Feature 1. Here the main channel is ~4m wide with low grade, shallow banks. The substrate is dominated by sand and there was recent evidence of cattle activity. The site was completely dry during the survey. The vegetation at this site is heavily influenced by the adjacent “plain”. While riparian vegetation does occur it is constricted and confined immediately adjacent to the channel. The riparian vegetation that is present is dominated by a tallest stratum of River Red Gum. The mid-stratum is dominated by plants that also inhabit the adjacent vegetation community and include <i>Corymbia setosa</i> and <i>Acacia shirleyi</i>. The lower stratum is also dominated by plants from the adjacent plain vegetation and include <i>Heteropogon triticeus</i> and <i>Aristida hygrometrica</i>. Limitations – The site could not be sampled for a range of aquatic ecology parameters as no water was present.	Dry at the time of sampling.

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
TRIB2			TRIB2 is located in the downstream reaches of Drainage Feature 1. The site is comprised of a wide (~10m) shallow channel. Bank height is <1.5m to the top of the high bank on a very shallow gradient. The substrate is dominated by fine sand, with the site completely dry during sampling. There was evidence of recent cattle activity within the creek. The riparian vegetation can be described as a Weeping Tea Tree/ River Red Gum woodland. However, unlike the Woolgar River sites (WR1-WR4) there is considerable influence from the surrounding vegetation due to the smaller size of the channel. Non riparian species within the taller stratum adjacent to the channel include <i>Eucalyptus leptophleba</i>, <i>Eucalyptus microtheca</i> and <i>Corymbia bella</i>. The lower stratum is dominated by tussock grasses, including <i>Heteropogon contortus</i> and <i>Chrysopogon fallax</i>. No aquatic vegetation was present. Limitations – The site could not be sampled for a range of aquatic ecology parameters as no water was present.	Dry at the time of sampling.

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
TRIB3			TRIB3 is positioned in the mid-reaches of Drainage Feature 3. Similar to the Southern Creek sites (TRIB1 and TRIB2), the channel was relatively wide (<8m) with very shallow high banks (<1m high). The substrate is dominated by fine sand, with the site completely dry during sampling. There was a large amount of woody debris in-channel, with evidence of recent cattle activity within the creek. The vegetation at this site is heavily influenced by the vegetation on the adjacent "plain". While riparian vegetation does occur immediately adjacent to the channel, it is constricted and confined. The riparian vegetation that is present is dominated by a tallest stratum of River Red Gum. Non riparian species within the taller stratum that inhabit the high bank include <i>Corymbia bella</i>. The mid-stratum is dominated by plants that also inhabit the adjacent plain, including <i>Acacia shirleyi</i> and <i>Lophostemon grandiflorus</i>. The lower stratum is sparse. Where plants do occur they are synonymous with the adjacent vegetation and include <i>Heteropogon triticeus</i> and <i>Aristida hygrometrica</i>. No aquatic vegetation was present. Limitations – The site could not be sampled for a range of aquatic ecology parameters as no water was present.	Dry at the time of sampling.

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
TRIB4			TRIB4 is located in the headwaters of Drainage Feature 4. The site is characterised by gully erosion with heavily scoured and often failing banks. The channel is relatively narrow (<4m) with bank height ~1.5m. The bed is comprised of coarse sand and gravel with old mine workings prevalent throughout the catchment area. No water was present during sampling. Woody debris and exposed roots were regularly encountered throughout the site. The riparian vegetation at TRIB4 is extremely limited. The vegetation at this site is heavily influenced by vegetation not considered reflective of riparian communities. This includes a mixture of <i>Eucalyptus/Corymbia</i> species with a mid-stratum dominated by <i>Petalostigma banksia</i>. The lower stratum immediately adjacent to the channel is dominated by <i>Cenchrus ciliaris</i> (Buffel Grass) and <i>Triodia spp.</i> No aquatic macrophytes were observed inhabiting the site. Limitations – The site could not be sampled for a range of aquatic ecology parameters as no water was present.	Dry at the time of sampling.

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
FD1			FD1 is an in-channel farm dam located in the downstream reaches of Middle Creek. The site is heavily impacted by cattle with some present during sampling. Algae was observed around the margins, while the water was heavily turbid. The water depth was shallow (<1m) during sampling. The substrate was dominated by fine sediment and there was little available complex structure (i.e. woody debris, etc). The vegetation associated with the FD1 site is highly modified. The vegetation immediately adjacent is exclusively dominated by the invasive species <i>Acacia farnesiana</i>. No aquatic macrophytes were observed inhabiting the site. Limitations – Full surveys were conducted during post wet season survey although high turbidity levels limited the effectiveness of electrofishing techniques.	Total score: 30 (poor) Scores for each habitat variable: 1. Bottom substrate: 1/20 2. Embeddedness: 2/20 3. Velocity/depth: 2/20 4. Channel alteration: 13/15 5. Bottom scouring: 1/15 6. Pool/riffle, run/bend ratio: 1/15 7. Bank stability: 8/10 8. Bank vegetative stability: 1/10 9. Streamside cover: 1/10

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
FD2			FD2 is an in-channel farm dam located in the downstream reaches of Southern Creek. The site is heavily impacted by cattle with some present during sampling. The water was highly turbid with a depth of >1.2m during sampling. The substrate was dominated by fine sediment and there was little available complex structure (i.e. woody debris, etc). The vegetation associated with the FD2 site is highly modified. The vegetation immediately adjacent is exclusively dominated by the invasive species <i>Acacia farnesiana</i>. No aquatic macrophytes were observed inhabiting the site. Limitations – Full surveys were conducted during post wet season survey although high turbidity levels limited the effectiveness of electrofishing techniques.	Total score: 36 (fair/moderate) Scores for each habitat variable: 1. Bottom substrate: 1/20 2. Embeddedness: 1/20 3. Velocity/depth: 2/20 4. Channel alteration: 12/15 5. Bottom scouring: 1/15 6. Pool/riffle, run/bend ratio: 2/15 7. Bank stability: 6/10 8. Bank vegetative stability: 3/10 9. Streamside cover: 6/10

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
N/A – Drainage Feature 2	 <i>Drone image of Drainage Feature 2 towards the upstream end of the reach encompassed by the project site boundary.</i>	 <i>Drone image of Drainage Feature 2 within the mid-reaches encompassed by the project site.</i>	Drainage Feature 2 was ground-truthed via a drone fly over during the 2019 field surveys. The system presented similar to that of Drainage Feature 1 and Drainage Feature 3 with a sand dominated substrate interspersed in the upper reaches with rocky/cobble sections. The channel had low (maximum 1 m high) high banks with a width of 5 to 10 m dependent on the location. Infrequent, bank failure was noted, likely associated with cattle use. The riparian vegetation was comprised of Weeping Tea Tree/ River Red Gum woodland with considerable amount of non-riparian flora contributing to the assemblage of a similar composition to that described for the TRIB2 site. The drainage line traversing the project site was dry during the 2019 field survey.	Not assessed.

Site	Upstream view	Downstream view	Description	Habitat bioassessment score
N/A – Drainage Feature 5	<i>No images available</i>		Similar to Drainage Feature 4, the upper reaches of Drainage Feature 5 are characterised as a small gully (bank height <1 m; channel width <3 m) displaying high levels of erosion. The gully is continuing to cut into the landscape, mobilising sediments to the lower reaches. The substrate was dominated by fine sands and soil, with no true riparian community. Instead, the associated vegetation was of similar composition to that of the surrounding plain, with a similar assemblage to that discussed for monitoring site TRIB4. The system was completely dry at the time of survey.	Not assessed.

6.3 SURFACE WATER QUALITY

As discussed in Section 4.2.5, the EAR Surface Water Report presents an assessment of baseline surface water quality based on all available water quality data. As such, this section discusses the quality of water experienced within the Woolgar River and two Farm Dams (noting that all the Drainage Features were dry during the surveys) during the aquatic ecology sampling rounds only for comparison with biotic trends.

Low EC levels were recorded at FD2 while all other sites appeared to be senescing pools experiencing the effects of evaporation with WR1 and WR2 recorded slightly above the ANZECC & ARMICANZ (2000) guidelines for northern Australia (Table A1.1). The higher electrical conductivity levels are expected with natural drying processes in senescing pools being an overriding factor influencing water quality in ephemeral rivers.

Dissolved oxygen records were outside the referenced default guideline values at all sites except WR5 and FD2 (Table A1.1). This suggests that the remnant pools that were sampled at these sites are influenced by eutrophication with WR1, WR4 and FD1 recording dissolved oxygen levels below the chronic limit (i.e. ~68% dissolved oxygen saturation) of extended exposure for native, tropical freshwater fish (Table A1.2; Burrows et al., 2007). Similar to EC, these low levels of DO are a potential limiting factor for some aquatic fauna persisting within these drying pools.

Turbidity levels were low at all Woolgar River sites (WR1 to WR5) and elevated in the farm dams at FD1 and FD2 (Table A1.1) however these observations were made during periods of nil flow. Turbidity levels during periods of flow is expected to be higher. The turbidity of water at FD1 and FD2 is due to the increased fine sediment composition generally observed in farm dams combined with the cattle activity noted at each site, stirring up the fine sediment and keeping it in suspension. The increased suspended sediments are likely also influencing other aspects of the water quality including the metal composition at FD1 and FD2, with aluminium and other metals known to occur in colloidal form within suspended sediments.

Dissolved aluminium and copper levels were both elevated in the farm dams, while total aluminium was also elevated in FD1 (Table A1.1). These metals are often elevated in colloidal form in north Australian ephemeral watercourses. In colloidal form they are able to pass through a 0.45µm filter, increasing the levels of dissolved aluminium and copper, although these levels are not representative of bioavailable levels within the waters. All other sites were generally compliant with metal guideline values (Table A1.1).

Ammonia, total nitrogen and total phosphorus levels observed during the post-wet season survey were also elevated compared to guideline values in samples collected from most sites, with particularly high values recorded in WR4, FD1 and FD2 (Table A1.1). The levels of these nutrients are related to impacts from cattle accessing the waterhole at WR4 and the farm dams for drinking water. Elevated nutrient levels can cause excessive growth of nuisance algae and plants with associated secondary impacts to resident aquatic fauna. Note; algal blooms (potentially cyanobacteria), potentially as a result of these elevated nutrients, were noted along the margins of FD1 during sampling (Figure 11).

6.4 SEDIMENT QUALITY

The sediment analysis results are presented in Appendix 1 and summarised in the following sections.

6.4.1 PARTICLE SIZE DISTRIBUTION

Particle size distribution of bed sediments changed with habitat type (Figure 12).

Woolgar River sites were dominated by sand while the farm dams (Sites FD1 and FD2) were dominated by fine sediments (Figure 12). This is not unexpected as in-channel farm dams slow flows down upon entry, allowing fine sediments to settle out of suspension. Hence, the increase in fine sediment composition at such sites is common.

Larger grain sizes generally provide a more complex habitat for macroinvertebrate communities to utilise, increasing the diversity of Families present. Despite this, FD2 was the only site to record cobble within the sample (Figure 12). This is possibly associated with the material the dam was constructed with, rather than naturally occurring within the channel. Gravel composition was relatively consistent across all watercourse sites, generally comprising <20% of the sample (Figure 12).

6.4.2 METAL/METALLOID CHEMISTRY

The sediment analysis results are presented in Table A1.2 and Table A1.3 alongside the applied sediment quality guideline values (i.e. the Low ISQG values per ANZG (2018)). These guideline values are provided for context only and are not intended to be interpreted as “maximum permissible levels”. The comparison shows that:

- Baseline sediment chemistry is naturally variable, despite correcting the results for particle size.
- In the larger 63µm – 2mm particle size fraction (i.e. sand), the metal and metalloid concentrations were below the applied guideline values at all sample sites.

In the smaller <63µm particle size fraction (i.e. fine sediments), the metal and metalloid concentrations were generally an order of magnitude higher than those recorded within the larger particle size fraction for all quality characteristics. This is due to the increased total surface area of the smaller fraction, which increases the available surface binding area for metals and metalloids. The occurrence of certain metals (including lead) in naturally elevated concentrations is expected given the extensively weathered geology and enrichment commonly associated with gold deposits.

6.5 MACROINVERTEBRATE COMMUNITIES

6.5.1 TAXONOMIC RICHNESS AND ABUNDANCE

Composite macroinvertebrate samples were collected from various sites during the April 2019 sampling trip. Thirty-seven (37) different macroinvertebrate taxa were collected. This diversity is similar to that identified by Waltham *et al.* (2013) for several sites within the upper Flinders River that identified fifty (50) families over two sampling events. Best-practice guideline values are not available for the region for comparison. Instead, results must be compared to each other with inferences made.

Taxonomic richness and abundance at each site were moderate with taxonomic richness ranging from seventeen to twenty-two families in watercourse sites and five to eight in farm dams (Figure 13). Again, these results are similar to Waltham *et al.* (2013) which recorded site richness ranging between eight and twenty-nine, dependent on habitat targeted. In the current study, the lowest richness was recorded at FD1, an area highly impacted by cattle and drying processes when sampled. Within the farm dams, water quality and structural complexity were both poor with little (if any) edge habitat. Low richness values are often observed within habitats that are desiccating and relatively devoid of structure. Edge habitats are generally more structurally diverse and exhibit higher rates of primary production compared to bed habitats, and therefore exhibit a diverse macroinvertebrate community assemblage (Choy *et al.*, 2002).

WR1 recorded the greatest diversity of macroinvertebrate Families inhabiting any site (Figure 13). This site incorporated an extensive woody debris with trailing vegetation also present, increasing the structural complexity and diversity of habitats sampled.

It should be noted, however, that abundance results do not closely mirror taxonomic richness levels at each site (Figure 14 and Figure 13). This is uncommon, with DNRM (2001) stating that a minimum of 200 organisms should be collected per macroinvertebrate sample as the number of Families found increases with the number of individual organisms collected. This effect is suggested to reduce after 200 organisms have been collected (DNRM, 2001). However, macroinvertebrate samples at the project site were of relatively low abundance and the samples were picked clean in the time constraints outlined within the AusRivAS methods (DNRM, 2001). Despite this, the results for taxonomic richness were similar to that to Waltham *et al.* (2013) suggesting they are appropriate/representative of the region.

The full raw data results of the number of individuals of each macroinvertebrate family collected at each site across the study area are provided in Appendix 2.

6.5.2 PET RICHNESS

PET richness is calculated by the sum of the number Plecoptera (stoneflies), Ephemeroptera (mayflies) and Trichoptera (caddisflies) families present at a site. PET taxa are generally sensitive to environmental change and anthropogenic disturbances. Therefore, the number of PET taxa inhabiting a site can be a measure of site condition, or can provide an indication of an un-impacted site's potential to be influenced by proposed anthropogenic activities. PET richness levels between 2 and 5 are considered relatively standard in tropical north Australian systems (QWQG, 2009), with bed habitats dominated by finer sediments generally scoring at the lower end, while edge habitats and/or riffle zones generally recording PET taxa values at the higher end of this range or above.

PET richness at all sites ranged between zero and five (Figure 15). The farm dams again recorded the lowest levels with no PET taxa found in either dam (Figure 15). This is potentially a result of the large amounts of fine sediments and relatively poor water quality compared to the watercourse sites. The water quality is heavily influenced by the high amount of cattle activity noted at both farm dams.

The other watercourse site had PET richness scores between 2 and 5, as is expected for tropical north Australian systems.

6.5.3 SIGNAL INDEX VALUES

SIGNAL index values provide an indication of the sensitivity a macroinvertebrate community has to environmental change. It is calculated as the average SIGNAL score of each Family recorded at a site (non-weighted in accordance with Queensland methods; DES, 2018). Macroinvertebrate communities with a SIGNAL index value of equal to or less than 3 are considered to be highly tolerant to environmental change, while those with a value equal to or greater than 8 are highly sensitive to environmental change.

Most sites recorded average SIGNAL grades of between 3 and 4, with 2 Woolgar River sites (WR02 and WR04) recording levels greater than 4 (Figure 16). This suggests most macroinvertebrate communities inhabiting the area are tolerant to environmental change.

The bars within Figure 16 show the SIGNAL score for the most tolerant and most sensitive Families collected at each site. All Woolgar River sites recorded Families with a maximum sensitivity score of 8 suggesting that limited components of the community are highly susceptible to change. All sites recorded the lowest SIGNAL scores below 3. Families with a SIGNAL score of less than 3 are considered highly tolerant to environmental change and/or pollution. The raw data provided in Appendix 2 shows the vast majority of taxa recorded at each site are considered tolerant to environmental change.

6.5.4 SHANNON-WIENER DIVERSITY INDEX

Values for the Shannon-Wiener Diversity Index generally score between 1.5 and 3, with the higher values signifying greater biodiversity. All Woolgar River sites scored diversity index values of greater than 2 (considered average), suggesting the system is in good health (Figure 17). WR1 and WR2 scored values greater than 2.5, suggesting the macroinvertebrate communities inhabiting these sites are in excellent condition (Figure 17). FD1 scored a diversity index of below 1.5, suggesting the macroinvertebrate community inhabiting this farm dam is highly depauperate.

Evenness values are recorded between 0 and 1. The higher the value the more even the spread of organisms across all families recorded, with a result of 1 suggesting all Families present have an equal abundance. The lower the evenness value the more the community is represented as a monoculture, dominated by one or two families. The evenness results show that all sites displayed a similar high evenness of Families within the communities present. All sites are slightly skewed (i.e. less than 1) by the abundance of some Families, although this is common/expected in natural systems (Figure 17).

6.5.5 AUSRIVAS MODELLING

Ausrivas modelling of the macroinvertebrate data indicates that FD1 was the most biologically impaired site (Table 7). The Band for all sites ranged between A and C (Table 7). The Band provides the description of the level of biological impairment with:

- Band A classed as *similar to reference sites*;
- Band B classed as *significantly impaired*; and
- Band C classed as *severely impacted*.

These results are consistent with the outcomes of other indices that found the macroinvertebrate community at FD1 to be in poor health.

Table 7: Observed taxa results for each site with greater than 50% probability of occurrence

Site	Number of families collected (50%)	O/E score (50%)	O/E SIGNAL score (50%)	Band
WR1	6	0.62	0.92	B
WR2	8	0.83	1.05	A
WR4	8	0.83	1.05	A
FD1	3	0.36	1.16	C
FD2	6	0.72	0.84	B

The O/E SIGNAL score (50%) results show that within both habitats the observed SIGNAL scores (with >50% probability of occurring) were generally similar to those expected (a value of 1.00 signifies the scores are equal) and sometimes better (i.e. a value >1.00; Table 7). Note; the macroinvertebrate assemblages inhabiting FD1 appears to be far more sensitive than expected. This is actually a result of the exceedingly low number of families inhabiting the site skewing the data.

The bandwidth in Table 8 shows the upper O/E score (50%) for each Band allocated. When compared against the results in Table 7 it can be seen that FD1 was equal to the upper limit of Band C, while WR2 and WR4 were in the lower range on Band A (range 1.21 – 0.78).

Table 8: Overall site results and macroinvertebrate taxa information relevant to each site

Site	Overall site assessment Band	Upper O/E score for the allocated Band	Number of taxa predicted to occur (with >50% probability) but not collected	Most sensitive taxa recorded (including SIGNAL grade)
WR1	B	0.78	7	Leptophlebiidae (S.G. – 8)
WR2	A	1.21	5	Leptophlebiidae & Philopotamidae (S.G. – 8)
WR4	A	1.21	5	Leptophlebiidae (S.G. – 8)
FD1	C	0.36	8	Hydracarina (S.G. – 6)
FD2	B	0.78	5	Hydracarina (S.G. – 6)

The number of families and/or sub-families expected with over 50% probability of occurring and not collected at the sites ranged from 5 to 8 (Table 8). The families and/or sub-families missing from the bed habitats at most sites were comprised of both sensitive (S.G. ≥5) and tolerant (S.G. <5) taxa. The highest sensitivity taxa, based on SIGNAL grades, collected at any site were Leptophlebiidae and Philopotamidae with a SIGNAL grade of 8 collected within the Woolgar River (Table 8).

These AusRivAS results suggest that the Woolgar River macroinvertebrate communities area in relatively good condition. Macroinvertebrate communities inhabiting the farm dams and the spring site are impacted which is expected given these sites have been historically altered through anthropogenic disturbances.

6.5.6 BAITED TRAPS

One large freshwater decapod species was caught using baited traps. A species of freshwater crab (*Austrothelphusa transversa*) was only collected at FD2, with no evidence of the species inhabiting any of the other sites visited.

Austrothelphusa transversa are native to dams, creeks, lagoons and swamps across northern Australia, from Broome in northern Western Australia to the central coast of Queensland (Jones & Morgan, 2002). The species can burrow down to approximately 1m below ground level and plug the hole when flows cease during the dry season. While underground they become inactive until the onset of the monsoonal rains with the wet season (Jones & Morgan, 2002). Opposed to most saltwater crabs, the freshwater crab has evolved to have no free-swimming larvae stage to assist with dispersion. Instead, their eggs hatch immediately as juveniles (Jones & Morgan, 2002).

6.5.7 SUMMARY

The data suggest that macroinvertebrate communities across the project site are relatively depauperate. However, this result is not unexpected as it is commonly observed within ephemeral north Australian rivers at the end of the wet season. Despite this, biodiversity indices suggest that the system, with the exception of the farm dams, is in good health.

None of the species of macroinvertebrates identified during the field assessments, from database searches or literature reviews are listed under the EPBC Act or the NC Act.

6.6 FISH COMMUNITIES

6.6.1 SPECIES RICHNESS AND ABUNDANCE

Four (4) species of freshwater fish were identified utilising the project site during field surveys, including:

- Macleay's Glassfish (*Ambassis macleayi*);
- Chequered Rainbowfish (*Melanotaenia splendida inornata*);
- Spangled Perch (*Leioptherapon unicolor*); and
- Hyrtl's Catfish (*Neosilurus hyrtlii*).

Figure 18 displays the species richness of fish communities inhabiting each site. Table A3.1 shows the abundance of each fish species recorded at each sampling site. Species richness appears to be higher in the Woolgar River than the neighbouring farm dams. No fish were caught/observed within FD1, potentially a result of the heavily impacted nature of the site.

WR2 and WR4 presented the most diverse fish assemblages of any site recording three different species (Figure 18). This is potentially correlated with the diversity of habitats present at the site (including undercut banks, exposed roots, open pools and woody debris) and the greater size of the remnant pools available.

Tables displaying photographs of individuals caught, as well as a write up on the ecology of species identified, are provided in Appendix 3 (refer to Table A3.2 and Table A3.3). No species listed under the EPBC Act or the NC Act were found during the field surveys.

Waltham *et al.* (2013) undertook fish surveys throughout the Flinders River catchment area in known permanent waterholes and flowing creeks. While the study did not sample within the Woolgar River catchment area it did sample sites upstream and downstream of the confluence of Woolgar River and the Flinders River. The study identified a total of eight (8) freshwater fish species upstream of the confluence and a further four (4) species in a permanent waterhole downstream. It is suggested that the additional four species observed in the Waltham *et al.* (2013) study likely also utilise the Woolgar River associated with the project site as it provides similar habitats to the upper Flinders River (i.e. no permanent waterholes). These additional four species include:

- Bony Bream (*Nematolosa erebi*);
- Sleepy Cod (*Oxyleotris lineolata*);
- Golden Goby (*Glossogobius aureus*); and
- Barred Grunter (*Amniataba percooides*).

None of these species are listed under the EPBC Act or the NC Act.

6.6.2 LIFE HISTORY STAGES

Figure 19 shows the average fork length of individuals caught for each species. In general, adults and/or sub-adults of each species were caught. All species collected were less than 100mm long, with Hyrtl's Catfish being the longest species observed (Figure 19).

The ephemeral nature of the watercourses combined with the sizes of the fish encountered suggests that the majority of the specimens collected migrated from permanent freshwater pools located further afield in the Woolgar River catchment area. Refer to Table A3.2 in Appendix 3 for further discussion on the ecology of species identified during field surveys.

6.7 TURTLE COMMUNITIES

No listed freshwater turtle species (under either the EPBC Act or the NC Act) were identified from the database searches as potentially inhabiting within the region.

No freshwater turtles were caught/observed with the project site. However, the common Saw-shelled Turtle (*Myuchelys latisternum*) was observed in a large dam in proximity to the project site (approximately 10km away).

6.8 OTHER AQUATIC VERTEBRATES

There are no aquatic vertebrates recorded or likely to be present within the project site. No aquatic pest species are known to inhabit the area.

6.9 AQUATIC FLORA

Only two emergent aquatic flora species (*Cyperus difformis* and *Cyperus sp.*) were observed throughout the Woolgar River survey sites (i.e. WR1 to WR5). WR1 recorded the highest percent cover of any site at 7 % (Table 9). No macrophytes were observed within the other onsite drainage features. The lack of extensive macrophyte beds within the Woolgar River and its tributaries is associated with the ephemeral nature of the system combined with the shifting sediment loads observed during periods of flow.

The most widely distributed species was *Cyperus difformis*. This species was observed growing along the banks throughout the Woolgar River, although its presence was patchy (Table 9) These results display a relatively depauperate (in diversity) but healthy aquatic vegetation community inhabiting the Woolgar River, with only natural processes influencing community structure at each site (e.g. flow rate and riparian cover).

No aquatic Weeds of National Significance (WONS) were observed during field surveys. None of the aquatic flora species identified within the project site are listed under the EPBC Act or the NC Act.

Table 9: Percent cover of aquatic flora species observed at each site

Site	Type	WR1	WR2	WR4	WR5	FD1	FD2
<i>Cyperus difformis</i>	Emergent	5		1	2		
<i>Cyperus sp.</i>	Emergent	2					
Percent Cover		7		1	2		
Species Richness		2	0	1	1	0	0

6.10 STYGOFAUNA RESULTS

6.10.1 HYPORHEIC SAMPLING

The majority of organisms collected from the Woolgar River alluvium were stygoxene or terrestrial fauna (Table 10). Stygoxene fauna generally occur within surface water environments, although they are also known to facultatively utilise the hyporheic zone (Gibert *et al.*, 1994). This is a typical result for hyporheic zone sampling, as this zone is generally utilised by both surface water and groundwater fauna (Boulton, 1993).

No obligate stygofauna were identified in the hyporheic zones sampled and therefore, there are no impacts to obligate stygofauna in the hyporheic zone from the project site.

Table 10: Stygofauna sampling results for monitoring bores (MB) and hyporheic zones (^h)

Order	Family	MB1B	MB2A	MB2B	MB3B	MB4B	MB5B	MB6B	MB7A	MB7B	WR1 ^h	WR2 ^h	WR3 ^h	WR4 ^h	WR5 ^h
Acarina	Mesostigmata														
Arachnida	Araneae sp.1														
	Araneae sp.2														
	Araneae sp.3														
Collembola	Isotomidae														
Coleoptera	Hydraenidae										6				
	Hydrophilidae														
	Mycteridae c.f.										2			1	
	Staphylinidae										4	2	2		
Diptera	Ceratopogonidae										20	487	17	58	
	Chironomidae/ Chirominae										1	79	6	2	
	Chironomidae/ Tanypodinae										1	54			
	Dolichopodidae												1		
	Tipulidae										3		11		
Ephemeroptera	Caenidae											1			
Hemiptera	Aphidoidea														
	Gelastocoridae										1				
Nematomorpha	Gordiidae										1			1	
Oligochaeta	Capiloventridae										253	65	37	172	
	Enchytraetidae										4	78	3	6	2
Thysanoptera	Thrips	1					6								
	Total Taxa	1	0	0	0	0	1	0	0	0	11	7	7	6	1

Terrestrial families.
 Stygofauna families.

The Woolgar River sites were dominated by Ceratopogonidae and Oligocheata (Table 10). The community composition was similar between all Woolgar River sites (except WR5) with species richness ranging from six to eleven and displaying a reduction with increasing distance downstream (Table 10). The Woolgar River sites were predominantly comprised of stygofauna associated with the sandy riverbed.

6.10.2 BORE SAMPLING

No stygofauna were present within the bores sampled during the 2019 and 2022 surveys. Therefore, there are no project impacts on stygofauna associated with groundwater in the vicinity of the project site.

Thrips were collected in two bores during the 2019 sampling round (Table 10). Thrips are a terrestrial fauna that likely accessed the top of the bore via inappropriate capping, providing them access to a humid environment in an otherwise dry climate. Thrips are, therefore, not stygofauna.

6.11 AQUATIC MNES & MSES

This section summarises the aquatic MNES and MSES identified as present or likely to be present in the study area, based on the desktop assessment and field surveys.

6.11.1 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE (MNES)

There were no aquatic MNES recorded or likely to occur within the project site.

6.11.2 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE (MSES)

There are several ecological values relevant to aquatic systems that are considered MSES. Table 11 provides a summary of MSES that are relevant to aquatic ecology and indicates whether the MSES are present or potentially present within the project site.

Table 11: Summary of MSES relevant to aquatic ecology

MSES*	Comment	Report Cross Reference
Aquatic habitat mapped as essential habitat for protected wildlife	No aquatic habitats mapped as essential habitat for protected wildlife occurring on or near (within a 20km searched buffer) of the project site. Therefore, mapped essential aquatic habitat is not assessed any further within this report.	Section 5.2 Appendix 4
WPA or HES wetlands shown on the Map of Referable Wetlands	No mapped wetlands occur within or in near (within a 20km searched buffer) the project site. Therefore, the project does not have the potential to influence HES or associated WPAs.	Section 5.2 Appendix 4
A wetland or watercourse designated as HEV waters	Government mapping does not show any HEV waters within close proximity to the project site (within a 20km searched buffer). Therefore, HEV waters are not assessed any further within this report.	Section 5.2 Appendix 4
Protected wildlife habitat, including habitat for Endangered, Vulnerable or Special Least Concern species	There is no preferred habitat for protected aquatic wildlife in or near (within a 20km searched buffer) the project site. Therefore, these MSES are not assessed any further within this report.	Section 5.2 Appendix 4
Fish habitat areas declared under the <i>Fisheries Act 1994</i>	No FHA are mapped within, or in close proximity to (within a 20km searched buffer), the project site. Therefore, fish habitat areas are not assessed any further within this report.	Section 5.2 Appendix 4
Waterway providing for fish passage	DAF waterway mapping indicates that there is a low risk to fish passage from waterway barrier works in the majority of the ephemeral drainage features traversing the project site. Drainage feature 1 is mapped as having a moderate risk for fish passage within the project site and a high risk for a short reach at the downstream end of the project site. The Woolgar River is mapped as having major risk to fish passage from waterway barrier works (Figure 7). Potential impacts to fish passage are discussed within Section 8.	Section 5.2 Section 8 Appendix 4

* MSES are detailed/described within the *Queensland Environment Offsets Regulation (2014)*.

Note that regulated vegetation within a defined distance of a watercourse is an MSES and is discussed in the EAR Terrestrial Ecology Report.

7. BASELINE AQUATIC ECOLOGY VALUES

7.1 INTRODUCTION

This section draws on the outcomes of the desktop assessment and the field survey results to describe the aquatic ecological values observed within the study area. The aquatic habitats present within the study area include:

- The Woolgar River;
- The drainage features traversing the project site; and
- The two farm dams within the project site.

Each of these is discussed in the following sections.

7.2 WOOLGAR RIVER

The Woolgar River is an ephemeral watercourse characterised by a shifting, sand dominated, substrate with occasional vegetated islands as well as rock bars. The riparian zones are still largely intact, although the moderately steep high banks still regularly display erosion scars, likely associated with the extensive cattle use. Depressions within the Woolgar River bed likely dry out over the dry season.

The Woolgar River provides aquatic habitat for a variety of common aquatic flora and fauna species (i.e. species not listed as Threatened under Commonwealth or State legislation). The riparian zones, vegetated islands and pools of water which persist during the dry season within the Woolgar River also provide habitat for listed terrestrial fauna species. These listed terrestrial species, and their associated habitat, are discussed in the EAR Terrestrial Ecology Report.

Habitat condition assessments undertaken at sites throughout the reaches of the Woolgar River associated with the project site found that the system was in moderate / fair condition. Surface water quality, and a range of macroinvertebrates, fish and aquatic flora that are typical of tropical, ephemeral rivers were documented.

The Woolgar River is a waterway that provides for the passage of fish (Figure 7). DAF waterway mapping produced under the Fisheries Act confirms that the Woolgar River is a purple waterway which suggests that any waterway barrier works on this system is a “major” risk to the sustainability of resident fish populations.

Based on the results of the aquatic ecology assessment, the biological integrity of aquatic ecosystems associated with the Woolgar River are considered unmodified although other physical and chemical indicators have been adversely affected by human activity to a relatively small but measurable degree in the project site and its surrounds. Hence, the Woolgar River meets the definition of a slightly disturbed water, as described in Section 6 of the EPP Water.

7.3 DRAINAGE FEATURES

The drainage features that traverse the project site all display similar attributes, including:

- Highly ephemeral;
- Sand dominated, substrates prone to shifting;
- Occasional gravel and cobble dominated reaches;



- Riparian zones established on shallow high banks; and
- Impacts from cattle leading to an aquatic habitat condition of slightly disturbed.

The drainage features provide aquatic habitat for a variety of common aquatic flora and fauna species. The riparian zones of the drainage features may also provide habitat to listed terrestrial fauna species. These listed terrestrial species, and their associated habitat, are discussed in the EAR Terrestrial Ecology Report.

The highly ephemeral nature of these systems within the project site limits the aquatic ecology values they provide to the greater Woolgar River system. DAF waterway mapping indicates that there is a low risk to fish passage from waterway barrier works in the majority of the ephemeral drainage features traversing the project site. Drainage Feature 1 is mapped as having a moderate risk for fish passage within the project site and a high risk for a short reach at the downstream end of the project site.

Based on the results of the aquatic ecology assessment, the physical and chemical indicators have been adversely affected by human activity to a relatively small but measurable degree in the project site and its surrounds. Hence, for a conservative approach the drainage features are classed as slightly disturbed waters in accordance with the EPP Water.

7.4 FARM DAMS

The two farm dams are man-made structures both of which were constructed to dam the channels of minor drainage features within the project site. They are a source of potentially permanent water and are heavily impacted cattle activity.

Habitat condition assessments undertaken at both farm dams found that the aquatic habitat of both dams was in poor condition due to a lack of aquatic flora species and limited aquatic fauna.

The farm dams also provide habitat to listed terrestrial fauna species. These listed terrestrial species, and their associated habitat, are discussed in the EAR Terrestrial Ecology Report.

The overall aquatic habitat condition of the farm dams has been assessed as low as they both have poor biocondition scores, poor surface water quality and low diversity and abundance of macroinvertebrates, fish and aquatic flora which suggests the systems are highly disturbed aquatic ecosystems.

8. IMPACT ASSESSMENT

8.1 INTRODUCTION

The project involves the development of three open cut pits and associated mining infrastructure within the project site (as shown in Figure 2). The project activities have the potential to give rise to impacts on aquatic ecosystems due to:

- Physical disturbance of aquatic habitats;
- Changes to the surface water setting (i.e. surface water flow or quality);
- Changes to the groundwater regime (i.e. groundwater levels or quality); and/or
- Biosecurity issues.

The project impacts of physical disturbance on vegetation associated with aquatic habitats (i.e. clearing of riparian and wetland vegetation) has been assessed in the EAR Terrestrial Ecology Report. Hence, direct vegetation clearing impacts are not discussed further in this report.

The EAR Surface Water describes the potential impacts of the project on surface water flow and quality. The large majority of the project site is above the 0.1% (1 in 1,000) Annual Exceedance Probability (AEP) flood extents associated with the Woolgar River. The three open cut pits and all mine infrastructure are located well above the Woolgar River 0.1% (1 in 1,000) AEP flood level. Hence, there is limited potential for interaction between the project activities and the Woolgar River flows and associated floodplain and aquatic ecosystems.

The EAR Groundwater Report describes the project's effects on the groundwater regime. It concluded that:

- The Woolgar River is located outside the predicted extents of drawdown on the groundwater table from the project. Hence, the localised drawdown on the groundwater table is not predicted to have any effect on river baseflow or the natural flow regime in the Woolgar River.
- The groundwater table does not intersect the ground surface in the drainage features that traverse the project site. There is no groundwater seepage through the creek beds or banks, and therefore groundwater seepage does not provide baseflow to the drainage features.
- Project activities are not predicted to give rise to any significant impacts on groundwater quality.

This aquatic ecology impact assessment therefore focuses on the remaining elements of the project that have the potential to give rise to physical disturbance of aquatic habitats and surface water effects of the project on aquatic habitats. The aquatic ecology impact assessment is structured as follows:

- Section 8.2 describes the physical disturbance of aquatic ecosystems due to:
 - Construction of the Woolgar River offtake.
 - Construction of the BVS Pit Drainage Diversion.
 - Construction of drainage feature road crossings.
- Section 8.3 describes the project's effects on surface water flow/quality (based on the EIS Surface Water Report findings) due to:
 - Water supply abstraction from the Woolgar River and associated effects on downstream flows.
 - Open cut mining effects on catchment yield and associated surface flows.

- Mine water discharges.
- Erosion and sedimentation.
- Section 8.4 describes the potential for project activities to introduce or spread weeds and feral animals.
- Section 8.5 describes the potential impacts of the project's disturbance and surface water effects on aquatic habitats, flora and fauna (including threatened species, migratory species and MSES).

8.2 PHYSICAL DISTURBANCE OF AQUATIC ECOSYSTEMS

8.2.1 WOOLGAR RIVER OFFTAKE

The project will require a raw water supply. The raw water supply will involve the abstraction of surface water from an offtake located on the Woolgar River. The Woolgar River offtake and associated infrastructure will be located in the north-western part of the project site, on the southern bank of the Woolgar River channel (Figure 2).

The offtake will comprise:

- A small excavated sump for the pump inlet pipes in the Woolgar River bank, adjacent to the riverbed. The off-channel sump will be approximately 10 m wide x 20 m long at its base. The internal batter slopes of the sump will be lined with rock and/or concrete. The sump inlet will be a rock gabion weir running parallel to the river bank. The rock gabion will reduce sediment accumulation in the sump and will act as a sill that deters fish using the sump during low flows by preferentially guiding fish along the riverbank away from the sump.
- Pump inlet pipes and a 10H:1V access ramp from the river bed to the pump station constructed on the riverbank above the sump.
- A pump station at the top of the river bank, including a hardstand area and pumps, and a pump station access track located on the Woolgar River floodplain (outside of the river channel).

The offtake construction will occur during the dry season when the Woolgar River is not flowing. As part of construction activities, vegetation will be cleared from the footprint of the offtake infrastructure area. Topsoil and subsoil will be stripped from this area and stockpiled for reuse in rehabilitation.

Once the offtake is commissioned, a shallow pumping pool will form in the sump at the start of the following wet season. The Woolgar River experiences significant flows that will inundate the sump and river bank. Due to the significant flows in the river, the water level in the river will remain high for extended periods during the wet season. At the end of the wet season, the volume of water flowing in the river will decrease, causing the water level in the river to fall. When the water level in the river falls below the sump inlet, water will cease to flow into the sump. Following the cessation of flow into the sump, the residual pumping pool will rapidly dissipate due to infiltration and evaporation. Hence, the presence of a pumping pool in the sump will be largely limited to the wet season when the Woolgar River is in flow.

During mining operations, water will be pumped from the river to the Raw Water Dam via a dedicated pipeline. Section 8.3.1 describes the take of surface water from the Woolgar River and the associated downstream surface water flow effects.

The offtake construction will require the clearing of approximately 0.25 ha for the sump, pump suction pipes and access ramp. The offtake construction will include stabilisation of the disturbed area of the river bank with rock armouring and/or shotcrete to ensure the bank remains stable and the pumps can continue to operate during wet season flows events.

On completion of mining, the offtake will be removed, the off-channel sump will be backfilled to reinstate the pre-mining riverbank surface and the disturbed areas will be rehabilitated.

The offtake will not result in any obstruction to the river channel or flows. It will therefore not have a significant impact on fish passage during flow events in the river. Overall, the construction and operation of the pump station is not expected to result in any significant adverse impact on the aquatic ecology of the river.

8.2.2 BVS PIT DRAINAGE DIVERSION

The north-eastern part of the BVS Pit footprint is traversed by Drainage Feature 1 and 2 (Figure 2). Drainage Feature 1 and 2 join within the BVS Pit footprint. Drainage Feature 1 joins the Woolgar River approximately 3.2 km downstream of the BVS Pit footprint.

Prior to commencement of mining operations, a permanent Drainage Diversion will be constructed to divert Drainage Feature 1 and 2 around the BVS Pit.

The conceptual alignment of the Drainage Diversion is shown in Figure 2. The Drainage Diversion is approximately 2.1 km long and extends around the eastern and northern sides of BVS Pit.

A diversion drain inlet embankment will be constructed across Drainage Feature 1 and 2 upstream of the BVS Pit. Surface water from upstream reaches of these drainage features will enter the diversion inlet works during (and immediately following) seasonal runoff events. The inflowing surface water will be directed to the diversion drain located at the northern end of the inlet works (on Drainage Feature 1). Surface water will flow along the diversion drain to the diversion drain outlet on Drainage Feature 1.

The BVS Pit Drainage Diversion will remain in place after mine closure.

On this basis, construction of the BVS Pit Drainage Diversion will effectively:

- Remove a 0.6 km long reach of Drainage Feature 1 between the diversion inlet works and its confluence with Drainage Feature 2; and
- Replace a 1.8 km long reach of Drainage Feature 1 and 2 with a 2.1 km long drainage channel that exhibits similar characteristics.

Whilst the drainage diversion does not require authorisation under the *Water Act 2000*, the detailed design of the diversion will consider relevant aspects of the Department of Natural Resources, Mines and Energy (DNRME) Guideline: *Works that interfere with water in a watercourse for a resource activity*, in order to replicate aquatic habitat features of the diverted drainage feature reaches, as far as practicable.

8.2.3 ROAD CROSSINGS OF DRAINAGE FEATURES

No watercourse road crossings are required as part of the project.

The project involves the construction of seven new road crossings of drainage features. The road crossing locations are shown in Figure 2 and include:

- One haul road crossing of the BVS Pit Drainage Diversion; and
- Six access road / access track crossings on Drainage Features 1, 2 and 3.

Conceptually, the haul road crossing will include several culverts within an engineered embankment in order to allow unimpeded low flows. The drainage channel bed and banks upstream of the culvert inlets and downstream of the culvert outlets will be constructed with scour protection and an apron to minimise erosion. Any upstream and downstream embankment slopes (i.e. slopes that form the culvert headwall) will be surfaced with rock lining or other suitable material to prevent erosion.

The access road crossings will be rock-fill causeways with low flow culverts.

The section of the roads located on the crossings will be paved with scour resistant material to prevent erosion. The pavement surface specification will be refined during the detailed design process to ensure a suitable scour resistance based upon the design flow velocities for each crossing. During higher flow conditions, excess stormwater will flow over the scour resistant road surface and back into the natural drainage channel on the downstream slope.

Drainage feature 1 is mapped as a moderate risk for fish passage due to waterway barrier works. All other drainage features crossed by mine roads are mapped as low risk from waterway barrier works. The haul road over the BVS Pit drainage diversion and two access roads cross Drainage Feature 1. For these crossings, appropriate mitigation measures for fish passage will be adopted as part of the detailed design and construction of the proposed crossings. State Code 18 outlines best practice engineering solutions, including the addition of baffles, rock chutes and light wells depending on the final design of the crossings and the targeted primary species. These measures will be considered, where appropriate, as part of the detailed design of the culverts. With the inclusion of appropriate fish passage measures, the culverts are predicted to have minimal influence on the resident fish communities inhabiting the site drainage features.

The crossings could potentially alter any aquatic habitats immediately surrounding the proposed crossing locations (i.e. within 10 m upstream and downstream) due to the removal of riparian vegetation and the alteration of the bed habitat. Impacts due to the loss of riparian vegetation are addressed in the EAR Terrestrial Ecology Report. The potential impacts on aquatic habitats are discussed in Section 8.5.1.

8.3 PROJECT EFFECTS ON SURFACE WATER FLOW AND QUALITY

8.3.1 ABSTRACTION OF SURFACE WATER FROM THE WOOLGAR RIVER

The project will require a raw water supply from the Woolgar River offtake.

The effects of surface water take from the Woolgar River offtake on downstream flows are presented in the EAR Surface Water Report. The EAR Surface Water Report indicates that the proposed surface water take is unlikely to result in a significant change in the flow regime of the Woolgar River downstream of the off-take for the following reasons:

- The off-take is temporary and is limited to the relatively short 11 year mine life.
- The operation of the Woolgar River offtake will not change the overall frequency or duration of flows in the Woolgar River (i.e. flows in the Woolgar River are predicted on approximately 12% of all days, under existing conditions and while the offtake is operating).
- Low flow conditions (up to 5 cumecs or 432 ML/day) currently occur on approximately 8.5% of all days (i.e. 70% of the days that the river is flowing). The operation of the Woolgar River offtake will not change the duration, timing, frequency or volume of low flows up to 5 cumecs (i.e. 432 ML/day). This is because the offtake will not operate when the Woolgar River flowrate is 5 cumecs or less.
- For the remaining 30% of days when the river is flowing, the flow rate in the Woolgar River is greater than 5 cumecs. During these flow conditions, the off-take will operate at up to 1.5 cumecs and is predicted to result in a minor reduction in downstream river flows.

- The reduction in flow will increase to a maximum when river flow is at 6.5 cumecs and will then proportionately reduce as the receiving flow increases. The modelled off-take corresponds to approximately 2.9% of the mean annual flow in the Woolgar River at the project site. For the 25th percentile wet year (representative of a wet year with higher river flows) the modelled off-take is 1.9% of the annual flow. For the 75th percentile dry year (representative of a dry year with lower river flows) the modelled off-take is 7.1 % of the annual flow. Given the naturally high variability in the rainfall dependent annual flows in the Woolgar River, these relatively minor reductions in flow are unlikely to be discernible from the natural variability in river flow from year to year.
- River flows above bank full flow engage the floodplain. Bank full flows in the river are conservatively estimated to be in the order of 300 cumecs, and significantly larger than the maximum abstraction rate of 1.5 cumecs. Consequently, the proposed 1.5 cumecs maximum rate of extraction will only represent a 0.5% reduction in bank full flow and hence is unlikely to result in any discernible change to the volume of flood flows or frequency of floodplain engagement in the Woolgar River. Hence, the offtake will not give rise to any changes to the frequency of flooding events along the riparian zone associated with the Woolgar River.

Therefore, it is expected the offtake's flow effects will have negligible influence on the overall aquatic ecology values of the Woolgar River downstream of the offtake.

8.3.2 MINING EFFECTS ON CATCHMENT YIELD

Open cut mining can potentially affect catchment yield by altering the contributing catchment to downstream areas.

The development of the mine and its associated water management system will result in the capture and diversion of runoff. During project operations, this will include runoff from contained catchments in the open cut mine and mine infrastructure area. Post mine closure, runoff to the final void catchments will be retained on site. This will result in a reduction in the total catchment runoff from the project site compared to pre mining conditions.

During mining operations, the maximum contained catchment area is approximately 270 ha. This represents a negligible proportion (approximately 0.25%) of the upstream Woolgar River catchment area.

The final landform will contain open cut pit voids, and rehabilitated WRDs and the TSC. The final landform will be free-draining, with the exception of the final void catchments. The highwall drainage diversions will remain post mining to limit the final void catchment areas. The total final void catchment area will be 170 ha (i.e. 0.13% of the upstream Woolgar River catchment area).

The effects of these activities on surface water flows in downstream drainage features has been addressed in the EAR Surface Water Report. The surface water assessment concluded that runoff from the contained catchment areas during mining and post closure will represent a negligible proportion of the total yield of the Woolgar River catchment at the project site. This negligible change in catchment yield is not expected to have a measurable effect on the natural surface flow regime in watercourses traversing the project site and any change is expected to be indistinguishable within the context of the significant natural year-to-year variations in surface water flow in these creeks.

Overall, no significant catchment yield effects are expected at downstream areas during mining operations and following establishment of the final rehabilitated landform.

8.3.3 SURFACE WATER QUALITY EFFECTS

The mine water management system has been designed to operate as a nil discharge system. This design ensures that there will be no requirement to discharge mine affected water (MAW).

Hence, the potential surface water quality effects of the project are limited to stormwater runoff from disturbed areas (that are not otherwise captured in the mine water management system). Stormwater runoff from disturbed areas typically contains suspended sediments.

The EAR Surface Water Report provides a summary of the site drainage arrangements and an overview of the erosion and sediment control measures that will be adopted.

An Erosion and Sediment Control Plan will be developed prior to commencement of construction to address erosion and the control of suspended sediment in drainage from the project site.

With the application of appropriate controls on runoff from disturbed areas and areas at increased risk of erosion, it is expected that the project will not result in any significant change in turbidity or suspended sediment levels in local surface waters.

8.4 PROJECT EFFECTS ON BIOSECURITY

Several invasive species, and cattle, with the potential to impact native aquatic flora and fauna communities already inhabit the area, including feral pigs, feral dogs, feral cats and cane toads. There is currently no management of invasive species within the study area. Feral animal management is proposed to be undertaken within the project site. It is therefore expected that impacts of feral animals will be controlled as a result of the project, particularly in local ecosystems along the Woolgar River and its associated drainage features.

8.5 IMPACT ASSESSMENT

8.5.1 AQUATIC HABITATS, FLORA AND FAUNA

8.5.1.1 WOOLGAR RIVER

The only predicted impacts on the Woolgar River aquatic habitat relate to the construction of the Woolgar River offtake.

As discussed in Section 8.2.1, approximately 0.25 ha will be disturbed during construction of the offtake for the sump, pump suction pipes and access ramp. The disturbance area will occur along approximately 105 m of the river. The majority of this distance is for the construction of the access ramp. Section 7.2 explains that the riverbank in this area is a slightly disturbed aquatic ecosystem. The offtake construction will therefore directly impact approximately 0.25 ha of slightly disturbed aquatic habitat. The impacted area does not provide habitat for any listed or threatened aquatic species.

On completion of mining, the offtake will be removed, the off-channel sump will be backfilled to reinstate the pre-mining riverbank surface and the disturbed areas will be rehabilitated. It is expected that aquatic flora will become established on the rehabilitated riverbank. Hence, there is not expected to be a significant residual impact on the aquatic habitats, flora or fauna present in the Woolgar River following decommissioning of the offtake and rehabilitation of the offtake disturbance area.

During mining operations, there is potential for a small pool in the offtake sump to persist a short time following cessation of flows in the river channel. However, as discussed in Section 6.2, this type of habitat is naturally occurring throughout the Woolgar River channel. Hence, the intermittent presence of pooled water in the offtake sump is not expected to have a significant impact on aquatic flora or fauna within the river.

Based on this assessment, the construction and operation of the offtake point is not expected to have a significant residual impact on the aquatic habitats, flora or fauna present in the Woolgar River.

8.5.1.2 LOCAL DRAINAGE FEATURES

The predicted impacts on aquatic habitats and aquatic flora and fauna communities in the local drainage features relate to the construction of the road crossings and the BVS Pit drainage diversion.

Construction of the road crossings will alter the aquatic habitats at, and immediately surrounding, the proposed crossing locations (generally within 10 m upstream and downstream). However, the drainage features at the road crossing locations exhibit extensive shifting, sandy substrates, with no significant stable, complex aquatic habitat features (such as pools, undercut banks, riffles, etc.). Mitigation measures must be adopted during the construction phase to ensure the disturbance area does not expand past the proposed 10 m boundary thereby limiting potential of any significant impacts on the adjacent aquatic habitats, this includes:

- Designing each crossing to allow unimpeded flows;
- Installing bank and bed armouring, where necessary (i.e. dependent on engineering designs); and
- Operating in accordance with an Erosion and Sediment Control Plan.

The haul road crossing is proposed over the BVS Pit drainage diversion and therefore the construction of the haul road crossing will not cause any significant aquatic habitat impacts in addition to those incurred by the diversion drain.

The BVS Pit diversion drain will be approximately 2.1 km long and designed to allow unimpeded flows through the system. The installation of the BVS Pit drainage diversion will result in approximately 1.8 km of channel associated with Drainage Features 1 and 2 being removed. There are no listed aquatic MNES or MSES fauna and flora within these drainage features and therefore the BVS Pit drainage diversion will not adversely impact aquatic MNES or MSES fauna and flora.

As well as direct habitat loss, the construction and operation of the diversion has the potential to influence habitats within the length, and immediately downstream of, the diversion drain through increasing flow velocities as well as erosion and sedimentation processes, while also providing little stable habitat for aquatic flora and fauna. However, these potential impacts will be minimised by adopting similar mitigation measures to those proposed for the crossings above, including:

- Designing the diversion drain in accordance with current best practice standards, where feasible;
- Installing bank and bed armouring, where necessary (i.e. dependent on engineering designs), including, where possible, promoting riparian vegetation growth/rehabilitation; and
- Operating in accordance with an Erosion and Sediment Control Plan.

These measures will limit the potential of any significant impacts from the proposed BVS Pit drainage diversion.

Impacts to fish passage from the crossings of Drainage Feature 1 will be minimised through the consideration of appropriate mitigation measures from best practice guidelines, during detailed design. With appropriate mitigation measures in place, the Drainage Feature 1 crossings are not expected to have a significant impact on fish passage.

8.5.1.3 FARM DAMS

The farm dams will not be disturbed by the project activities and the project is not predicted to significantly affect the volume or flow of surface water into the dams. Hence, the project is not expected to have a significant impact on the aquatic habitats, flora or fauna present in the farm dams.

8.5.2 WEEDS AND FERAL ANIMALS

Several invasive species with the potential to impact native aquatic flora and fauna communities already inhabit the study area, including feral pigs, feral dogs, feral cats, cane toads and cattle. The presence of invasive species across the project site will be effectively managed through the adoption of a weed and feral animal management plan. This will manage invasive species within an area that they currently freely inhabit with no management in place.

No aquatic pest species were observed inhabiting the project site. The potential for invasive aquatic pest species to be spread to the project site or downstream aquatic habitats is not increased by the development of the project given the development and implementation of a weed and feral animal management plan.

8.5.3 THREATENED AND MIGRATORY SPECIES

No listed threatened or migratory aquatic species were identified inhabiting the aquatic habitats within the study area. Therefore, the project is not predicted to have a significant impact on any listed threatened or migratory species.

8.5.4 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE

Table 12 provides a summary of the MSES within the aquatic ecology study area and assesses their status against the significant residual impact criteria as detailed within the *Significant Residual Impact Guideline* (DEHP, 2014). It concludes that the project is not expected to have any significant impact to any aquatic MSES.

Table 12: Assessment of potential impacts to MSES

MSES	Presence	Assessment of Significant Residual Impacts*	
		Significant Residual Impact Criteria	Potential Impacts
Aquatic habitat mapped as essential habitat for protected wildlife	No essential habitat is mapped within the project site.	N/A	N/A
WPA or HES wetlands shown on the <i>Map of Referable Wetlands</i>	No HES wetlands or associated WPAs are mapped within the project site.	N/A	N/A
A wetland or watercourse designated as HEV waters	Government mapping does not show any HEV waters within the aquatic ecology study area and historical and ongoing anthropogenic disturbances in the study area and wider Woolgar River catchment area show that waters are disturbed and therefore not HEV waters.	N/A	N/A
Protected wildlife habitat, including habitat for <i>Endangered, Vulnerable or Special Least Concern</i> species	No protected species (under the NC Act) are present or potentially present within the aquatic ecology study area (refer to Appendix 4).	N/A	N/A
Fish habitat areas declared under the Fisheries Act 1994	None present (refer to Appendix 4).	N/A	N/A
Waterway providing for fish passage	Drainage Feature 1 (moderate risk)	Result in the mortality or injury of fish.	Impacts on fish passage from the construction of road crossings of Drainage Feature 1 will be mitigated by the

MSES	Presence	Assessment of Significant Residual Impacts*	
		Significant Residual Impact Criteria	Potential Impacts
		Result in conditions that substantially increase risks to the health, wellbeing and productivity of fish seeking passage.	inclusion of appropriate measures for fish passage in the detailed road crossing design. Consequently, no significant impacts on fish passage are predicted. The construction of road crossings on drainage features is not predicted to have a significant impact on fish passage as the construction process can be undertaken during dry periods.
		Reduce the extent, frequency or duration of fish passage previously found at a site.	
		Substantially modify, destroy or fragment areas of fish habitat necessary for the breeding and/or survival of fish.	
		Result in a substantial and measurable change in the hydrological regime of the waterway.	
		Lead to significant changes in water quality parameters that provide cues for movement in local fish species.	

*Significant residual impact criteria for all discussed MSES are detailed within the *Significant Residual Impact Guideline* (DEHP, 2014).



8.5.5 CUMULATIVE IMPACTS

There are no approved resource projects in the vicinity of the project site that could potentially contribute to cumulative impacts on aquatic ecology with the project.

9. CONCLUSION

The aquatic ecology baseline assessment was composed of two major sections:

- A literature review that determined the relevant legislation, guidelines, policies and regulations pertinent to mine development and operations, as well as clarifying the regional setting and existing background aquatic values for the area; and
- A detailed survey of aquatic habitats, water quality, sediment quality and flora inhabiting all surface aquatic environments – as well as fauna within both surface water and groundwater systems.

The project site is located in the Flinders River sub-basin within the North West Regional Plan area. Several ephemeral freshwater streams are associated with the site. The main watercourse is Woolgar River, which flows into the Flinders River well downstream of the project site.

The entire region has been grazed and historical gold mining operations are well documented within the local 'Woolgar' area. The impacts associated with these anthropogenic disturbances are observed throughout the watercourses, with elevated sediment and nutrient loads recorded during the survey. Water quality results suggest eutrophication may be taking place within some of the remnant pools sampled.

Habitat condition across the project site was generally moderate. Sediment quality results found most samples to be compliant with guideline values. However, lead was elevated throughout the region. The elevated lead results are expected to be a result of the natural weathering processes of the local geology. Particle size distribution transitioned within each watercourse, with all drainage features predominantly composed of sand and gravel. Finer sediments were generally dominant in the constructed in-channel farm dams. The coarser substrates (particularly gravel and cobble) are generally considered more structurally complex, promoting greater diversity of macroinvertebrate assemblages utilising the system.

The study identified relatively depauperate aquatic fauna and flora assemblages within the local watercourses, although most communities appeared in good condition. Thirty-seven (37) macroinvertebrate species were identified inhabiting the project site, including a species of macro-decapoda. Four (4) species of native freshwater fish, one (1) species of aquatic reptile and twelve (12) species of aquatic flora were also found during the field assessment. None of the species or communities found inhabiting the surface waters of the project site are listed. No stygofauna were recorded within the various aquifers noted on site.

An impact assessment undertaken for the project identified the key potential hazards posed to the receiving aquatic ecosystems from the activities associated with the project during construction, operation and closure. Potential key hazards include:

- Physical disturbance of aquatic ecosystems due to the construction of the Woolgar River pump station and the construction of road crossings on Southern Creek and Middle Creek;
- The take of water from the Woolgar River;
- The potential for project activities to introduce or spread weeds and feral animals;
- The construction of waterway barriers; and
- Cumulative effects.

The risks, to the identified aquatic ecology values, from these hazards has been appropriately mitigated within the design phase of the project through the adoption of current best-practice measures, where necessary.

Based on this assessment, the key conclusions of the aquatic ecology assessment are as follows:



- no significant or high value aquatic habitats are present within the project site or downstream creeks;
- no listed or threatened aquatic flora or fauna species are present within the project site or downstream creeks;
- the project will not impact aquatic habitats, flora or fauna because:
 - the project's disturbance footprint is largely confined to areas outside the Woolgar River and its tributaries;
 - the project activities are not expected to give rise to significant effects on the groundwater regime or the local surface water setting;
 - appropriate measures will be implemented to mitigate erosion and sedimentation and maintain fish passage, as necessary.

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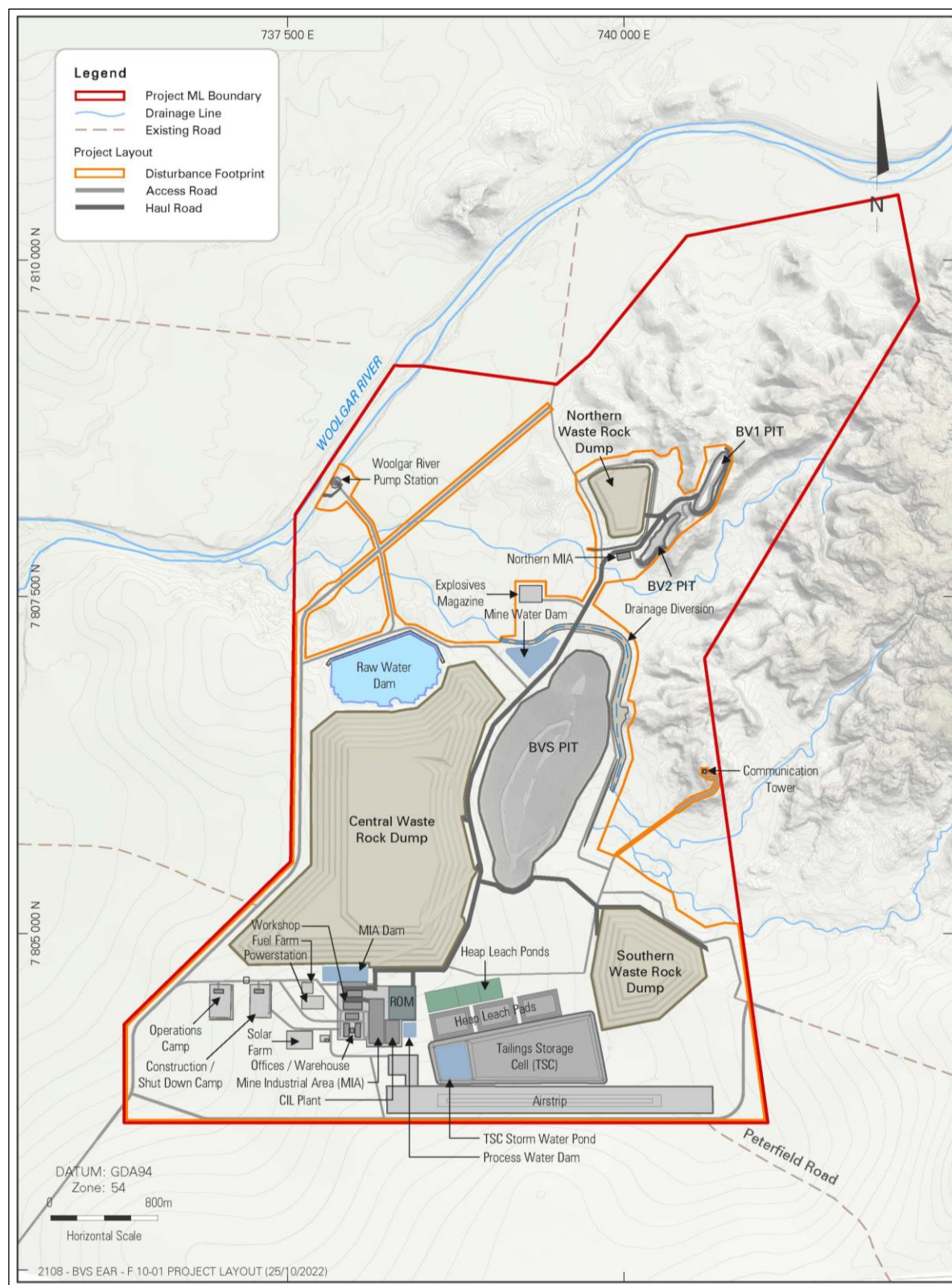
CLIENT: STRATEGIC MINERALS CORPORATION PTY LTD
PROJECT: BIG VEIN SOUTH GOLD PROJECT
REPORT: AQUATIC ECOLOGY ASSESSMENT
DATE: NOVEMBER 2022



FIGURES



Figure 1: Project site location, Queensland (figure provided by HEC).



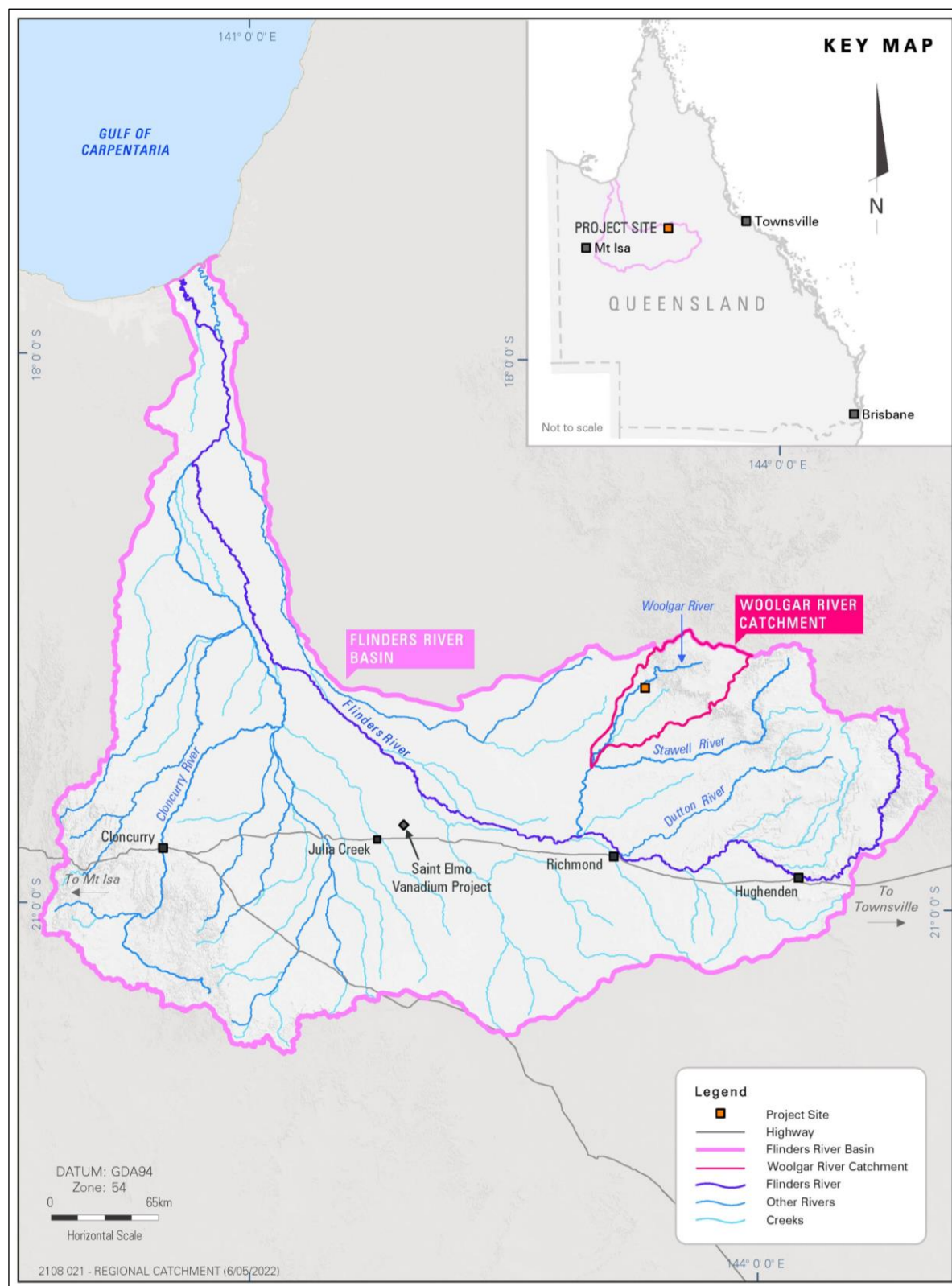


Figure 3: Regional catchment setting (figure provided by HEC).

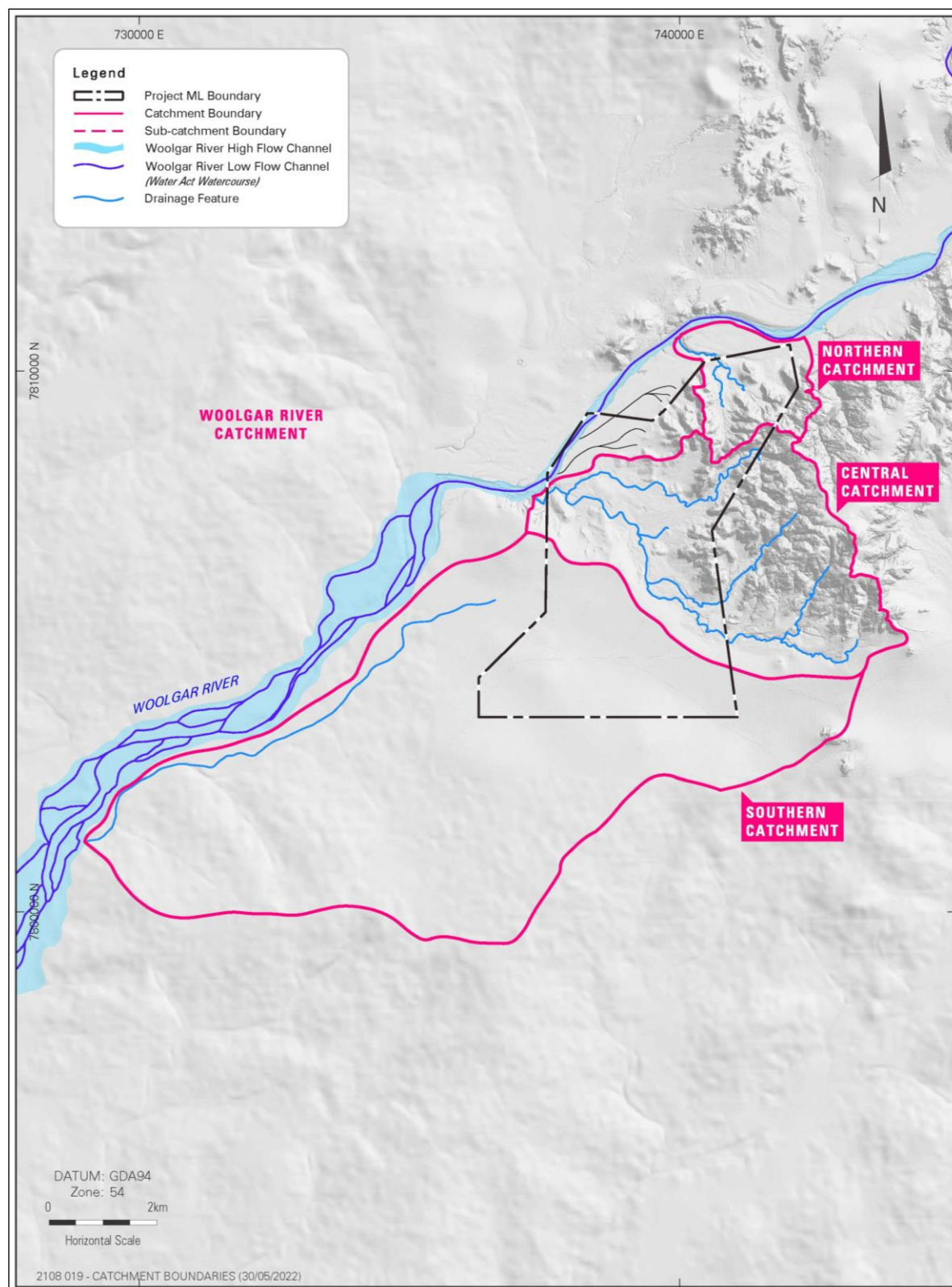


Figure 4: Local catchment setting (figure provided by HEC).

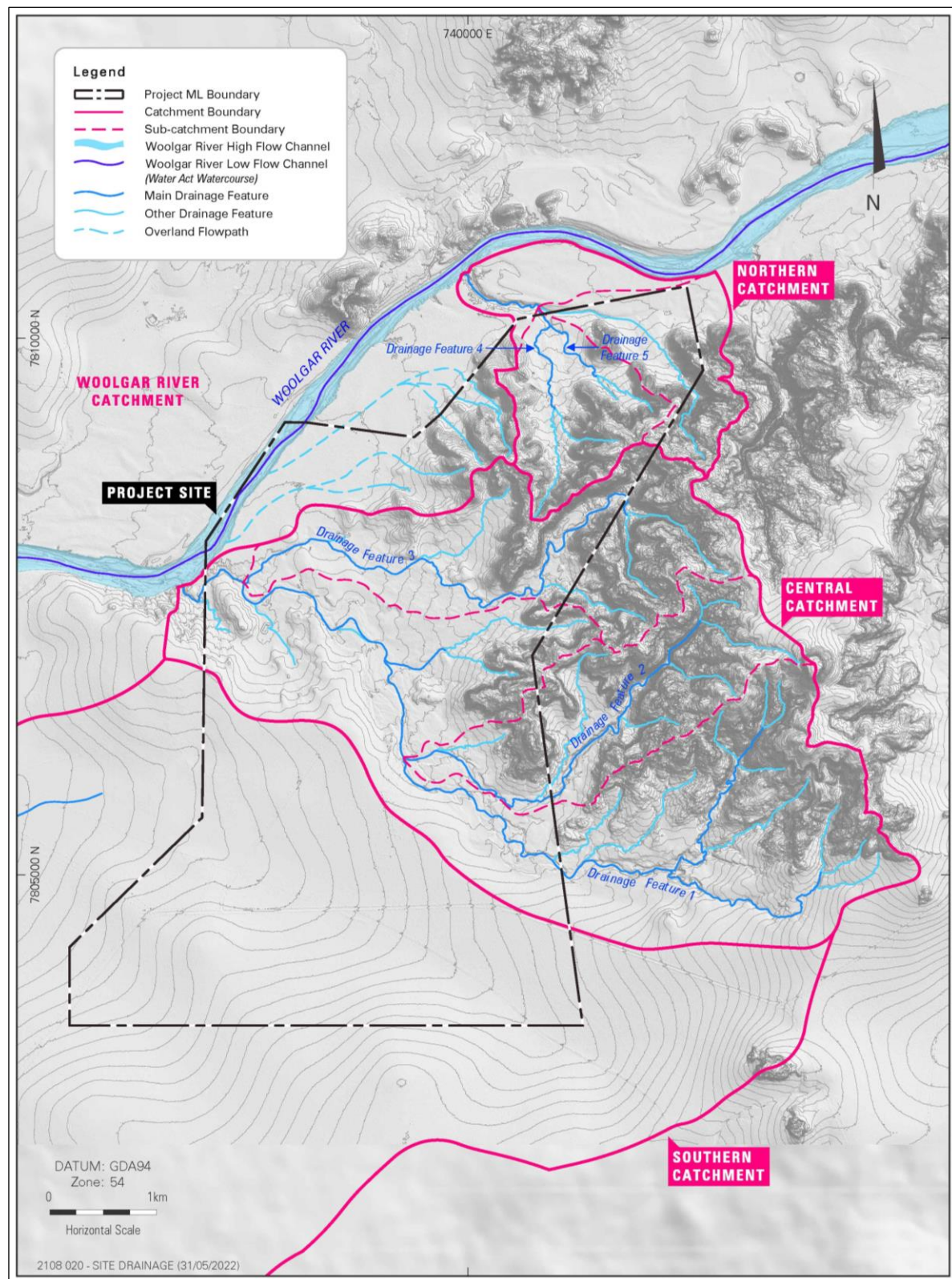


Figure 5: Site drainage plan (figure provided by HEC).

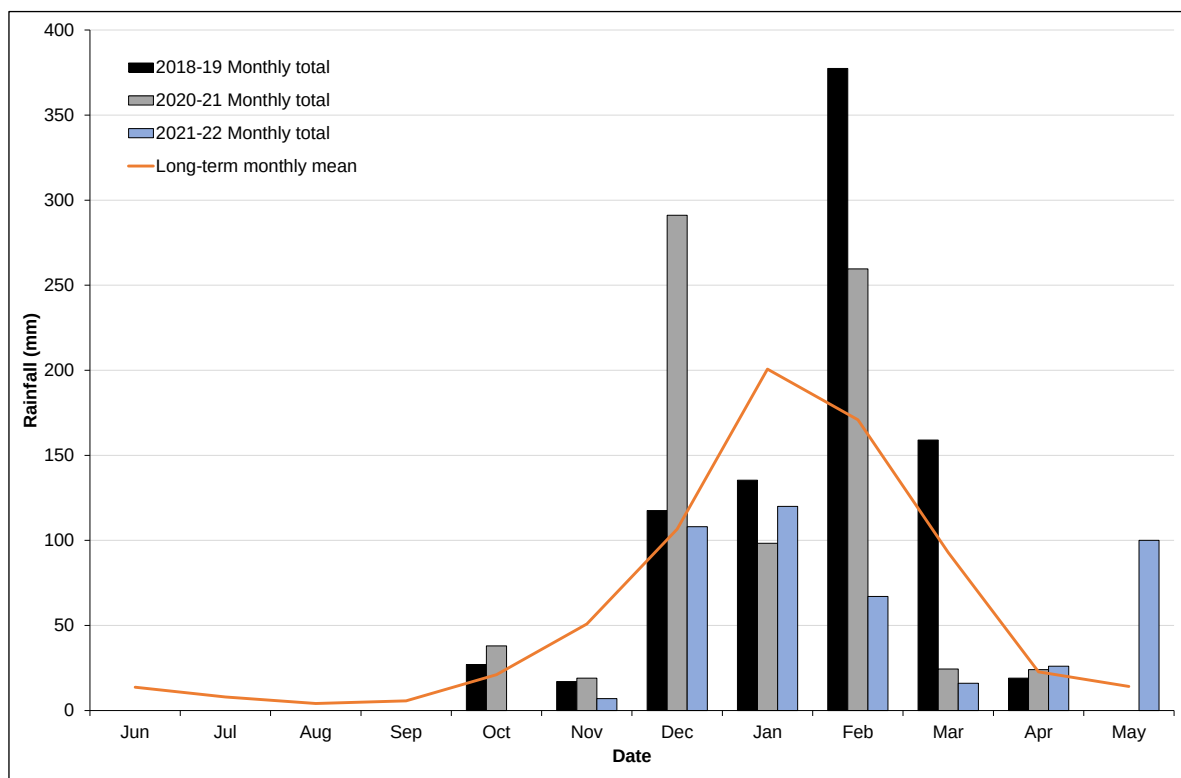


Figure 6: 2019-2018, 2020-2021 and 2021-2022 monthly rainfall totals compared against long term means (at Gilberton Station #30019; BOM, 2022)

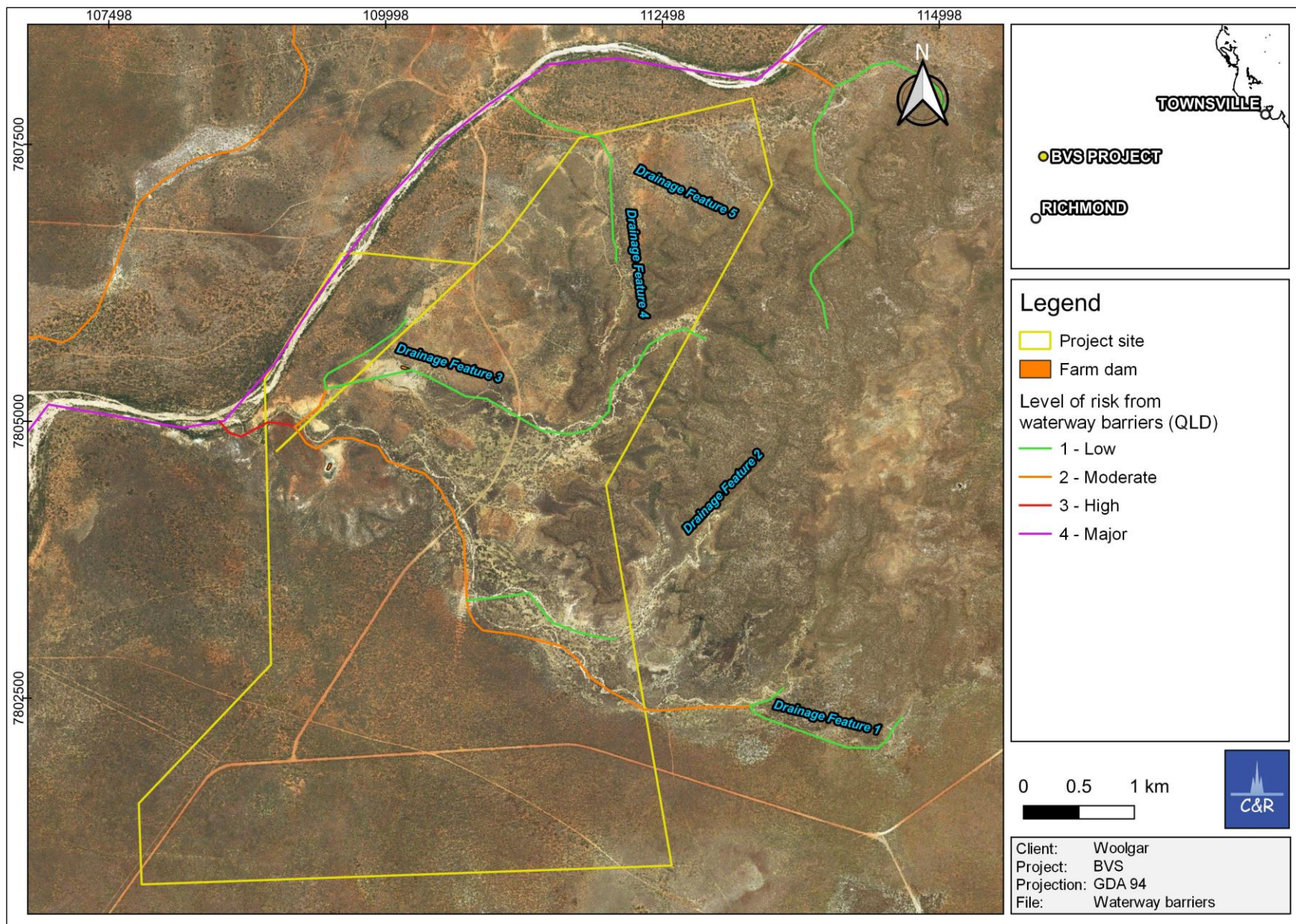


Figure 7: Waterway barrier works mapping developed by the Department of Agriculture and Fisheries

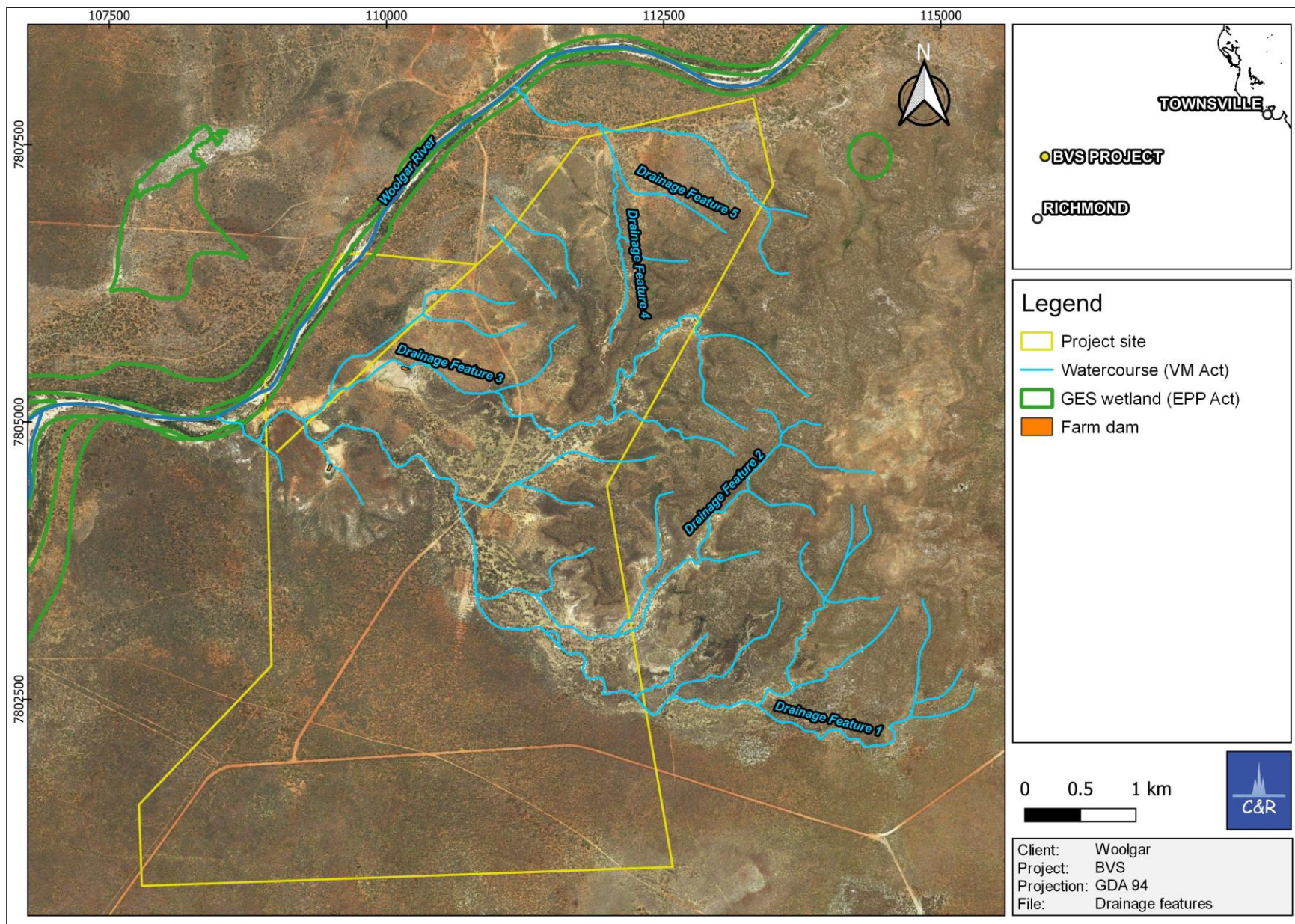


Figure 8: VM Act watercourse and General Ecological Significance wetland mapping.

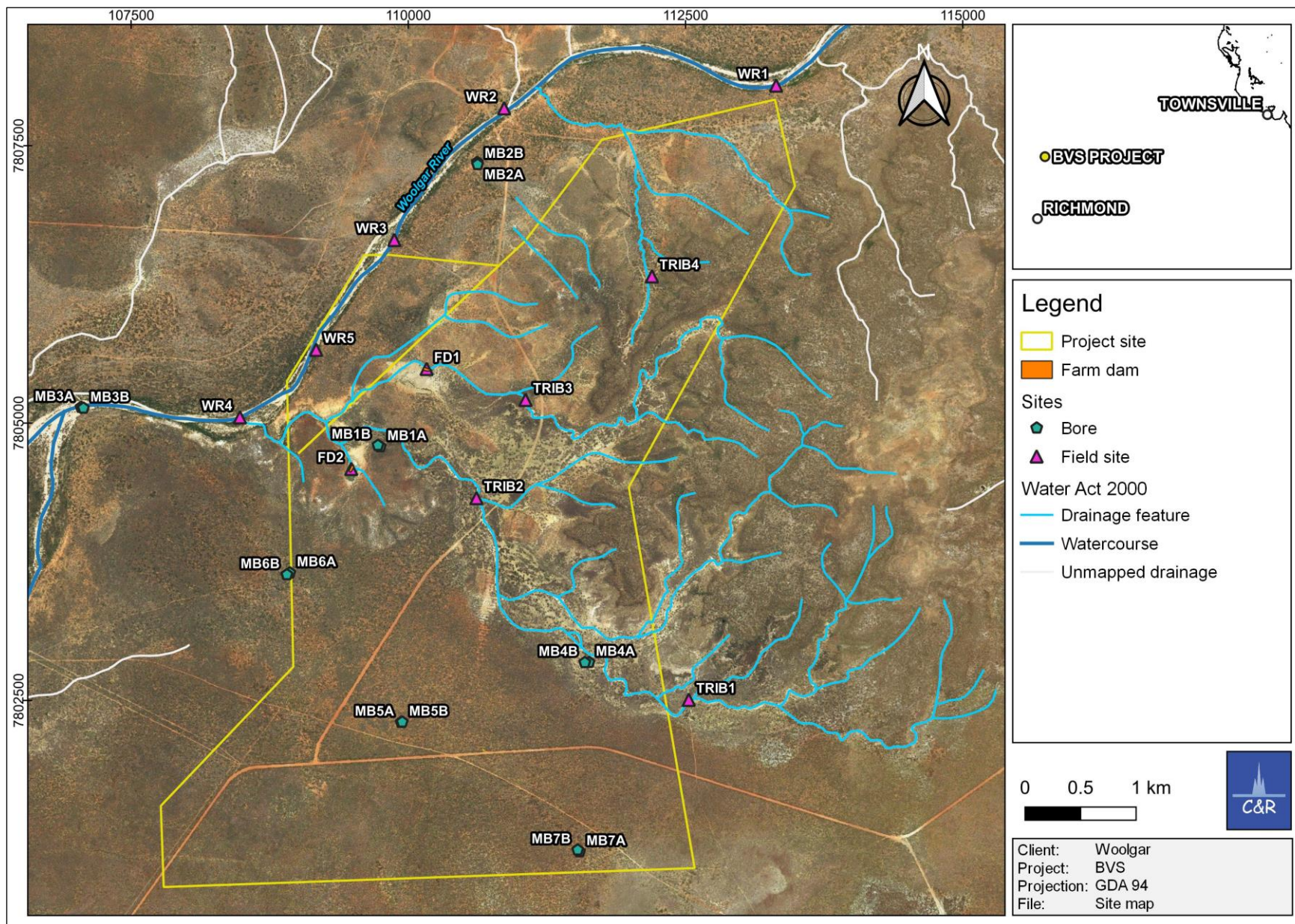


Figure 9: Site map

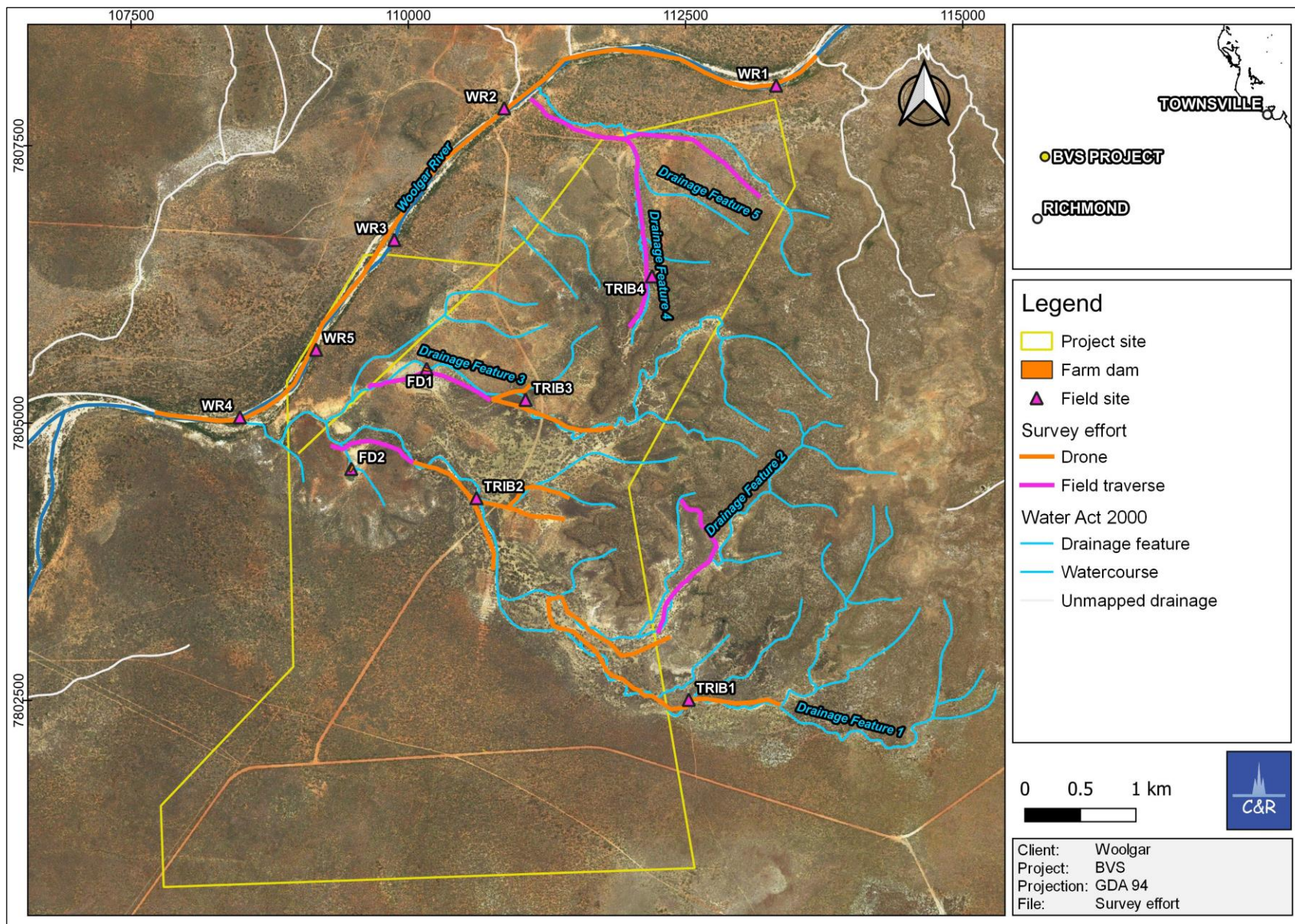


Figure 10: Drone survey and ground truthing undertaken across the site



Figure 11: Algal blooms, potentially cyanobacteria, observed along the edge of FD1 within livestock hoof prints

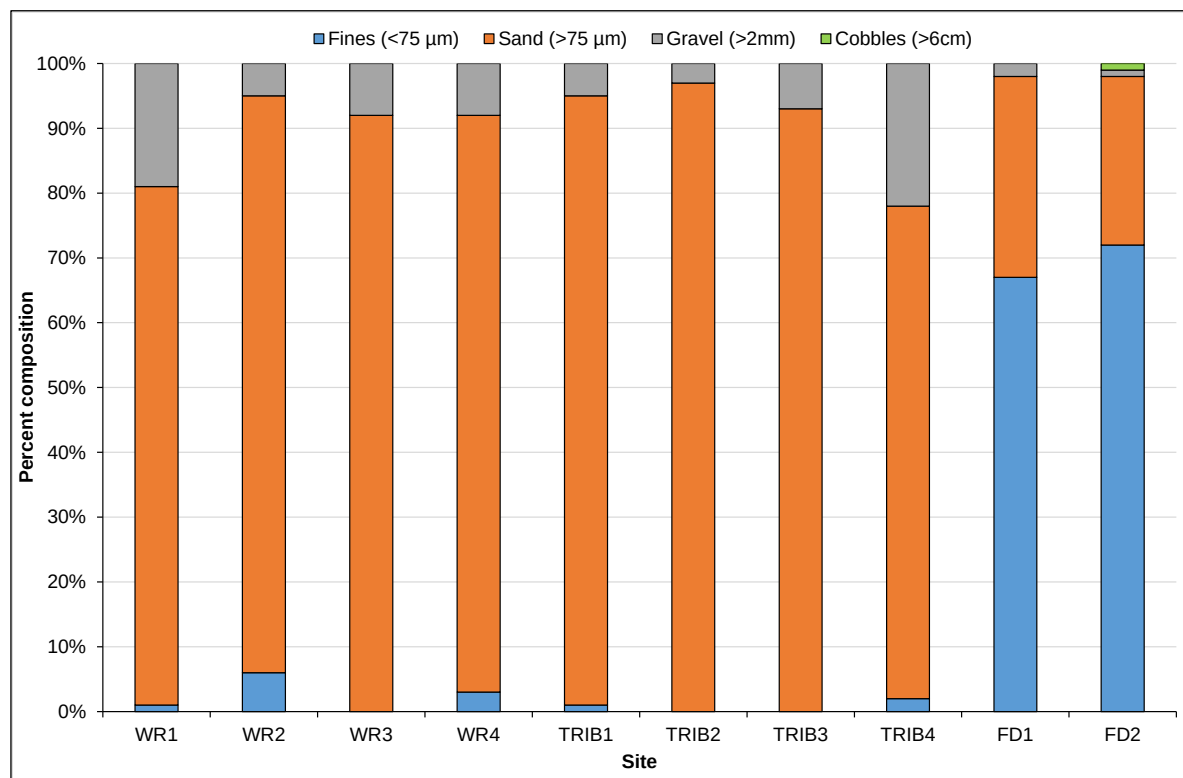


Figure 12: Particle size composition of sediment at each site.

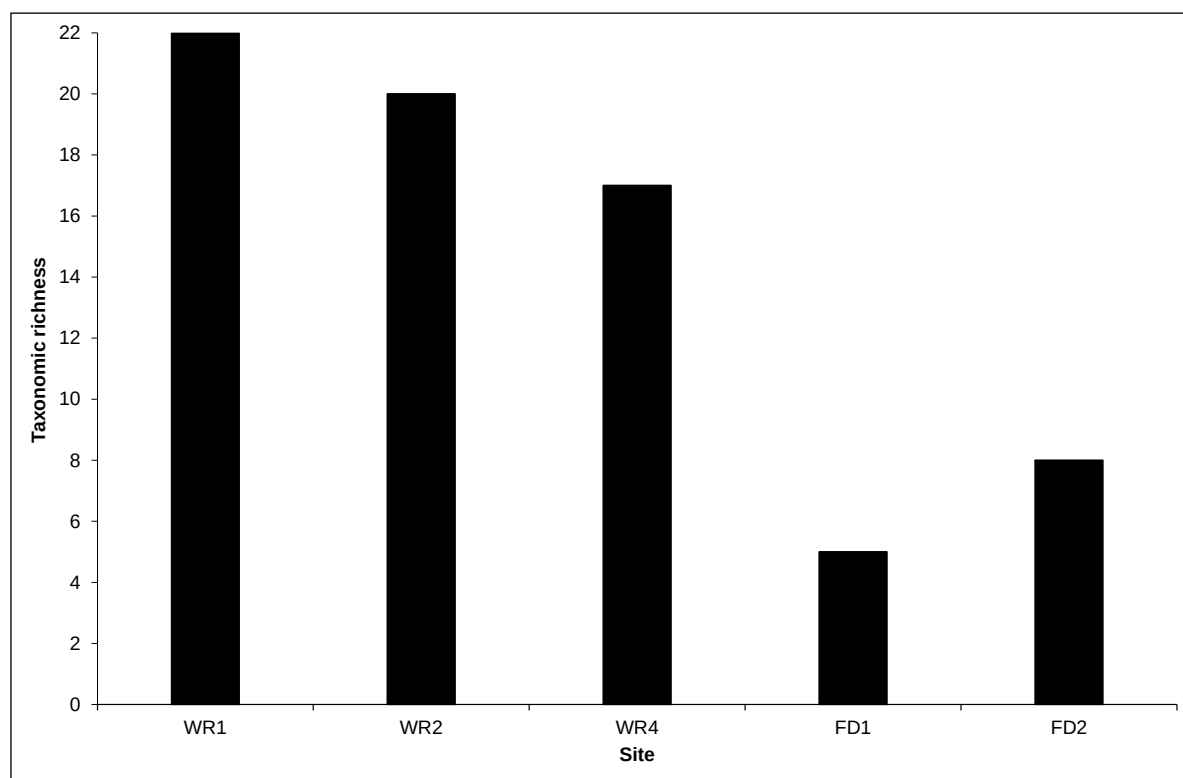


Figure 13: Macroinvertebrate taxonomic richness at each site.

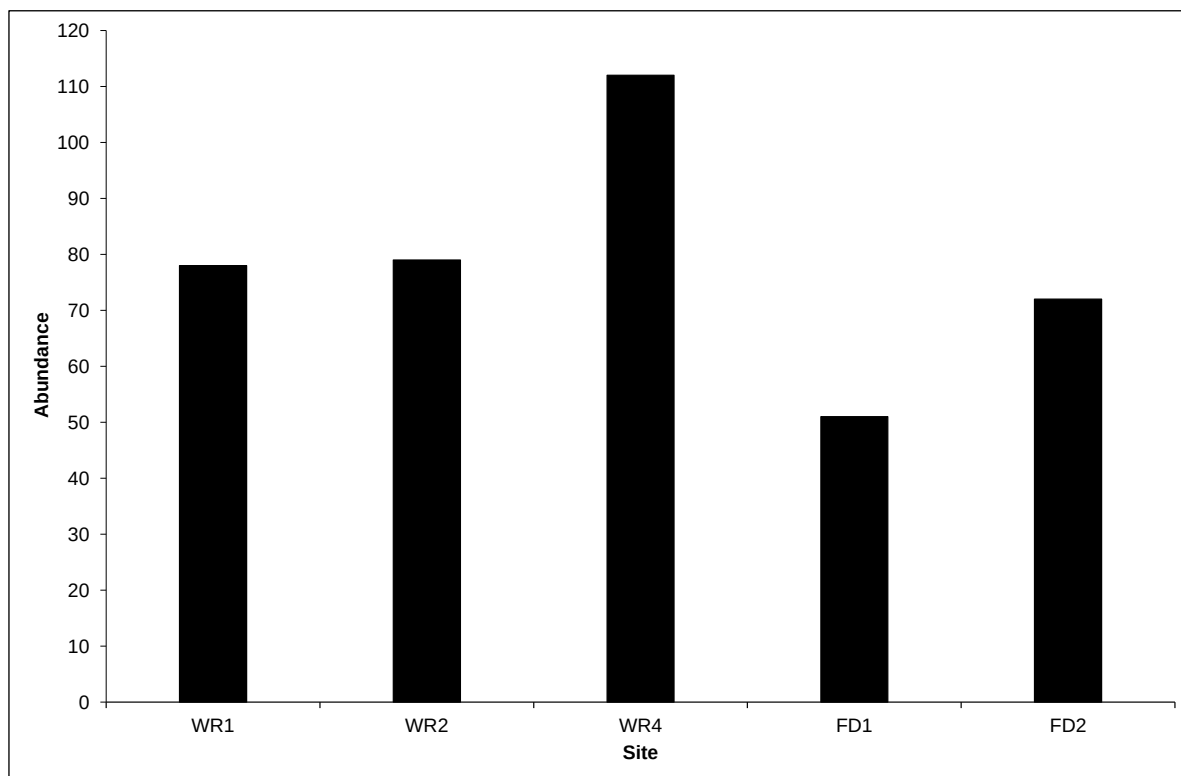


Figure 14: Macroinvertebrate abundance at each site.

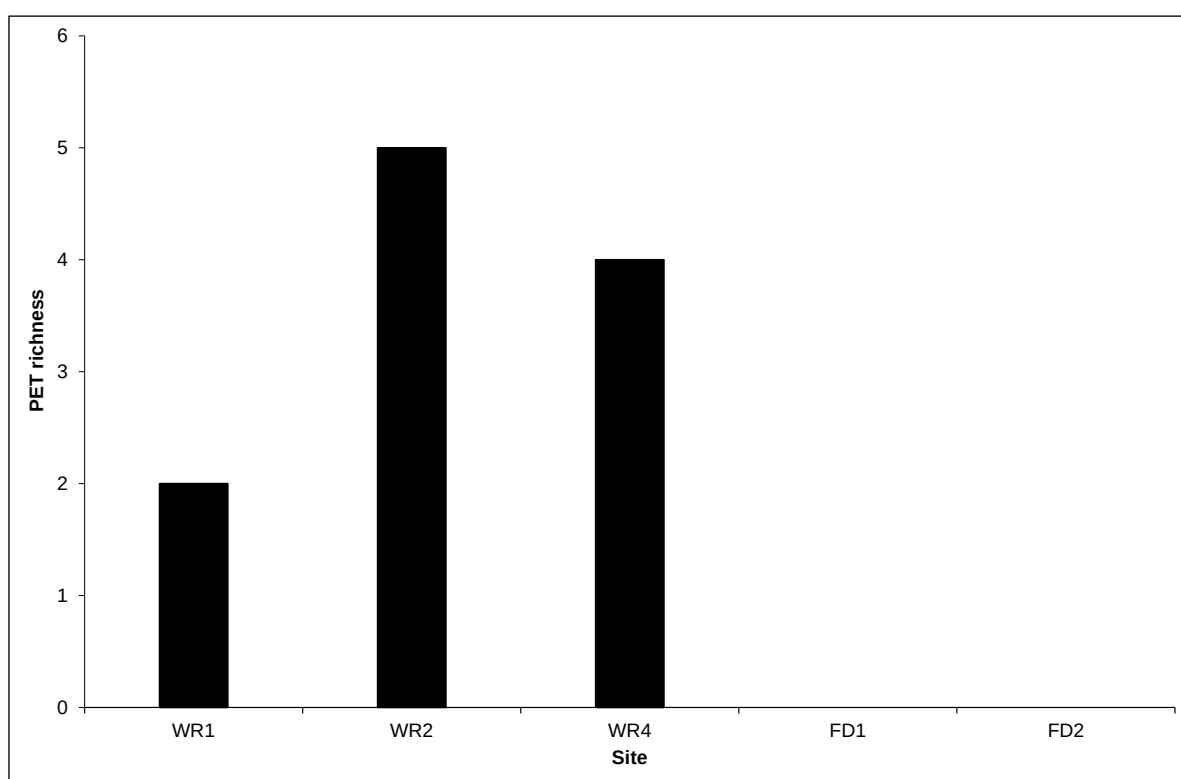


Figure 15: PET richness recorded within the edge habitat.

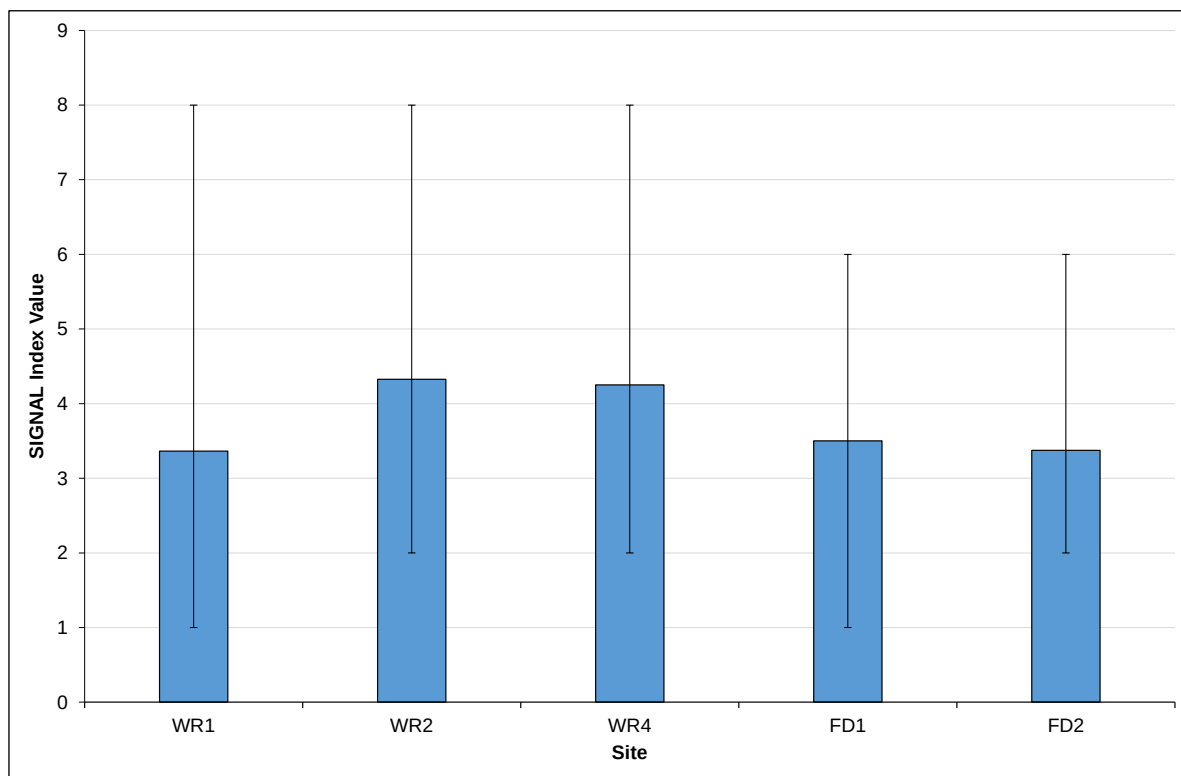


Figure 16: SIGNAL Index Values at each site with bars displaying the maximum and minimum SIGNAL score of any Family recorded.

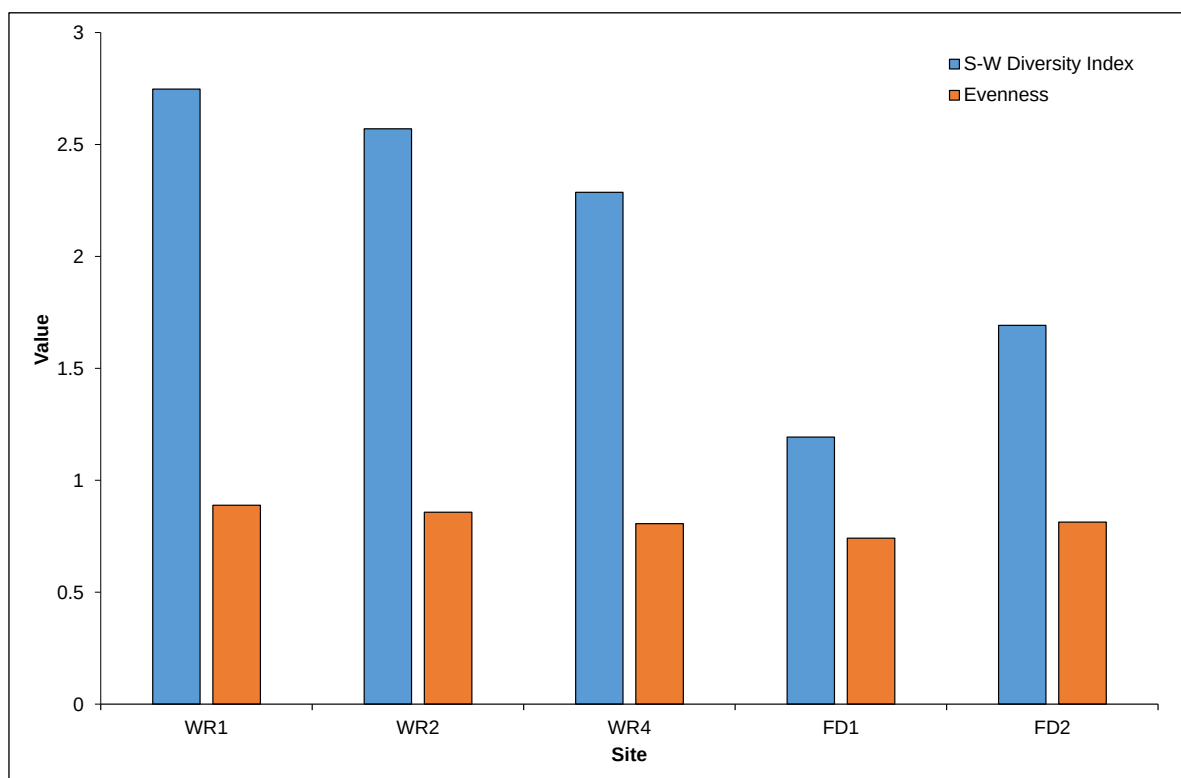


Figure 17: Shannon-Weiner Diversity Index and Evenness at each site

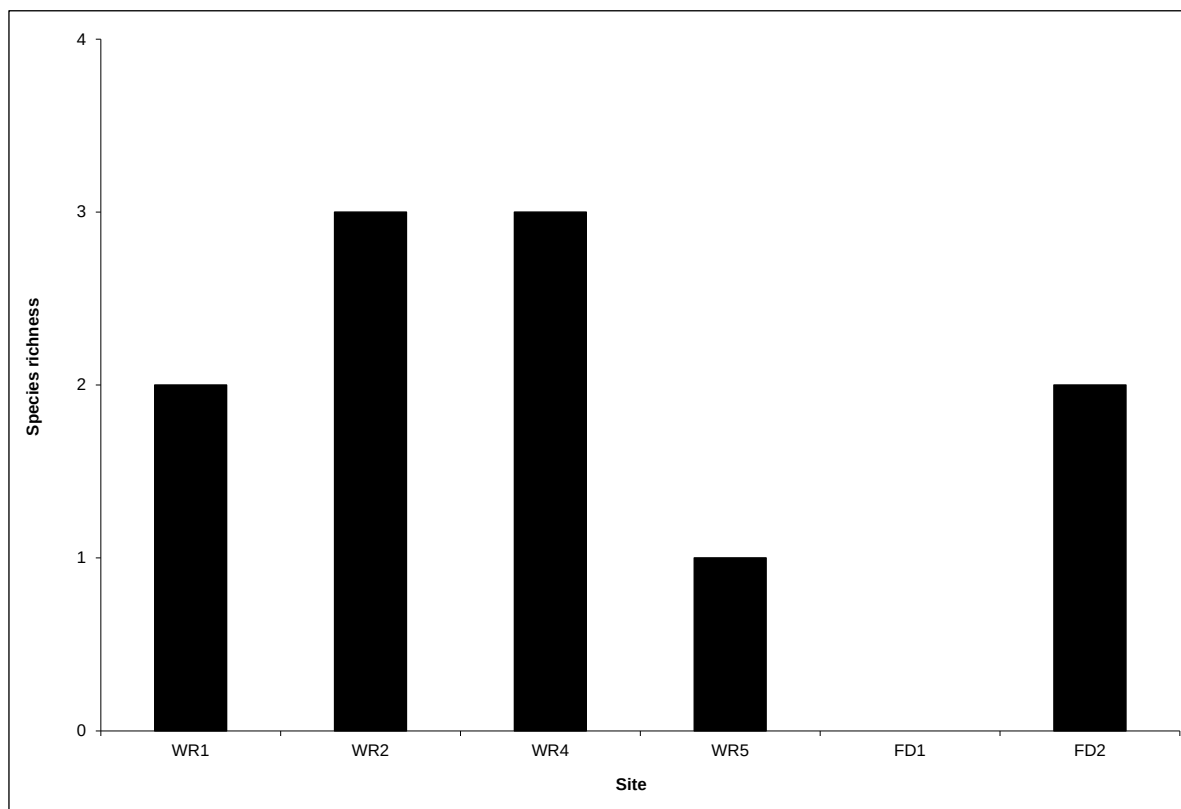


Figure 18: Taxonomic richness of fish communities present at each site.

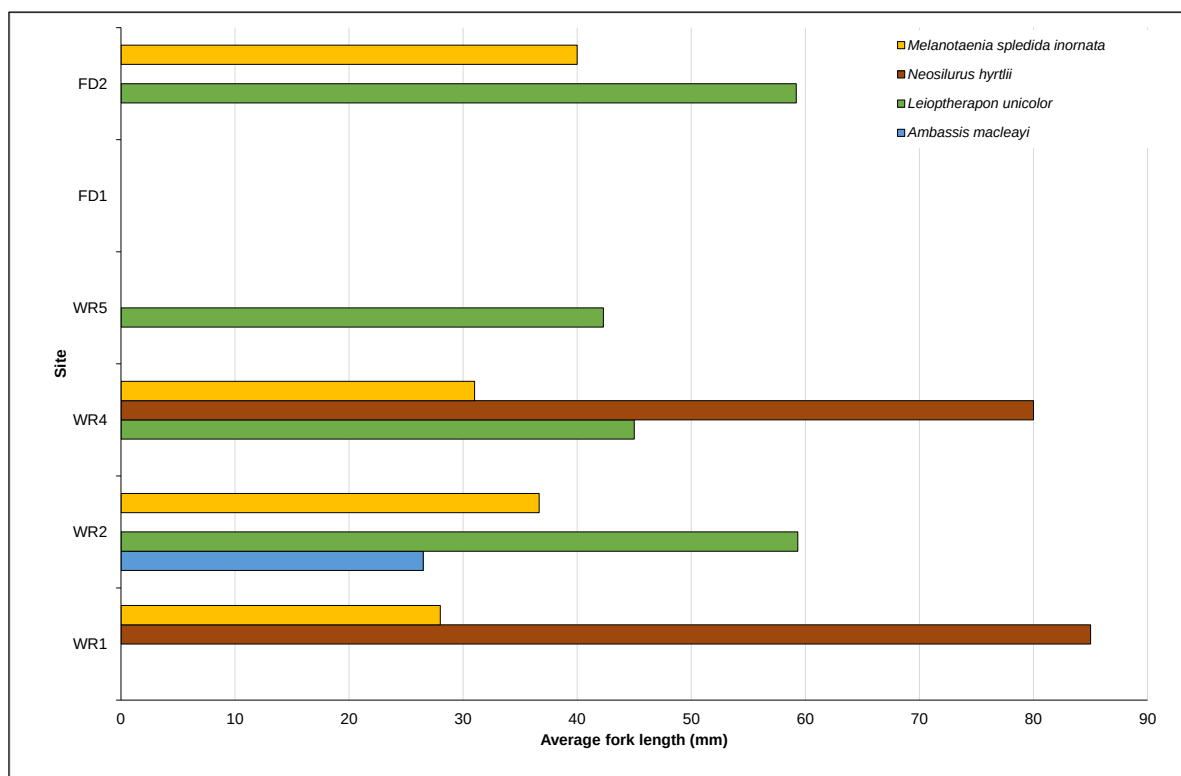


Figure 19: Average fork length of each species collected at each site.



APPENDIX 1 – FIELD SURVEY WATER QUALITY RESULTS

Table A1.1: Water quality characteristics at each sampled site compared to published default guideline values

Table A12-1: Water quality characteristics at each sampled site compared to published default guideline values										
Quality Characteristic	Units	LOR	WR1	WR2	WR4	WR5	FD1	FD2	Default Guideline Value	
pH Value	pH Unit	0.01	6.85	7.45	7.08	7.17	7.21	6.85	6.0-7.5 ¹	
Dissolved oxygen	%Sat	0.01	50.5	80.1	67	89.4	20.2	89.1	85 – 110	
Sodium Adsorption Ratio		0.01	1.76	1.24	1.28	-	0.60	0.17	NA	
Electrical Conductivity @ 25°C	µS/cm	1	277	267	218	132	231	78	250	
Total Dissolved Solids (Calc.)	mg/L	1	180	174	142	-	150	51	4000	
Suspended Solids (SS)	mg/L	5	<5	<5	14	-	155	55	NA	
Turbidity	NTU	0.1	2.8	1.7	7.9	2.8	1690	40.4	15	
Total Hardness as CaCO3	mg/L	1	59	70	56	-	53	27	NA	
Hydroxide Alkalinity as CaCO3	mg/L	1	<1	<1	<1	-	<1	<1	NA	
Carbonate Alkalinity as CaCO3	mg/L	1	<1	<1	<1	-	<1	<1	NA	
Bicarbonate Alkalinity as CaCO3	mg/L	1	77	79	67	-	99	32	NA	
Total Alkalinity as CaCO3	mg/L	1	77	79	67	-	99	32	NA	
Major Ions										
Sulfate as SO4 - Turbidimetric	mg/L	1	9	7	5	-	<1	<1	1000	
Chloride	mg/L	1	29	28	24	-	12	5	NA	
Calcium	mg/L	1	12	15	11	-	13	6	1000	
Magnesium	mg/L	1	7	8	7	-	5	3	NA	
Sodium	mg/L	1	31	24	22	-	10	2	NA	
Potassium	mg/L	1	4	5	4	-	25	5	NA	
Fluoride	mg/L	0.1	0.1	0.2	0.1	-	0.2	<0.1	2	
Dissolved Metals									95%ile	99%ile
Aluminium	mg/L	0.01	<0.01	<0.01	0.01	-	0.07	0.09	0.055	0.027
Arsenic	mg/L	0.001	0.001	<0.001	0.001	-	0.004	<0.001	0.013	0.001

Quality Characteristic	Units	LOR	WR1	WR2	WR4	WR5	FD1	FD2	Default Guideline Value	
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	0.0002	0.00006
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	0.001	0.00001
Cobalt	mg/L	0.001	0.003	<0.001	0.001	-	0.004	<0.001	NA	NA
Copper	mg/L	0.001	<0.001	<0.001	<0.001	-	<u>0.004</u>	<u>0.002</u>	0.0014	0.001
Lead	mg/L	0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	0.0034	0.001
Manganese	mg/L	0.001	0.873	0.299	0.310	-	<u>1.21</u>	0.161	1.9	1.2
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	0.0006	0.00006
Molybdenum	mg/L	0.001	0.001	<0.001	<0.001	-	0.006	<0.001	NA	NA
Nickel	mg/L	0.001	0.004	0.001	<0.001	-	0.005	0.002	0.011	0.008
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	0.011	0.005
Silver	mg/L	0.001	<0.001	<0.001	<0.001	-	<0.001	<0.001	0.00005	0.00002
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	-	0.001	<0.001	NA	NA
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	NA	NA
Zinc	mg/L	0.005	<u>0.005</u>	<0.005	<0.005	-	<0.005	<0.005	0.008	0.0024
Boron	mg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	0.37	0.09
Iron	mg/L	0.05	0.53	0.12	0.16	-	0.13	0.17	NA	NA
Total Metals										
Aluminium	mg/L	0.01	0.01	0.03	0.34	-	34.2	0.60	5	
Arsenic	mg/L	0.001	0.002	<0.001	0.002	-	0.018	0.002	0.5	
Cadmium	mg/L	0.0001	<0.0001	<0.0001	<0.0001	-	0.0001	<0.0001	0.01	
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	-	0.045	<0.001	1	
Cobalt	mg/L	0.001	0.003	<0.001	0.001	-	0.042	0.003	1	
Copper	mg/L	0.001	<0.001	<0.001	0.001	-	0.052	0.004	1	
Lead	mg/L	0.001	0.005	<0.001	<0.001	-	0.097	0.002	0.1	

Quality Characteristic	Units	LOR	WR1	WR2	WR4	WR5	FD1	FD2	Default Guideline Value	
Manganese	mg/L	0.001	1.02	0.310	0.338	-	3.38	0.411	NA	
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001	-	<0.0001	<0.0001	0.002	
Molybdenum	mg/L	0.001	0.001	<0.001	<0.001	-	0.004	<0.001	0.15	
Nickel	mg/L	0.001	0.001	0.001	0.002	-	0.037	0.002	1	
Selenium	mg/L	0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	0.02	
Silver	mg/L	0.001	0.002	<0.001	<0.001	-	<0.001	<0.001	NA	
Uranium	mg/L	0.001	<0.001	<0.001	<0.001	-	0.005	<0.001	0.2	
Vanadium	mg/L	0.01	<0.01	<0.01	<0.01	-	0.11	<0.01	NA	
Zinc	mg/L	0.005	0.008	<0.005	<0.005	-	0.204	0.005	20	
Boron	mg/L	0.05	<0.05	<0.05	<0.05	-	0.05	<0.05	5	
Iron	mg/L	0.05	1.25	0.30	1.14	-	81.8	3.17	NA	
Nutrients										
Ammonia as N	mg/L	0.01	0.09	0.08	1.37	-	1.78	0.07	0.9	0.32
Nitrite as N	mg/L	0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	30	
Nitrate as N	mg/L	0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	0.7; 400	0.017
Nitrite + Nitrate as N	mg/L	0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	NA	
Total Kjeldahl Nitrogen as N	mg/L	0.1	0.2	0.2	1.3	-	5.9	2.6	NA	
Total Nitrogen as N	mg/L	0.1	0.2	0.2	1.3	-	5.9	2.6	0.15	
Total Phosphorus as P	mg/L	0.01	<0.01	<0.01	0.02	-	0.95	0.23	0.01	
Reactive Phosphorus as P	mg/L	0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	0.005	

Highlighted yellow values indicate measurement/concentration is above with the referenced default guideline value(s) for this particular quality characteristic.
NA – Not available.

Table A1.2: Sediment quality characteristics at each sampled site within Woolgar River and Southern Creek compared to ANZG (2018) guideline levels

Quality Characteristic	Units	LOR	WR1		WR2		WR3		WR4		TRIB1		TRIB2		ISQG	
			<63µm	63µm - 2mm	<63µm	63µm - 2mm	<63µm	63µm - 2mm	<63µm	63µm - 2mm	<63µm	63µm - 2mm	<63µm	63µm - 2mm	Low	High
Aluminium	mg/kg	50	9840	580	7940	1230	9900	670	9080	1170	5480	150	5040	260	NA	NA
Arsenic	mg/kg	0.1	10.8	1.1	3.8	1.1	8.7	0.9	5.2	1.0	4.6	0.2	1.8	0.2	20	70
Boron	mg/kg	50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	NA	NA
Cadmium	mg/kg	0.1	0.2	<0.1	0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.5	10
Chromium	mg/kg	0.1	28.7	2.9	40.0	4.0	29.3	2.5	286	3.7	10.7	0.6	23.8	0.9	80	370
Cobalt	mg/kg	0.1	22.6	1.5	11.6	1.6	17.7	1.1	15.8	1.6	12.7	0.3	7.9	0.4	NA	NA
Copper	mg/kg	0.1	110	1.9	23.8	3.4	86.5	1.7	39.4	4.4	46.5	0.7	19.4	1.0	65	270
Iron	mg/kg	50	31600	3380	20400	3800	28000	2900	24300	4090	19600	800	11800	1130	NA	NA
Lead	mg/kg	0.1	188	3.6	38.3	3.8	122	2.8	58.8	3.6	38.4	0.5	19.9	0.8	50	220
Manganese	mg/kg	0.1	1660	97.0	533	60.2	1020	44.3	854	55.8	408	6.2	406	15.8	NA	NA
Mercury	mg/kg	0.01	0.08	<0.01	0.04	<0.01	0.06	<0.01	0.03	<0.01	0.02	<0.01	0.02	<0.01	0.15	1
Molybdenum	mg/kg	0.1	1.2	<0.1	0.4	<0.1	1.4	<0.1	0.6	<0.1	0.5	<0.1	0.4	<0.1	NA	NA
Nickel	mg/kg	0.1	22.8	1.5	12.4	2.3	26.0	1.4	18.0	2.2	8.6	0.3	7.7	0.4	21	52
Selenium	mg/kg	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Silver	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1	3.7
Uranium	mg/kg	0.1	1.2	0.2	1.2	0.2	1.2	<0.1	2.0	0.2	1.1	<0.1	4.3	0.3	NA	NA
Vanadium	mg/kg	1	57	6	45	7	51	5	48	7	53	2	20	2	NA	NA
Zinc	mg/kg	0.5	105	4.5	40.8	8.2	89.9	4.9	54.5	7.8	36.6	0.6	30.4	1.8	200	410
-2000µm	%	0.01	----	81.0	----	95.0	----	92.0	----	92.0	----	95.0	----	97.0	-	-
-63µm	%	0.01	0.86	----	5.00	----	0.86	----	2.91	----	0.86	----	0.45	----	-	-

Highlighted yellow values indicate measurement/concentration is above with the referenced default guideline value(s) for that particular quality characteristic.

NA – Not available.

Table A1.3: Sediment quality characteristics at each sampled site within Middle Creek, Northern Tributary and the Farm Dams compared to ANZECC & ARMCANZ (2000) guideline levels

Quality Characteristic	Units	LOR	TRIB3		TRIB4		FD1		FD2		ISQG	
			<63µm	63µm - 2mm	<63µm	63µm - 2mm	<63µm	63µm - 2mm	<63µm	63µm - 2mm	Low	High
Aluminium	mg/kg	50	10600	430	11200	1640	13200	2580	10500	1820	NA	NA
Arsenic	mg/kg	0.1	5.6	0.4	2.3	0.5	2.2	1.4	1.5	1.8	20	70
Boron	mg/kg	50	<50	<50	<50	<50	<50	<50	<50	<50	NA	NA
Cadmium	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.5	10
Chromium	mg/kg	0.1	17.8	1.3	31.7	4.5	31.4	8.5	15.8	10.0	80	370
Cobalt	mg/kg	0.1	12.6	0.7	13.6	1.6	11.8	3.7	10.7	5.0	NA	NA
Copper	mg/kg	0.1	43.6	1.0	29.6	2.9	24.1	10.8	26.7	9.2	65	270
Iron	mg/kg	50	24900	2180	27600	6090	23700	7160	16300	7040	NA	NA
Lead	mg/kg	0.1	58.2	1.6	35.5	2.8	24.8	9.1	22.9	16.4	50	220
Manganese	mg/kg	0.1	528	25.9	526	70.4	370	124	456	166	NA	NA
Mercury	mg/kg	0.01	0.05	<0.01	0.03	<0.01	0.02	0.02	0.01	0.01	0.15	1
Molybdenum	mg/kg	0.1	0.8	0.1	0.4	<0.1	0.5	0.4	0.1	0.2	NA	NA
Nickel	mg/kg	0.1	15.4	1.3	18.7	2.9	15.2	4.5	11.9	4.0	21	52
Selenium	mg/kg	1	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA
Silver	mg/kg	0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	1	3.7
Uranium	mg/kg	0.1	3.5	0.2	2.0	0.3	2.7	1.2	2.7	1.2	NA	NA
Vanadium	mg/kg	1	37	3	37	6	45	17	36	28	NA	NA
Zinc	mg/kg	0.5	66.4	2.6	59.4	7.8	97.5	21.7	52.6	11.4	200	410
-2000µm	%	0.01	----	93.0	----	78.0	----	98.0	----	99.0	-	-
-63µm	%	0.01	0.43	----	1.86	----	63.6	----	71.3	----	-	-

Highlighted yellow values indicate measurement/concentration is above with the referenced default guideline value(s) for that particular quality characteristic.

NA – Not available.



APPENDIX 2 – MACROINVERTEBRATE DATA

Table A2.1: Macroinvertebrate data collected

Phylum	Class	Subclass	Order	Family	Sub-family	SIGNAL Grade	WR1	WR2	WR4	FD1	FD2
Platyhelminthes	Rhabditophora		Tricladida	DugesIIDae		2					
Annelida	Clitellata	Oligochaeta				2	1	1			2
	Clitellata	Hirudinea	Arhynchobdellida	Richardsonianidae		4					
Arthropoda	Branchiopoda	Phyllopoda	Cladocera			5.5					
	Hexanauplia	Copepoda				5.5				2	
	Ostracoda					5.5		1			
	Arachnida	Acari	Trombidiformes	<i>Hydracarina</i>		6	2	13	30	1	19
	Insecta	Coleoptera	Coleoptera	Dytiscidae		2	10	15	15	26	8
				Hydrophilidae		2	6	3			
				Hydrochidae		4	7	1	3		
				Scirtidae		6					
				Hydraenidae		3	3				
				Noteridae		4					
				Staphylinidae		3	2				
		Diptera	Diptera	Unidentified		3	1				
				Chironomidae	Chironominae	3	5	4	10	8	19
				Chironomidae	Tanypodiinae	4	1				2
				Chironomidae	Orthoclaadiinae	4	1	3	1		18
				Chironomidae	Ceratopogonidae	4	1	1	1		2
		Ephemeroptera	Ephemeroptera	Baetidae		5		4	1		
				Caenidae		4	2	3	8		
				Leptophlebiidae		8	6	1	2		
		Hemiptera	Hemiptera	Corixidae		2			8		2
				Gerridae		4			2		
				Nepidae		3		2			
				Notonectidae		1	6			14	

Phylum	Class	Subclass	Order	Family	Sub-family	SIGNAL Grade	WR1	WR2	WR4	FD1	FD2
				Pleidae		2	3	3			
				Veliidae		3	1				
				Belastomatidae		1	1				
			Odonata	Gomphidae		5		3	16		
				Corduliidae		5	5	1	3		
				Libellulidae		4	12	12	9		
				Aeshnidae		4	1				
			Odonata (Zygoptera)	Platycnemidae		4		2	1		
				Coenagrionidae		2	1		1		
			Trichoptera	Leptoceridae		6		5	1		
				Philopotamidae		8		1			



APPENDIX 3 – FISH DATA

Ecology of Resident Fish Species

All species of fish caught during the study exhibited broad tolerances to the fundamental environmental conditions of concern to fish survival (Table A3.2). This is common of freshwater fish species that inhabit ephemeral watercourses, as each species must be able to withstand large natural fluctuations of environmental parameters in order to establish populations. For instance, the electrical conductivity of such systems can fluctuate widely from the wet season, when there are large volumes of freshwater input, to the dry season, when the remnant pools that act as refuges experience increases in ionic concentrations due to evaporative processes (Townsend 2002).

The resident native fish species found display similar reproductive life histories (Table A3.2). Most native species time their reproductively active period with the warmer wet season months (summer). The influx of water during this period generally ensures an increase in primary production and therefore an increase in food availability for juvenile fish.

Rainbowfish and Glassfish prefer to adhere their eggs to macrophytes or the roots of emergent terrestrial plants (Doupé *et al.* 2009; Table A3.2). As outlined within the site descriptions and the aquatic flora section of this report (Table 6 and Section 6.9), few sites possessed extensive macrophyte beds. However, the Spring recorded extensive aquatic vegetation suitable for fish spawning.

None of the fish species have a dormant stage within their life-history to cope with the reduced water availability during the dry season and, therefore, must seek refuge in permanent pools within the watercourses or further downstream (Table A3.2). The only permanent water within the area was associated with springs. Remnant pools observed within Woolgar River during the survey had reducing water quality from the evaporative processes influencing the systems. Instead, to survive the dry season fish species within project site must migrate to permanent waterholes lower on the Woolgar River or in the Flinders River catchment. Once flows have established in the subsequent wet season recruits from these lower permanent waterholes can then re-populate the on-site systems. Therefore, potential barriers to movement must be minimised to allow these species to continue to utilise these watercourses.

In summary, many of the species caught display migration patterns throughout their life history stages (Table A5.3). Therefore, barriers to fish passage within Woolgar River or its associated tributaries from any proposed development within these catchments is of concern and likely to have a significant influence on the fish communities present.

Table A3.1: Fish species and abundance present at each site

Family	Scientific name	Common name	WR1	WR2	WR4	WR5	FD1	FD2
Ambassidae	<i>Ambassis macleayi</i>	Macleay's Glassfish		2				
Melanotaenidae	<i>Melanotaenia splendida inornata</i>	Chequered Rainbowfish	240	58	86			2
Plotosidae	<i>Neosilurus hyrtl</i>	Hyrtl's Catfish	1		2			
Teripontidae	<i>Leioptherapon unicolor</i>	Spangled Perch		77	23	12		33

Table A3.2: Environmental tolerances and life history of the fish species caught during current surveys (Pusey *et al.* 2004)

Species	Common name	Environmental tolerances					Life history / Ecology
		Temp (°C)	EC (µS/cm)	pH (Units)	DO (mg/L)	Turbidity (NTU)	
<i>Ambassis macleayi</i>	Macleay's glassfish	22.9 – 38	2 – 620	4.8 – 9.1	1.0 – 9.1	1.0 – 150	This species reaches sexual maturity at <12 months old and lives for up to 3 years. They spawn at in thick macrophyte beds during flows within the wet season, with water temperature a likely trigger. The spawn in batches of several hundred eggs each day over a 7 day period. Fertilised eggs will hatch in <24hrs and the larvae will be able to actively feed after 3 days. Macleay's glassfish are known to undertake upstream migrations at the end of the wet season, likely looking for dry season refugia. Glassfish generally feed on macroinvertebrates, mainly aquatic insects and micro-crustaceans.
<i>Leiopotherapon unicolour</i>	Spangled perch	7.3 – 37.5	0 – 56,000	4 – 8.6	0.4 – ?	1.52 – 260	Spangled perch reach sexual maturity at 3 – 6 months. They spawn during the wet season months with the rising waters. Spawning occurs in shallow pools/backwaters on the bed habitat. Fertilised eggs will hatch after between 45 to 55hrs. Spangled perch are capable of large, quick migrations able to travel up to 9.5km/day. The direction of travel (upstream or downstream) is highly dependent on the watercourse features and habitats available. Their diet mostly consists of aquatic insects, macro-crustaceans and other fish.
<i>Melanotaenia splendida inornata</i> **	Chequered rainbowfish	15 – 32.5	6 – 790	6 – 8.47	1.1 – 11.6	0.1 – 16	Rainbowfish reach sexual maturity in less than 1 year and generally spawn within the summer months. They deposit their adhesive eggs onto macrophyte beds or root masses. Fertilised eggs will hatch after approximately 7 to 12 days. Rainbowfish will commence an upstream migration with the onset of the wet season. Their diet is dominated by aquatic insects, algae and terrestrial invertebrates.
<i>Neosilurus hyrtl</i>	Hyrtl's tandan	12.8 – 36	4 – 1855	5.2 – 9.1	1 – 11.4	0.25 – 170	Hyrtl's tandan reach sexual maturity at approximately 1 year old. They spawn throughout the wet season generally in bed habitat. Fertilised eggs will hatch after approximately 60hrs. This species is rarely observed migrating on mass. However, they are known to travel upstream with the onset of the wet season.

Species	Common name	Environmental tolerances					Life history / Ecology
		Temp (°C)	EC (µS/cm)	pH (Units)	DO (mg/L)	Turbidity (NTU)	
							Their diet consists mostly of aquatic insects, micro-crustaceans, detritus and molluscs.

** Insufficient information/data is available for the Chequered rainbowfish in relation to environmental tolerances and life history traits. Therefore, the data (and life history description) provided for the Chequered rainbowfish is actually that of the Eastern rainbowfish (*Melanotaenia splendida splendida*). However, these species are very similar and the information provided is an insight into the life history traits and environmental tolerances of the Chequered rainbowfish.

Table A3.3: Photos of each fish species collected on the project site

Scientific name	Common name	Picture
<i>Ambassis macleayi</i>	Macleay's glassfish	
<i>Leiopotherapon unicolour</i>	Spangled perch	
<i>Melanotaenia splendida inornata</i> **	Chequered rainbowfish	
<i>Neosilurus hyrtl</i>	Hyrtl's tandan	



APPENDIX 4 – SEARCH RESULTS



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

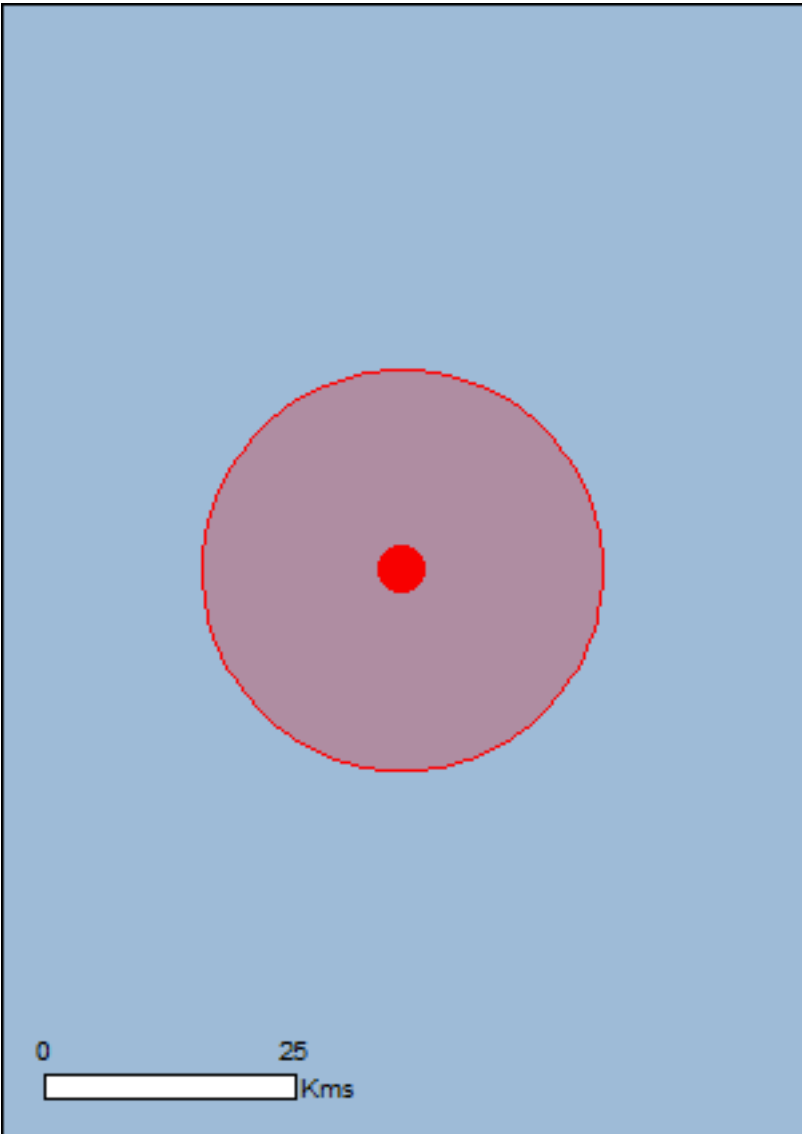
Report created: 12/09/19 21:52:38

- [Summary](#)
- [Details](#)

[Matters of NES](#)

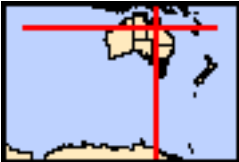
[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)
- [Caveat](#)
- [Acknowledgements](#)



This map may contain data which are
©Commonwealth of Australia
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[Coordinates](#)
Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	10
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	19
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	11
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat may occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat may occur within area
Mammals		
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Plants		
Acacia crombiei Pink Gidgee [10927]	Vulnerable	Species or species habitat likely to occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species

Name	Threatened	Type of Presence
habitat likely to occur within area		
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[<u>Resource Information</u>]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Ardea alba Great Egret, White Egret [59541]	Critically Endangered	Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]		Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]	Species or species habitat may occur within area	
Motacilla cinerea Grey Wagtail [642]	Species or species habitat may occur within area	
Motacilla flava Yellow Wagtail [644]	Species or species habitat may occur within area	
Pandion haliaetus Osprey [952]	Species or species habitat likely to occur within area	
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Reptiles		
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area

Extra Information

Invasive Species

[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Plants		
Acacia nilotica subsp. indica Prickly Acacia [6196]		Species or species habitat may occur within area
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Vachellia nilotica Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-19.82866 143.28195

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Office of Environment and Heritage, New South Wales](#)
- [Department of Environment and Primary Industries, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment, Water and Natural Resources, South Australia](#)
- [Department of Land and Resource Management, Northern Territory](#)
- [Department of Environmental and Heritage Protection, Queensland](#)
- [Department of Parks and Wildlife, Western Australia](#)
- [Environment and Planning Directorate, ACT](#)
- [Birdlife Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [South Australian Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.



Queensland Government

Department of Environment and Science

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest
ml: 90238

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@des.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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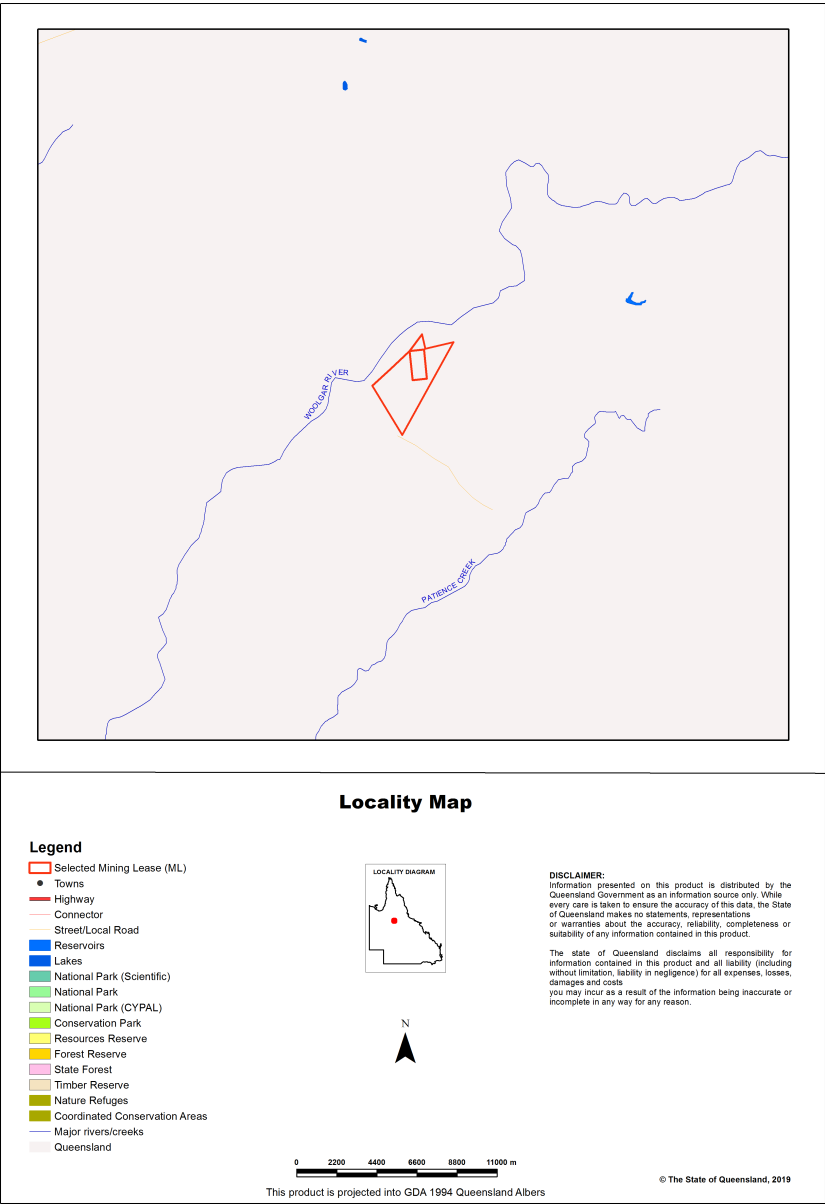
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Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI ml: 90238

Size (ha)	882.05
Local Government(s)	Richmond Shire
Bioregion(s)	Gulf Plains
Subregion(s)	Claraville Plains, Gilberton Plateau
Catchment(s)	Flinders



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992* ;
- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the *Marine Parks Act 2004* ;
- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;
- Threatened wildlife under the *Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;
- Regulated vegetation under the *Vegetation Management Act 1999* that is:
 - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;
 - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;
 - Category R areas on the regulated vegetation management map;
 - Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;
 - Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;
- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;
- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Referable Wetlands under the Environmental Protection Regulation 2008;
- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;
- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0.0 ha	0.0 %
1b Protected Areas- nature refuges	0.0 ha	0.0 %
2 State Marine Parks- highly protected zones	0.0 ha	0.0 %
3 Fish habitat areas (A and B areas)	0.0 ha	0.0 %
4 Strategic Environmental Areas (SEA)	0.0 ha	0.0 %
5 High Ecological Significance wetlands on the map of Referable Wetlands	0.0 ha	0.0 %
6a High Ecological Value (HEV) wetlands	0.0 ha	0.0 %
6b High Ecological Value (HEV) waterways **	0.0 km	Not applicable
7 Threatened species and Iconic species	0.0 ha	0.0 %
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	0.0 ha	0.0 %
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	0.0 ha	0.0 %
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0.0 ha	0.0 %
8d Regulated Vegetation - Essential habitat	0.0 ha	0.0 %
8e Regulated Vegetation - intersecting a watercourse **	9.0 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	0.0 ha	0.0 %
9a Legally secured offset areas- offset register areas	0.0 ha	0.0 %
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0.0 ha	0.0 %

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(no results)

1b. Protected Areas - nature refuges

(no results)

2. State Marine Parks - highly protected zones

(no results)

3. Fish habitat areas (A and B areas)

(no results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(no results)

5. High Ecological Significance wetlands on the Map of Referable Wetlands

(no results)

6a. High Ecological Value (HEV) waters - wetlands

(no results)

6b. High Ecological Value (HEV) waters - waterways

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7. Threatened wildlife and special least concern animal

(no results)

Threatened and special least concern species records

(no results)

Note: The Threatened and Special Least Concern Animal (7) layer originates from the previous MSES version (4.1, dated at 2014). The layer does not represent all currently listed species and is subject to review.

**Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)*

To request a species list for an area, or search for a species profile, access Wildlife Online at:

<https://www.qld.gov.au/environment/plants-animals/species-list/>

Refer to **Map 3 - MSES - Species** for an overview of the relevant MSES.

MSES - Regulated Vegetation

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Not applicable

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Not applicable

For further information relating to regional ecosystems in general, go to:

<https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/>

For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:

<https://environment.ehp.qld.gov.au/regional-ecosystems/>

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Not applicable

8d. Regulated Vegetation - Essential habitat

Not applicable

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Not applicable

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

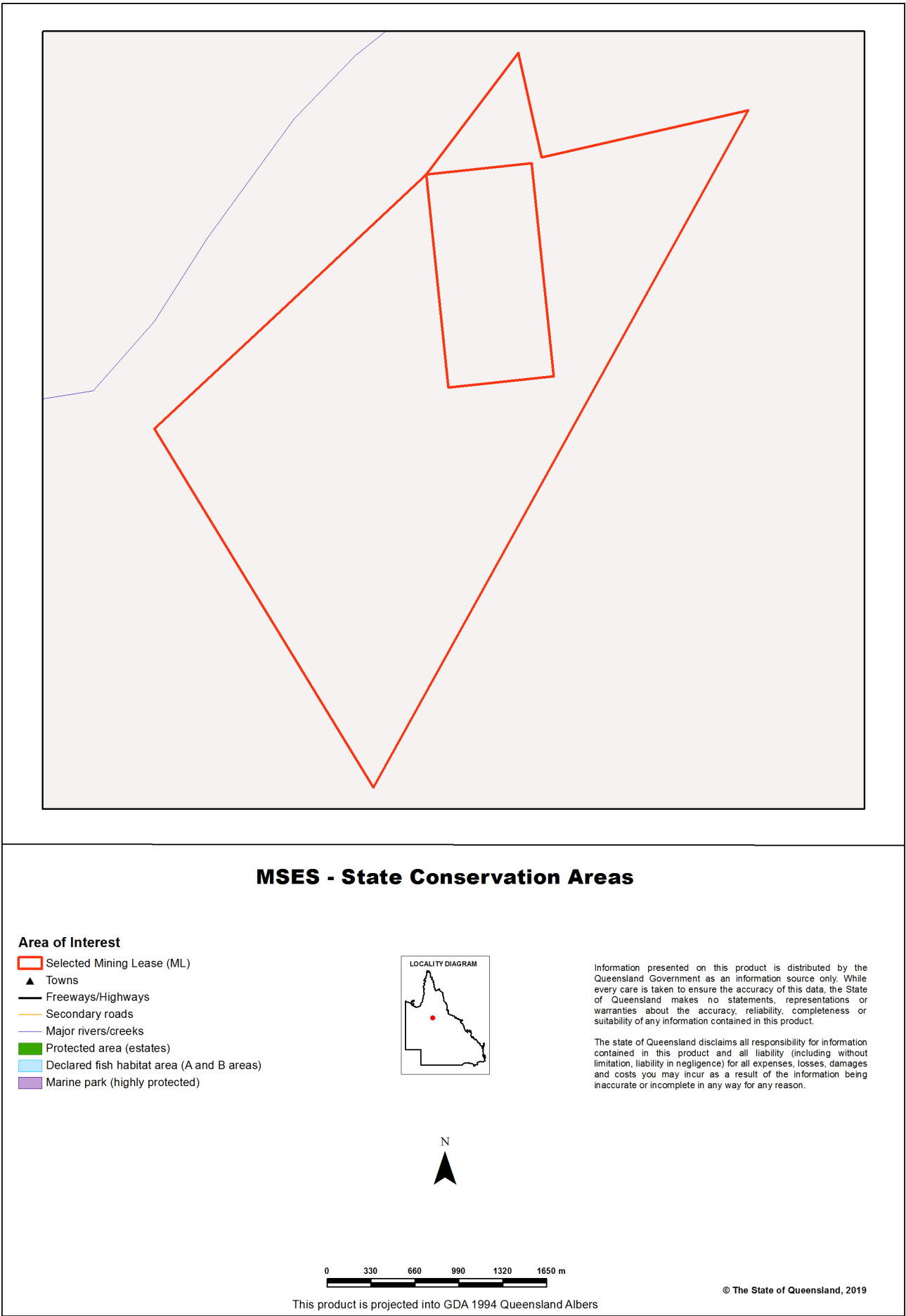
(no results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

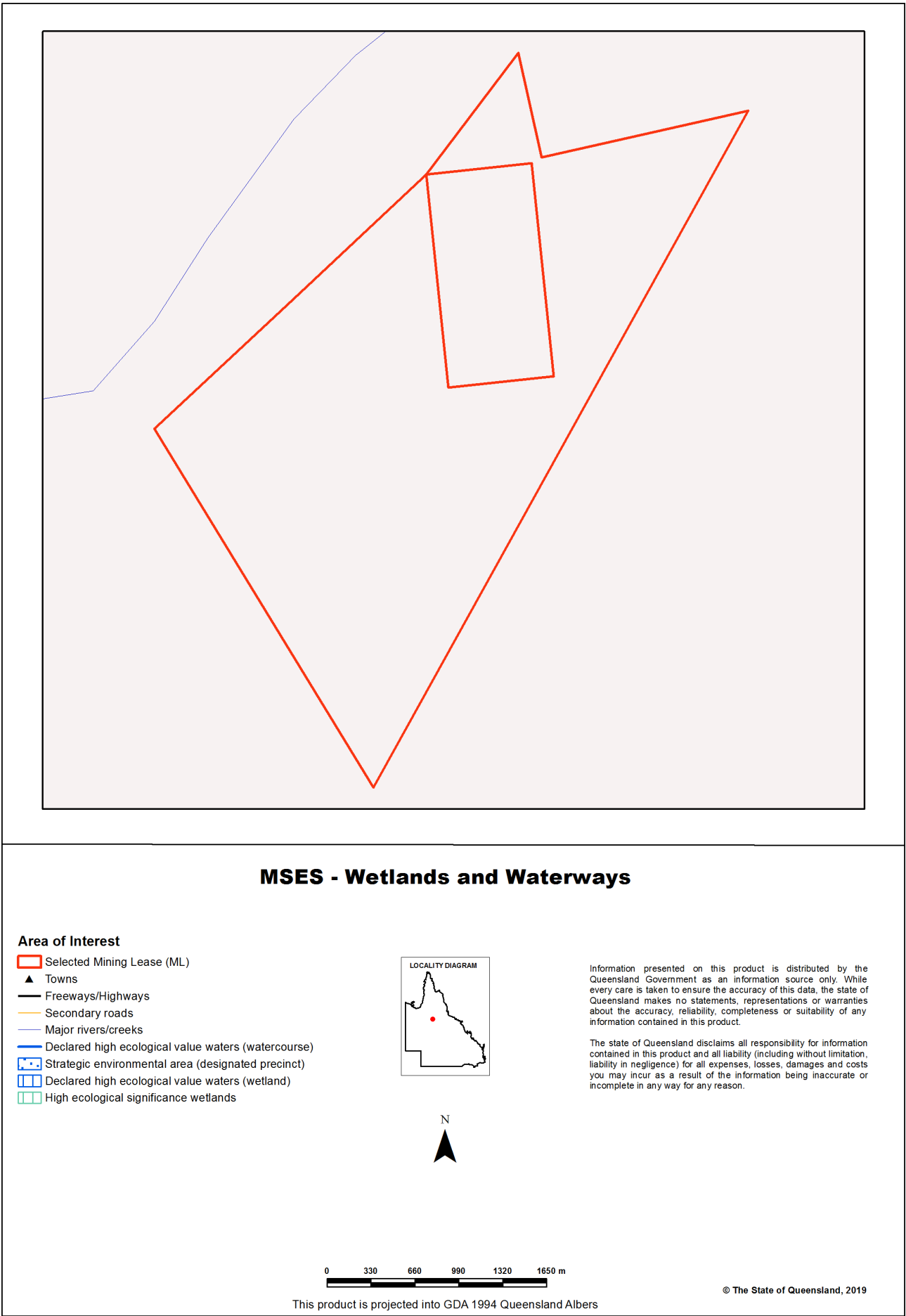
(no results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

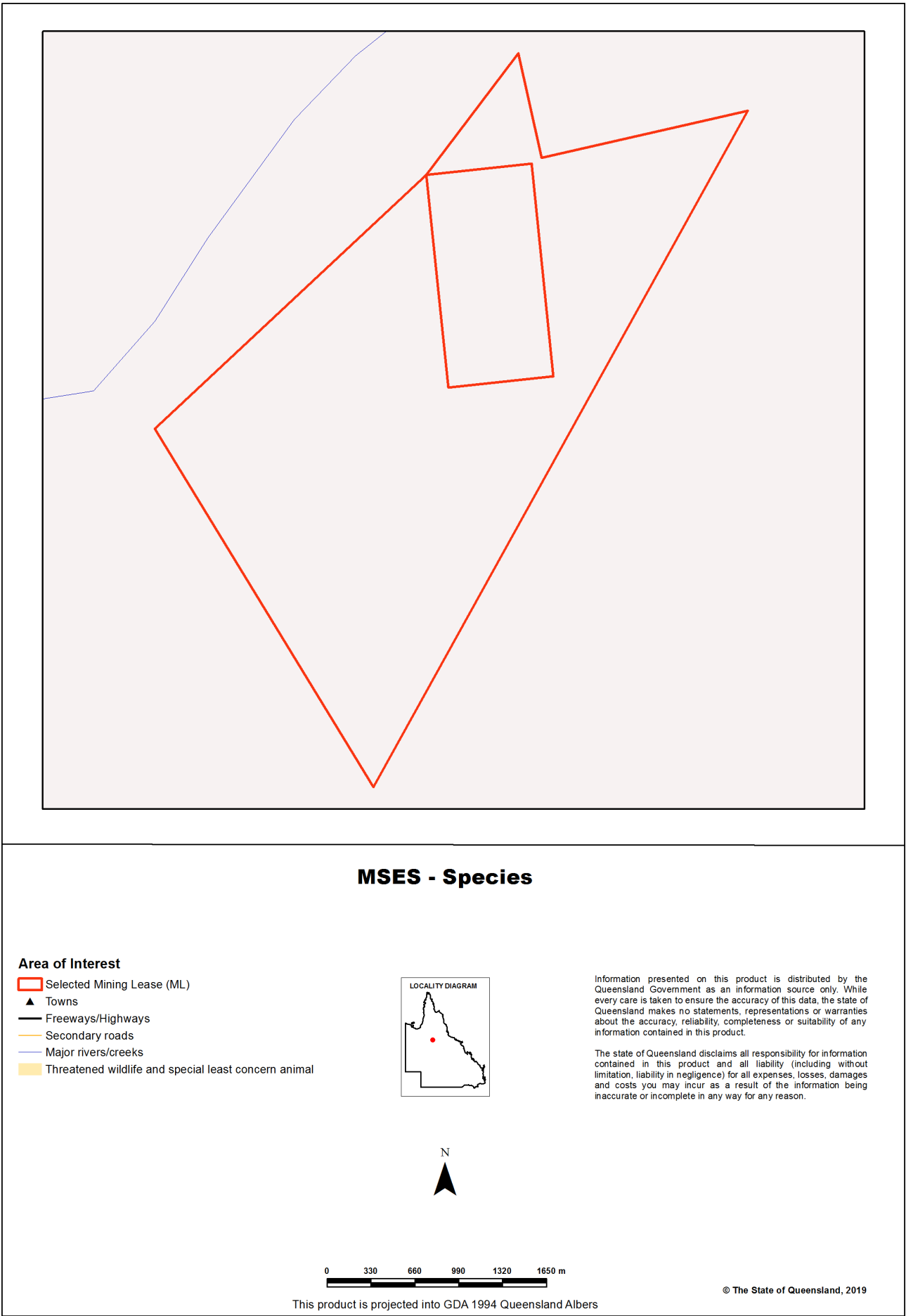
Map 1 - MSES - State Conservation Areas



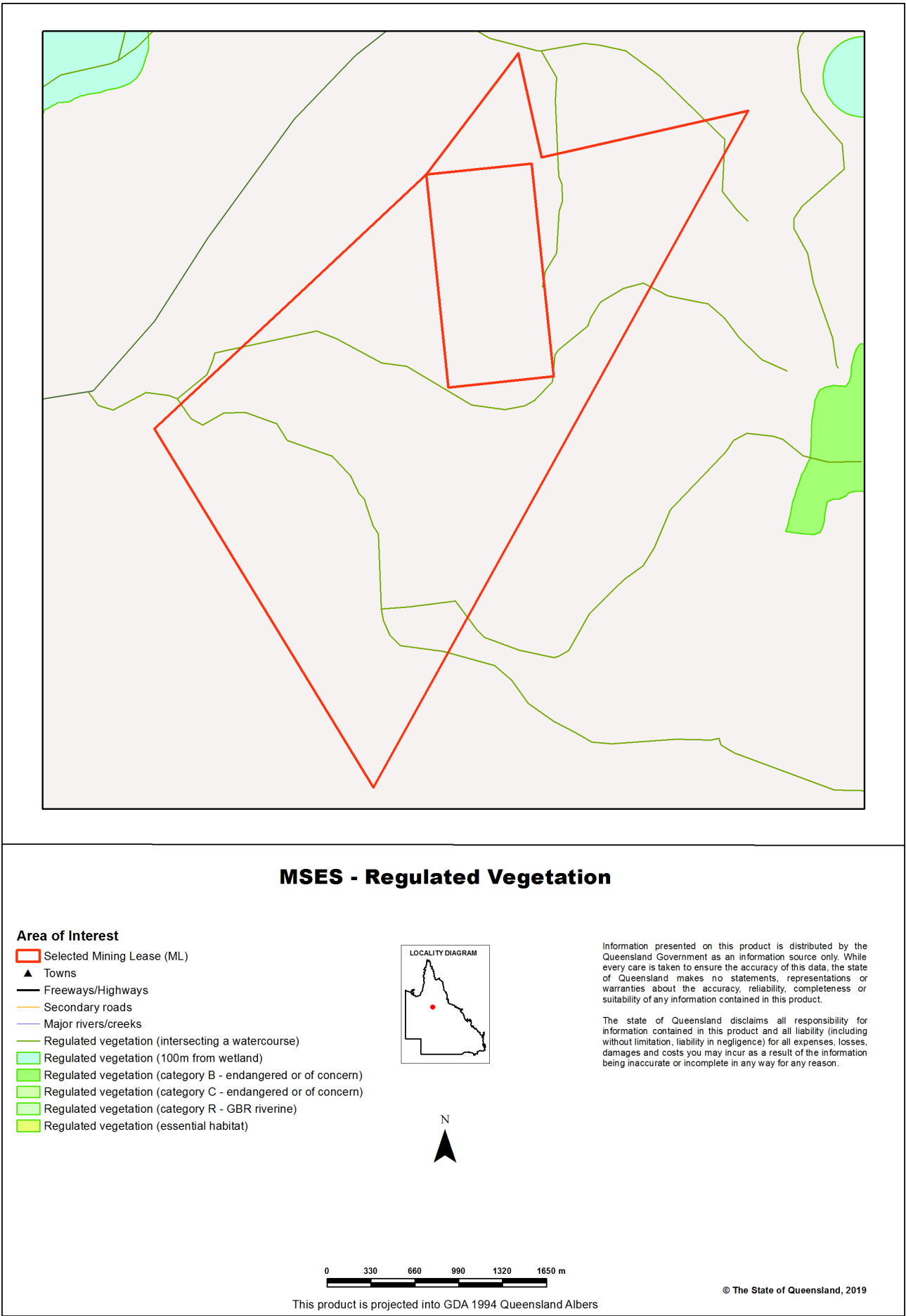
Map 2 - MSES - Wetlands and Waterways



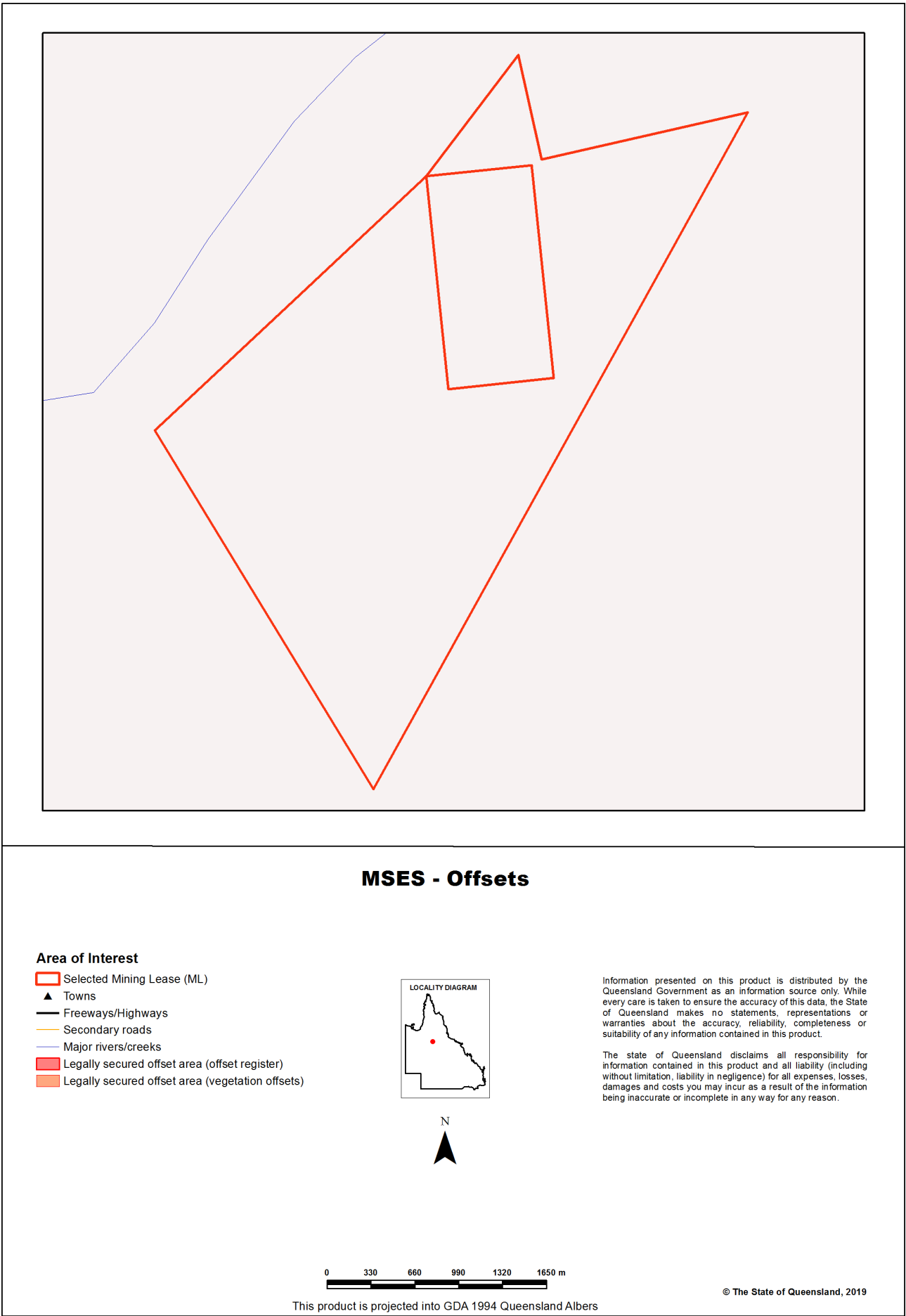
Map 3 - MSES - Species



Map 4 - MSES - Regulated Vegetation



Map 5 - MSES - Offset Areas



Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). The compiled MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The Queensland Government's "Method for mapping - matters of state environmental significance for use in land use planning and development assessment" can be downloaded from:

<http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html> .

Appendix 2 - Source Data

The datasets listed below are available on request from:

<http://qldspatial.information.qld.gov.au/catalogue/custom/index.page>

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

MSES layers	current QSpatial data (http://qspatial.information.qld.gov.au)
Protected Areas-Estates and Nature Refuges	- Protected areas of Queensland - Nature Refuges - Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Referable Wetland - wetland layers: - Wetland management area wetlands - Wetland protection area wetlands
wetlands in HEV waters	HEV waters: - EPP Water (multiple locations) intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 4, 2015) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000) - latest version 1.4
Wildlife habitat (threatened and special least concern)	-WildNet database species records - habitat suitability models (various)
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map - latest version 8.0
VMA Essential Habitat	Vegetation management - essential habitat map - latest version 4.41
VMA Wetlands	Vegetation management wetlands map - latest version 2.41
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DES
Regulated Vegetation Map	Vegetation management - regulated vegetation management map - latest version 1.41

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DES	- Department of Environment and Science
EP Act	- <i>Environmental Protection Act 1994</i>
EPP	- Environmental Protection Policy
GDA94	- Geocentric Datum of Australia 1994
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- <i>Nature Conservation Act 1992</i>
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- <i>Vegetation Management Act 1999</i>



Queensland Government

Department of Environment and Science

Environmental Reports

Biodiversity and Conservation Values

Biodiversity Planning Assessments and Aquatic Conservation Assessments

For the selected area of interest
ml: 90238

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or Area of Interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "Central co-ordinates" option, the resulting assessment area encompasses an area extending from 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: biodiversity.planning@des.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

Tables 1 to 8 provide an overview of the AOI with respect to selected topographic and environmental values.

Table 1: Area of interest details: ml: 90238

Size (ha)	882.05
Local Government(s)	Richmond Shire
Bioregion(s)	Gulf Plains
Subregion(s)	Claraville Plains, Gilberton Plateau
Catchment(s)	Flinders

The following table identifies available Biodiversity Planning Assessments (BPAs) and Aquatic Conservation Assessments (ACAs) with respect to the AOI.

Table 2: Available Biodiversity Planning and Aquatic Conservation Assessments

Assessment Type	Assessment Area and Version
Biodiversity Planning Assessment(s)	Gulf Plains v1.1
Aquatic Conservation Assessment(s) (riverine)	Eastern Gulf of Carpentaria v1.1
Aquatic Conservation Assessment(s) (non-riverine)	Eastern Gulf of Carpentaria v1.1

Table 3: Remnant regional ecosystems within the AOI as per the Qld Herbarium's 'biodiversity status'

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.0	0.0
Of concern	206.01	23.36
No concern at present	675.97	76.64

The following table identifies the extent and proportion of the user specified area of interest (AOI) which is mapped as being of "State", "Regional" or "Local" significance via application of the Queensland Department of Environment and Science's *Biodiversity Assessment and Mapping Methodology* (BAMM).

Table 4: Summary table, biodiversity significance

Biodiversity significance	Area (Ha)	% of AOI
State Habitat for EVNT taxa	0.0	0.0
State	17.41	1.97
Regional	322.44	36.56
Local or Other Values	542.13	61.46

Table 5: Non-riverine wetlands intersecting the AOI

Non-riverine wetland types intersecting the area of interest	#
(No Records)	

NB. The figures presented in the table above are derived from the relevant non-riverine Aquatic Conservation Assessment(s). Later releases of wetland mapping produced via the Queensland Wetland Mapping Program may provide more recent

information in regards to wetland extent.

Table 6: Named waterways intersecting the AOI

(no results)

Refer to **Map 1** for general locality information.

The following two tables identify the extent and proportion of the user specified AOI which is mapped as being of "Very High", "High", "Medium", "Low", or "Very Low" aquatic conservation value for riverine and non-riverine wetlands via application of the Queensland Department of Environment and Science's *Aquatic Biodiversity Assessment and Mapping Method* (AquaBAMM).

Table 7: Summary table, aquatic conservation significance (riverine)

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Very High	0.0	0.0
High	0.0	0.0
Medium	882.05	100.0
Low	0.0	0.0
Very Low	0.0	0.0

Table 8: Summary table, aquatic conservation significance (non-riverine)

Aquatic conservation significance (non-riverine wetlands)	Area (Ha)	% of AOI
(No Records)		

Biodiversity Planning Assessments

Introduction

The Department of Environment and Science (DES) attributes biodiversity significance on a bioregional scale through a Biodiversity Planning Assessment (BPA). A BPA involves the integration of ecological criteria using the *Biodiversity assessment and Mapping Methodology* (BAMM) and is developed in two stages: 1) **diagnostic criteria**, and 2) **expert panel criteria**. The diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion, while the expert panel criteria allows for the refinement of the mapped information from the diagnostic output by incorporating local knowledge and expert opinion.

The BAMM methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. While natural resource values such as dryland salinity, soil erosion potential or land capability are not dealt with explicitly, they are included to some extent within the biodiversity status of regional ecosystems recognised by the DES.

Biodiversity Planning Assessments (BPAs) assign three levels of overall biodiversity significance.

- **State significance** - areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales. In addition, areas flagged as being of State significance due to the presence of endangered, vulnerable and/or near threatened taxa, are identified as "State Habitat for EVNT taxa".
- **Regional significance** - areas assessed as being significant for biodiversity at the subregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- **Local significance and/or other values** - areas assessed as not being significant for biodiversity at state or regional scales. Local values are of significance at the local government scale.

For further information on released BPAs and a copy of the underlying methodology, go to:

<http://www.qld.gov.au/environment/plants-animals/biodiversity/planning/>

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

<http://qspatial.information.qld.gov.au/geoportal/>

The following table identifies the extent and proportion of the user specified AOI which is mapped as being of "State", "Regional" or "Local" significance via application of the BAMM.

Table 9: Summary table, biodiversity significance

Biodiversity significance	Area (Ha)	% of AOI
State Habitat for EVNT taxa	0.0	0.0
State	17.41	1.97
Regional	322.44	36.56
Local or Other Values	542.13	61.46

Refer to **Map 2** for further information.

Diagnostic Criteria

Diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion. These criteria are diagnostic in that they are used to filter the available data and provide a "first-cut" or initial determination of biodiversity significance. This initial assessment is then combined through a second group of other essential criteria.

A description of the individual diagnostic criteria is provided in the following sections.

Criteria A. Habitat for EVNT taxa: Classifies areas according to their significance based on the presence of endangered, vulnerable and/or rare (EVNT) taxa. EVNT taxa are those scheduled under the *Nature Conservation Act 1992* and/or the

Environment Protection and Biodiversity Conservation Act 1999. It excludes highly mobile fauna taxa which are instead considered in Criterion H and brings together information on EVNT taxa using buffering of recorded sites or habitat suitability models (HSM) where available.

Criteria B. Ecosystem value: Classifies on the basis of biodiversity status of regional ecosystems, their extent in protected areas (presence of poorly conserved regional ecosystems), the presence of significant wetlands; and areas of national importance such as the presence of Threatened Ecological Communities, World Heritage areas and Ramsar sites. Ecosystem value is applied at a bioregional (**B1**) and regional (**B2**) scale.

Criteria C. Tract size: Measures the relative size of tracts of vegetation in the landscape. The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts.

Criteria D. Relative size of regional ecosystems: Classifies the relative size of each regional ecosystem unit within its bioregion (**D1**) and its subregion (**D2**). Remnant units are compared with all other occurrences with the same regional ecosystem. Large examples of a regional ecosystem are more significant than smaller examples of the same regional ecosystem because they are more representative of the biodiversity values particular to the regional ecosystem, are more resilient to the effects of disturbance, and constitute a significant proportion of the total area of the regional ecosystem.

Criteria F. Ecosystem diversity: Is an indicator of the number of regional ecosystems occurring within an area. An area with high ecosystem diversity will have many regional ecosystems and ecotones relative to other areas within the bioregion.

Criteria G. Context and connection: Represents the extent to which a remnant unit incorporates, borders or buffers areas such as significant wetlands, endangered ecosystems; and the degree to which it is connected to other vegetation.

A summary of the biodiversity status based upon the diagnostic criteria is provided in the following table.

Table 10: Summary of biodiversity significance based upon diagnostic criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
Regional	Remnant contains at least 1 RE with <10 pc extent remaining or rare in subregion (B2)	53.01	6.01
Regional	Remnant contains at least one Of Concern RE (B1)	286.84	32.52
Local or Other Values	Refer to diagnostic data for additional information	542.13	61.46

Assessment of diagnostic criteria with respect to the AOI

The following table reflects an assessment of the individual diagnostic criteria noted above in regards to the AOI.

Table 11: Assessment of individual diagnostic criteria with respect to the AOI

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
A: Habitat for EVNT Taxa							881.98	100.0
B1: Ecosystem Value (Bioregion)			286.84	32.5	595.14	67.5		
B2: Ecosystem Value (Subregion)	53.01	6.0			828.97	94.0		
C: Tract Size			881.98	100.0				
D1: Relative RE Size (Bioregion)					188.59	21.4	693.39	78.6
D2: Relative RE Size (Subregion)	53.01	6.0			188.59	21.4	640.38	72.6
F: Ecosystem Diversity	389.92	44.2	492.06	55.8				
G: Context and Connection	716.44	81.2	165.54	18.8				

Other Essential Criteria

Other essential criteria (also known as expert panel criteria) are based on non-uniform information sources and which may rely more upon expert opinion than on quantitative data. These criteria are used to provide a "second-cut" determination of biodiversity significance, which is then combined with the diagnostic criteria for an overall assessment of relative biodiversity significance. A summary of the biodiversity status based upon the other essential criteria is provided in the following table.

Table 12: Summary of biodiversity significance based upon other essential criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
State	Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I)	17.41	1.97

A description of each of the other essential criteria and associated assessment in regards to the AOI is provided in the following sections.

Criteria H. Essential and general habitat for priority taxa: Priority taxa are those which are at risk or of management concern, taxa of scientific interest as relictual (ancient or primitive), endemic taxa or locally significant populations (such as a flying fox camp or heronry), highly specialised taxa whose habitat requirements are complex and distributions are not well correlated with any particular regional ecosystem, taxa important for maintaining genetic diversity (such as complex spatial patterns of genetic variation, geographic range limits, highly disjunct populations), taxa critical for management or monitoring of biodiversity (functionally important or ecological indicators), or economic and culturally important taxa.

Criteria I. Special biodiversity values: areas with special biodiversity values are important because they contain multiple taxa in a unique ecological and often highly biodiverse environment. Areas with special biodiversity values can include the following:

- Ia - centres of endemism - areas where concentrations of taxa are endemic to a bioregion or subregion are found.
- Ib - wildlife refugia (Morton *et al.* 1995), for example, islands, mound springs, caves, wetlands, gorges, mountain ranges and topographic isolates, ecological refuges, refuges from exotic animals, and refuges from clearing. The latter may include large areas that are not suitable for clearing because of land suitability/capability.
- Ic - areas with concentrations of disjunct populations.
- Id - areas with concentrations of taxa at the limits of their geographic ranges.
- Ie - areas with high species richness.
- If - areas with concentrations of relictual populations (ancient and primitive taxa).
- Ig - areas containing REs with distinct variation in species composition associated with geomorphology and other environmental variables.
- Ih - an artificial waterbody or managed/manipulated wetland considered by the panel/s to be of ecological significance.
- Ii - areas with a high density of hollow-bearing trees that provide habitat for animals.
- Ij - breeding or roosting sites used by a significant number of individuals.
- Ik - climate change refuge.

The following table identifies the value and extent area of the Other Essential Criteria H and I within the AOI.

Table 13: Relative importance of expert panel criteria (H and I) used to access overall biodiversity significance with respect to the AOI

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
H: Core Habitat Priority Taxa								
Ia: Centres of Endemism								
Ib: Wildlife Refugia	17.41	2.0						
Ic: Disjunct Populations								
Id: Limits of Geographic Ranges								
Ie: High Species Richness	17.41	2.0						
If: Relictual Populations								

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
Ig: Variation in Species Composition	17.41	2.0						
Ih: Artificial Wetland								
Ii: Hollow Bearing Trees	17.41	2.0						
Ij: Breeding or Roosting Site	17.41	2.0						
Ik: Climate Refugia								

NB. Whilst biodiversity values associated with Criteria I may be present within the site (refer to tables 12 and 15), for the New England Tableland and Central Queensland Coast BPAs, area and % area figures associated with Criteria Ia through to Ij cannot be listed in the table above (due to slight variations in data formats between BPAs).

Criteria J. Corridors: areas identified under this criterion qualify either because they are existing vegetated corridors important for contiguity, or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and "stepping stones".

Bioregional and subregional conservation corridors have been identified in the more developed bioregions of Queensland through the BPAs, using an intensive process involving expert panels. Map 3 displays the location of corridors as identified under the Statewide Corridor network. The Statewide Corridor network incorporates BPA derived corridors and for bioregions where no BPA has been assessed yet, corridors derived under other planning processes. *Note: as a result of updating and developing a statewide network, the alignment of corridors may differ slightly in some instances when compared to those used in individual BPAs.*

The functions of these corridors are:

- **Terrestrial** Bioregional corridors, in conjunction with large tracts of remnant vegetation, maintain ecological and evolutionary processes at a landscape scale, by:

- Maintaining long term evolutionary/genetic processes that allow the natural change in distributions of species and connectivity between populations of species over long periods of time;
- Maintaining landscape/ecosystems processes associated with geological, altitudinal and climatic gradients, to allow for ecological responses to climate change;
- Maintaining large scale seasonal/migratory species processes and movement of fauna;
- Maximising connectivity between large tracts/patches of remnant vegetation;
- Identifying key areas for rehabilitation and offsets; and

- **Riparian** Bioregional Corridors also maintain and encourage connectivity of riparian and associated ecosystems.

The location of the corridors is determined by the following principles:

- Terrestrial

- Complement riparian landscape corridors (i.e. minimise overlap and maximise connectivity);
- Follow major watershed/catchment and/or coastal boundaries;
- Incorporate major altitudinal/geological/climatic gradients;
- Include and maximise connectivity between large tracts/patches of remnant vegetation;
- Include and maximise connectivity between remnant vegetation in good condition; and

- Riparian

- Located on the major river or creek systems within the bioregion in question.

The total extent of remnant vegetation triggered as being of "State", "Regional" or "Local" significance due to the presence of an overlying BPA derived terrestrial or riparian corridor within the AOI, is provided in the following table. For further information on how remnant vegetation is triggered due to the presence of an overlying BPA derived corridor, refer to the relevant landscape BPA expert panel report(s).

Table 14: Extent of triggered remnant vegetation due to the presence of BPA derived corridors with respect to the AOI

Biodiversity Significance	Area (Ha)	% of AOI
State	0.0	0.0
Regional	0.0	0.0
Local	0.0	0.0

NB: area figures associated with the extent of corridor triggered remnant vegetation are only available for those bioregions where a BPA has been undertaken.

Refer to **Map 3** for further information.

Threatening process/condition (Criteria K) - areas identified by experts under this criterion may be used to amend (upgrade or downgrade) biodiversity significance arising from the "first-cut" analysis. The condition of remnant vegetation is affected by threatening processes such as weeds, ferals, grazing and burning regime, selective timber harvesting/removal, salinity, soil erosion, and climate change.

Assessment of Criteria K with respect to the AOI is not currently included in the "Biodiversity and Conservation Values" report, as it has not been applied to the majority of Queensland due to data/information limitations and availability.

Special Area Decisions

Expert panel derived "Special Area Decisions" are used to assign values to Other Essential Criteria. The specific decisions which relate to the AOI in question are listed in the table below.

Table 15: Expert panel decisions for assigning levels of biodiversity significance with respect to the AOI

Decision Number	Description	Panel Recommended Significance	Criteria Values
gup_l_41	Riparian ecosystems and associated areas	State	lb (wildlife refugia): VERY HIGH le (high species diversity): VERY HIGH lg (REs show distinct variation in species composition): VERY HIGH li (high density of hollow-bearing habitat trees): VERY HIGH lj (significant breeding or roosting sites): VERY HIGH

Expert panel decision descriptions:

gup_l_41

Riparian ecosystems in the Gulf Plains provide a refuge in otherwise seasonally droughty and sparsely vegetated landscapes that dominate non-riparian areas.

See also gup_fa_08 for specific values of western riparian systems.

Aquatic Conservation Assessments

Introduction

The Aquatic Biodiversity Assessment and Mapping Method or AquaBAMM (Clayton *et al.* 2006), was developed to assess conservation values of wetlands in Queensland, and may also have application in broader geographical contexts. It is a comprehensive method that uses available data, including data resulting from expert opinion, to identify relative wetland conservation/ecological values within a specified study area (usually a catchment). The product of applying this method is an Aquatic Conservation Assessment (ACA) for the study area.

An ACA using AquaBAMM is non-social, non-economic and identifies the conservation/ecological values of wetlands at a user-defined scale. It provides a robust and objective conservation assessment using criteria, indicators and measures that are founded upon a large body of national and international literature. The criteria, each of which may have variable numbers of indicators and measures, are naturalness (aquatic), naturalness (catchment), diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. An ACA using AquaBAMM is a powerful decision support tool that is easily updated and simply interrogated through a geographic information system (GIS).

Where they have been conducted, ACAs can provide a source of baseline wetland conservation/ecological information to support natural resource management and planning processes. They are useful as an independent product or as an important foundation upon which a variety of additional environmental and socio-economic elements can be added and considered (i.e. an early input to broader 'triple-bottom-line' decision-making processes). An ACA can have application in:

- determining priorities for protection, regulation or rehabilitation of wetlands and other aquatic ecosystems
- on-ground investment in wetlands and other aquatic ecosystems
- contributing to impact assessment of large-scale development (e.g. dams)
- water resource and strategic regional planning processes

For a detailed explanation of the methodology please refer to the summary and expert panel reports relevant to the ACA utilised in this assessment. These reports can be accessed at Wetland Info:

<http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca>

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

<http://qspatial.information.qld.gov.au/geoportal/>

Explanation of Criteria

Under the AquaBAMM, eight criteria are assessed to derive an overall conservation value. Similar to the Biodiversity Assessment and Mapping Methodology, the criteria may be primarily diagnostic (quantitative) or primarily expert opinion (qualitative) in nature. The following sections provide a brief description of each of the 8 criteria.

Criteria 1. Naturalness - Aquatic: This attribute reflects the extent to which a wetland's (riverine, non-riverine, estuarine) aquatic state of naturalness is affected through relevant influencing indicators which include: presence of exotic flora and fauna; presence of aquatic communities; degree of habitat modification and degree of hydrological modification.

Criteria 2. Naturalness - Catchment: The naturalness of the terrestrial systems of a catchment can have an influence on many wetland characteristics including: natural ecological processes e.g. nutrient cycling, riparian vegetation, water chemistry, and flow. The indicators utilised to assess this criterion include: presence of exotic flora and/or fauna; riparian, catchment and flow modification.

Criteria 3. Naturalness - Diversity and Richness: This criterion is common to many ecological assessment methods and can include both physical and biological features. It includes such indicators as species richness, riparian ecosystem richness and geomorphological diversity.

Criteria 4. Threatened Species and Ecosystems: This criterion evaluates ecological rarity characteristics of a wetland. This includes both species rarity and rarity of communities / assemblages. The communities and assemblages are best represented by regional ecosystems. Species rarity is determined by NCA and EPBC status with Endangered, Vulnerable or Near-threatened species being included in the evaluation. Ecosystem rarity is determined by regional ecosystem biodiversity status i.e. Endangered, Of Concern, or Not of Concern.

Criteria 5. Priority Species and Ecosystems: Priority flora and fauna species lists are expert panel derived. These are aquatic, semi-aquatic and riparian species which exhibit at least 1 particular trait in order to be eligible for consideration. For

flora species the traits included:

- It forms significant macrophyte beds (in shallow or deep water).
- It is an important food source.
- It is important/critical habitat.
- It is implicated in spawning or reproduction for other fauna and/or flora species.
- It is at its distributional limit or is a disjunct population.
- It provides stream bank or bed stabilisation or has soil binding properties.
- It is a small population and subject to threatening processes.

Fauna species are included if they meet at least one of the following traits:

- It is endemic to the study area (>75 per cent of its distribution is in the study area/catchment).
- It has experienced, or is suspected of experiencing, a serious population decline.
- It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment.
- It is currently a small population and threatened by loss of habitat.
- It is a significant disjunct population.
- It is a migratory species (other than birds).
- A significant proportion of the breeding population (>one per cent for waterbirds, >75 per cent other species) occurs in the waterbody (see Ramsar criterion 6 for waterbirds).
- Limit of species range.

See the individual expert panel reports for the priority species traits specific to an ACA.

Criteria 6. Special Features: Special features are areas identified by flora, fauna and ecology expert panels which exhibit characteristics beyond those identified in other criteria and which the expert panels consider to be of the highest ecological importance. Special feature traits can relate to, but are not solely restricted to geomorphic features, unique ecological processes, presence of unique or distinct habitat, presence of unique or special hydrological regimes e.g. spring-fed streams. Special features are rated on a 1 - 4 scale (4 being the highest).

Criteria 7. Connectivity: This criterion is based on the concept that appropriately connected aquatic ecosystems are healthy and resilient, with maximum potential biodiversity and delivery of ecosystem services.

Criteria 8. Representativeness: This criterion applies primarily to non-riverine assessments, evaluates the rarity and uniqueness of a wetland type in relation to specific geographic areas. Rarity is determined by the degree of wetland protection within "protected Areas" estate or within an area subject to the *Fisheries Act 1994*, *Coastal Protection and Management Act 1995*, or *Marine Parks Act 2004*. Wetland uniqueness evaluates the relative abundance and size of a wetland or wetland management group within geographic areas such as catchment and subcatchment.

Riverine Wetlands

Riverine wetlands are all wetlands and deepwater habitats within a channel. The channels are naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water. AquaBAMM, when applied to riverine wetlands uses a discrete spatial unit termed subsections. A subsection can be considered as an area which encompasses discrete homogeneous stream sections in terms of their natural attributes (i.e. physical, chemical, biological and utilitarian values) and natural resources. Thus in an ACA, an aquatic conservation significance score is calculated for each subsection and applies to all streams within a subsection, rather than individual streams as such.

Please note, the area figures provided in Tables 16 and 17, are derived using the extent of riverine subsections within the AOI. Refer to **Map 5** for further information. A summary of the conservation significance of riverine wetlands within the AOI is provided in the following table.

Table 16: Overall level/s of riverine aquatic conservation significance

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Very High	0.0	0.0

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
High	0.0	0.0
Medium	882.05	100.0
Low	0.0	0.0
Very Low	0.0	0.0

The individual aquatic conservation criteria ratings for riverine wetlands within the AOI are listed below.

Table 17: Level/s of riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic					882.05	100.0		
2. Naturalness catchment					882.05	100.0		
3. Diversity and richness	882.05	100.0						
4. Threatened species and ecosystems			882.05	100.0				
5. Priority species and ecosystems					882.05	100.0		
6. Special features								
7. Connectivity								
8. Representative-ness								

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to riverine wetlands within the AOI.

Table 18: Expert panel decisions for assigning overall levels of riverine aquatic conservation significance

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

(No Records)

Non-riverine Wetlands

Non-riverine wetlands include both lacustrine and palustrine wetlands, however, do not currently incorporate estuarine, marine or subterranean wetland types. A summary of the conservation significance of non-riverine wetlands within the AOI is provided in the following table. Refer to **Map 6** for further information.

Table 19: Overall level/s of non-riverine aquatic conservation significance

Aquatic conservation significance (non-riverine wetlands)	Area (Ha)	% of AOI
(No Records)		

The following table provides an assessment of non-riverine wetlands within the AOI and associated aquatic conservation criteria values.

Table 20: Level/s of non-riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
(No Records)								

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to non-riverine wetlands within the AOI.

Table 21: Expert panel decisions for assigning overall levels of non-riverine aquatic conservation significance.

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

(No Records)

Threatened and Priority Species

Introduction

This chapter contains a list of threatened and priority flora and/or fauna species that have been recorded on, or within 4km of the Assessment Area.

The information presented in this chapter with respect to species presence is derived from compiled databases developed primarily for the purpose of BPAs and ACAs. Data is collated from a number of sources and is updated periodically.

It is important to note that the list of species provided in this report, may differ when compared to other reports generated from other sources such as the State government's WildNet, HerbreCs or the federal government's EPBC database for a number of reasons.

Records for threatened and priority species are filtered and checked based on a number of rules including:

- Taxonomic nomenclature - current scientific names and status,
- Location - cross-check co-ordinates with location description,
- Taxon by location - requires good knowledge of the taxon and history of the record,
- Duplicate records - identify and remove,
- Expert panels - check records and provide new records,
- Flora cultivated records excluded,
- Use precise records less than or equal to 2000m,
- Use recent records greater than or equal to 1975 animals, greater than or equal to 1950 plants.

Threatened Species

Threatened species are those species classified as "Endangered" or "Vulnerable" under the *Environment Protection and Biodiversity Conservation Act 1999* or "Endangered", "Vulnerable" or "Near threatened" under the *Nature Conservation Act 1992*.

The following threatened species have been recorded on, or within approximately 4km of the AOI.

Table 22: Threatened species recorded on, or within 4km of the AOI

(no results)

NB. Please note that the threatened species listed in this section are based upon the most recently compiled DES internal state-wide threatened species dataset. This dataset may contain additional records that were not originally available for inclusion in the relevant individual BPAs and ACAs.

*JAMBA - Japan-Australia Migratory Bird Agreement; CAMBA - China-Australia Migratory Bird Agreement; ROKAMBA - Republic of Korea-Australia Migratory Bird Agreement; CMS - Convention on the Conservation of Migratory Species.

**Y - wetland indicator species.

BPA Priority Species

A list of BPA priority species that have been recorded on, or within approximately 4km of the AOI is contained in the following table.

Table 23: Priority species recorded on, or within 4km of the AOI

(no results)

NB. Please note that the list of priority species is based on those species identified in the BPAs, however records for these species may be more recent than the originals used. furthermore, the BPA priority species databases are updated from time to time. At each update, the taxonomic details for all species are amended as necessary to reflect current taxonomic name and/or status changes.

ACA Priority Species

A list of ACA priority species used in riverine and non-riverine ACAs that have been recorded on, or within approximately 4km of the AOI are contained in the following tables.

Table 24: Priority species recorded on, or within 4 km of the AOI - riverine

Species	Common name	Back on Track rank	Identified flora/fauna
<i>Eucalyptus camaldulensis</i>			FL

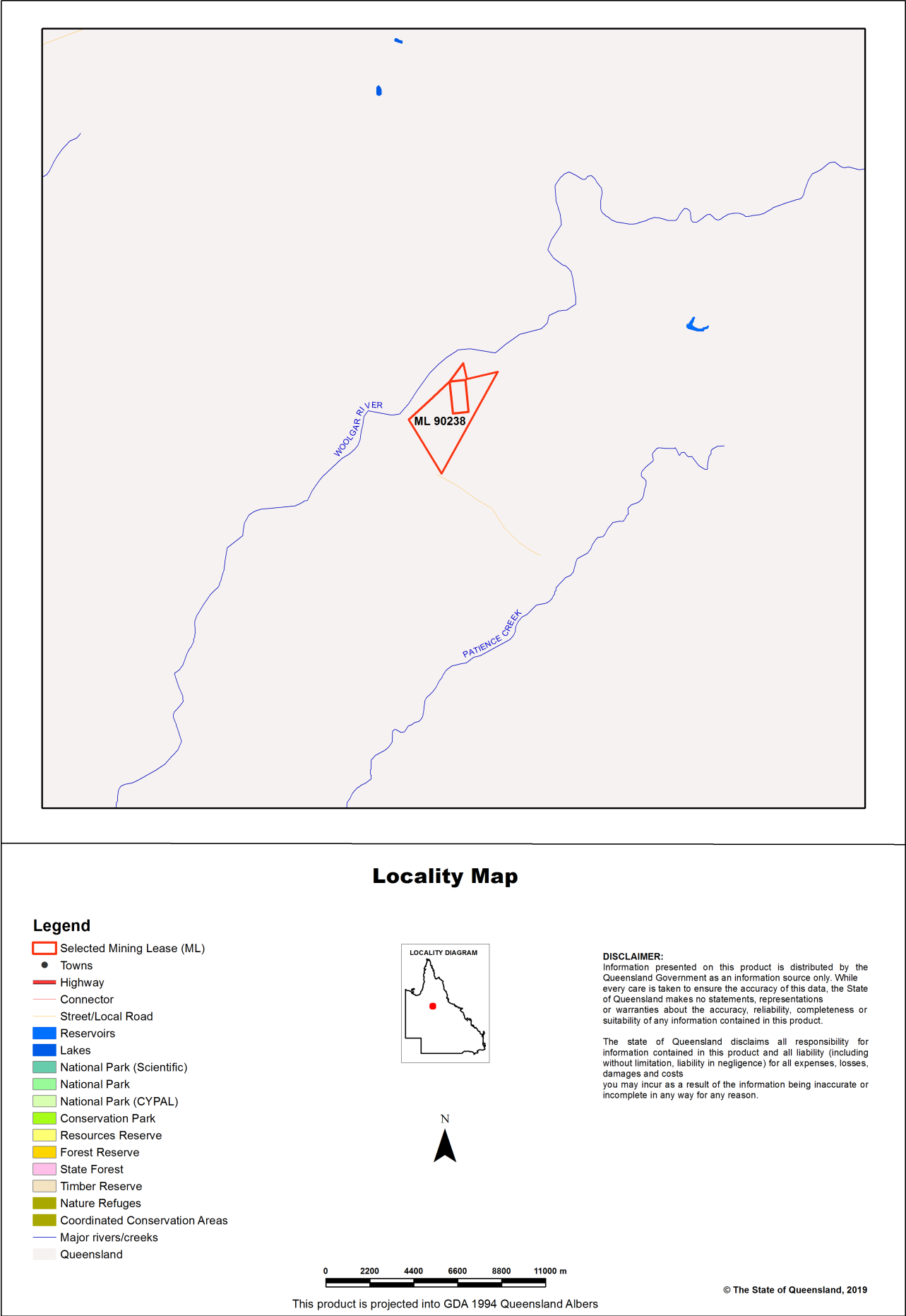
Table 25: Priority species recorded on, or within 4 km of the AOI - non-riverine

Species	Common name	Back on Track rank	Identified flora/fauna
<i>Eucalyptus camaldulensis</i>			FL

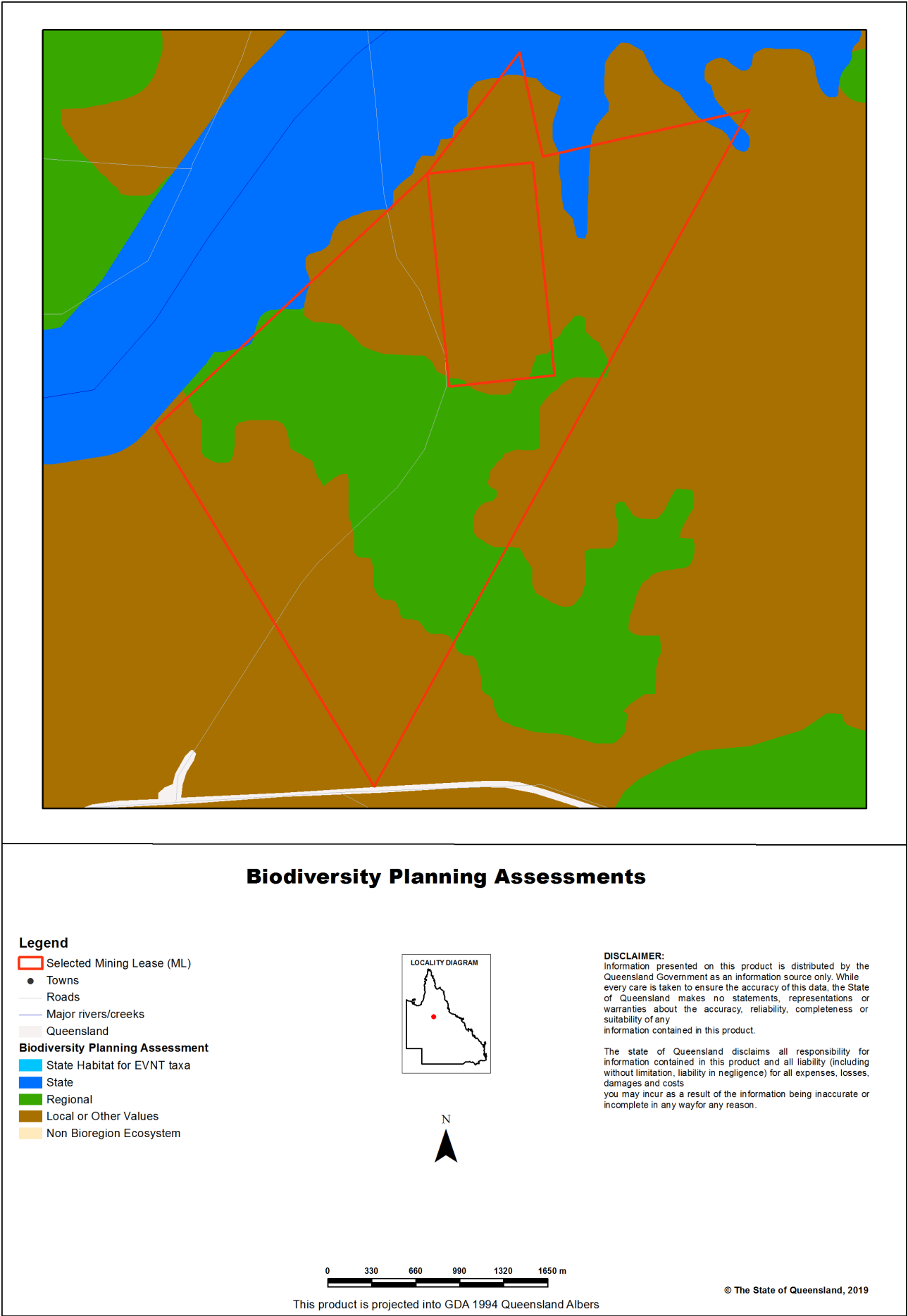
NB. Please note that the priority species records used in the above two tables are comprised of those adopted for the released individual ACAs. The ACA riverine and non-riverine priority species databases are updated from time to time to reflect new release of ACAs. At each update, the taxonomic details for all ACAs records are amended as necessary to reflect current taxonomic name and/or status changes.

Maps

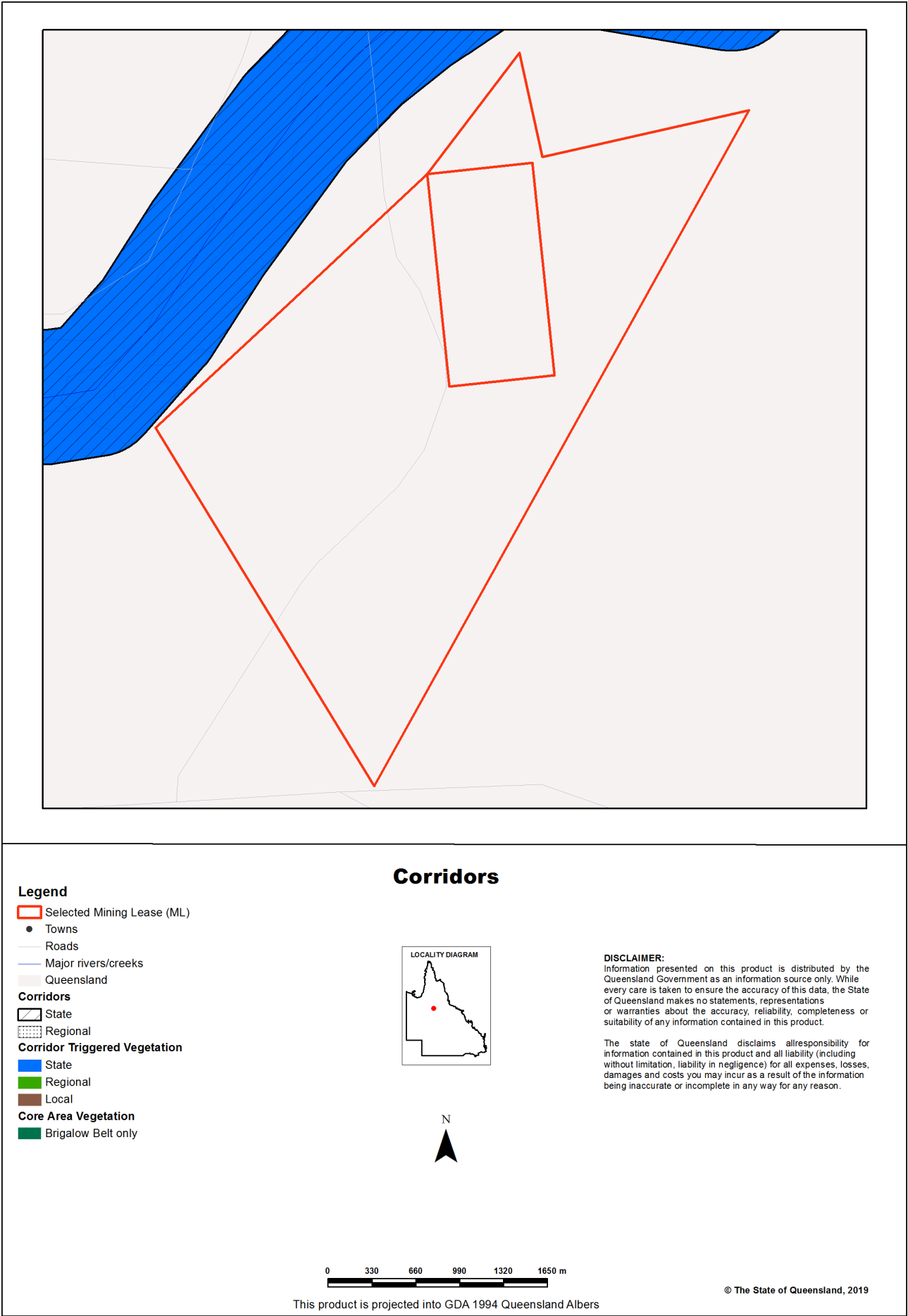
Map 1 - Locality Map



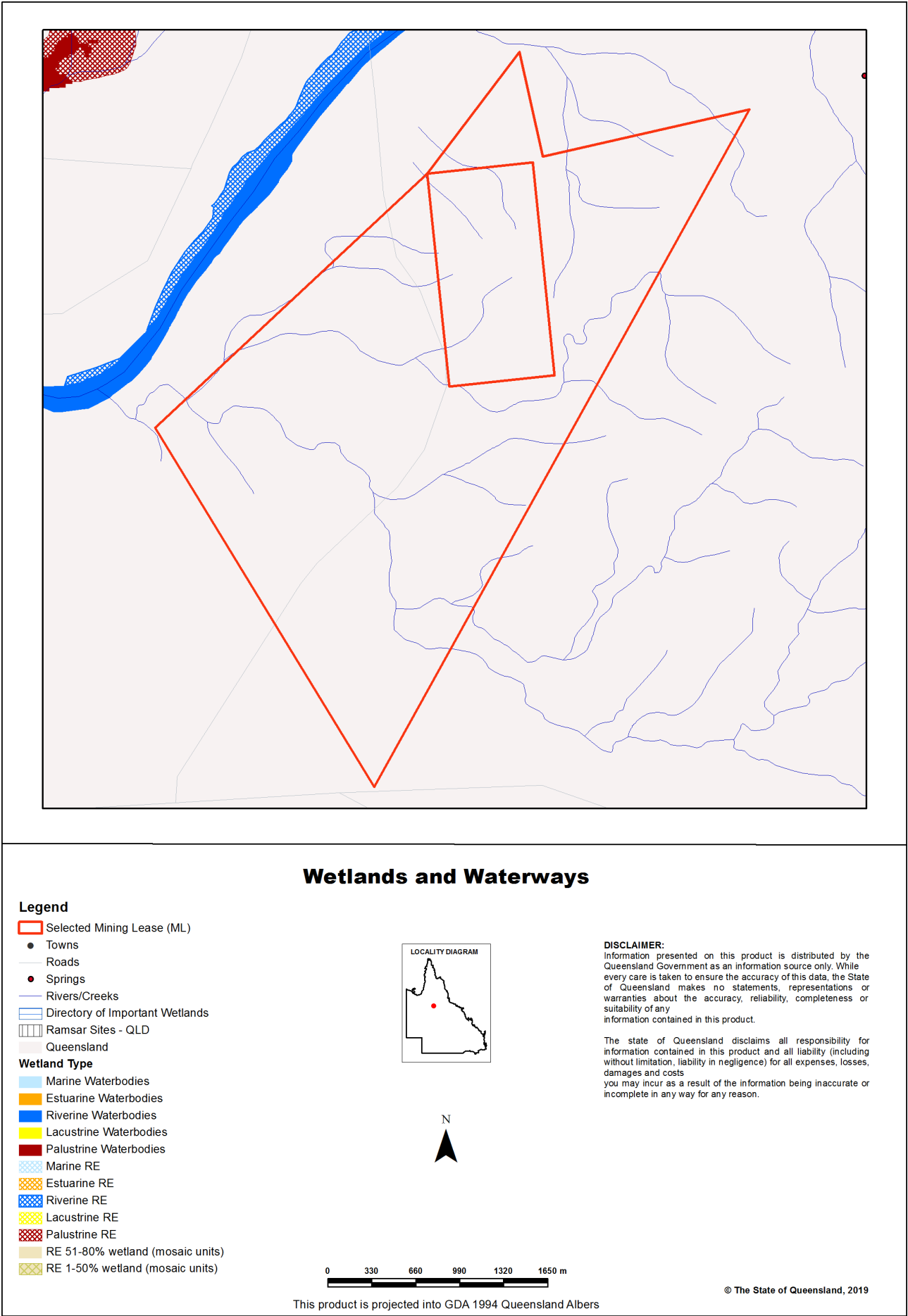
Map 2 - Biodiversity Planning Assessment (BPA)



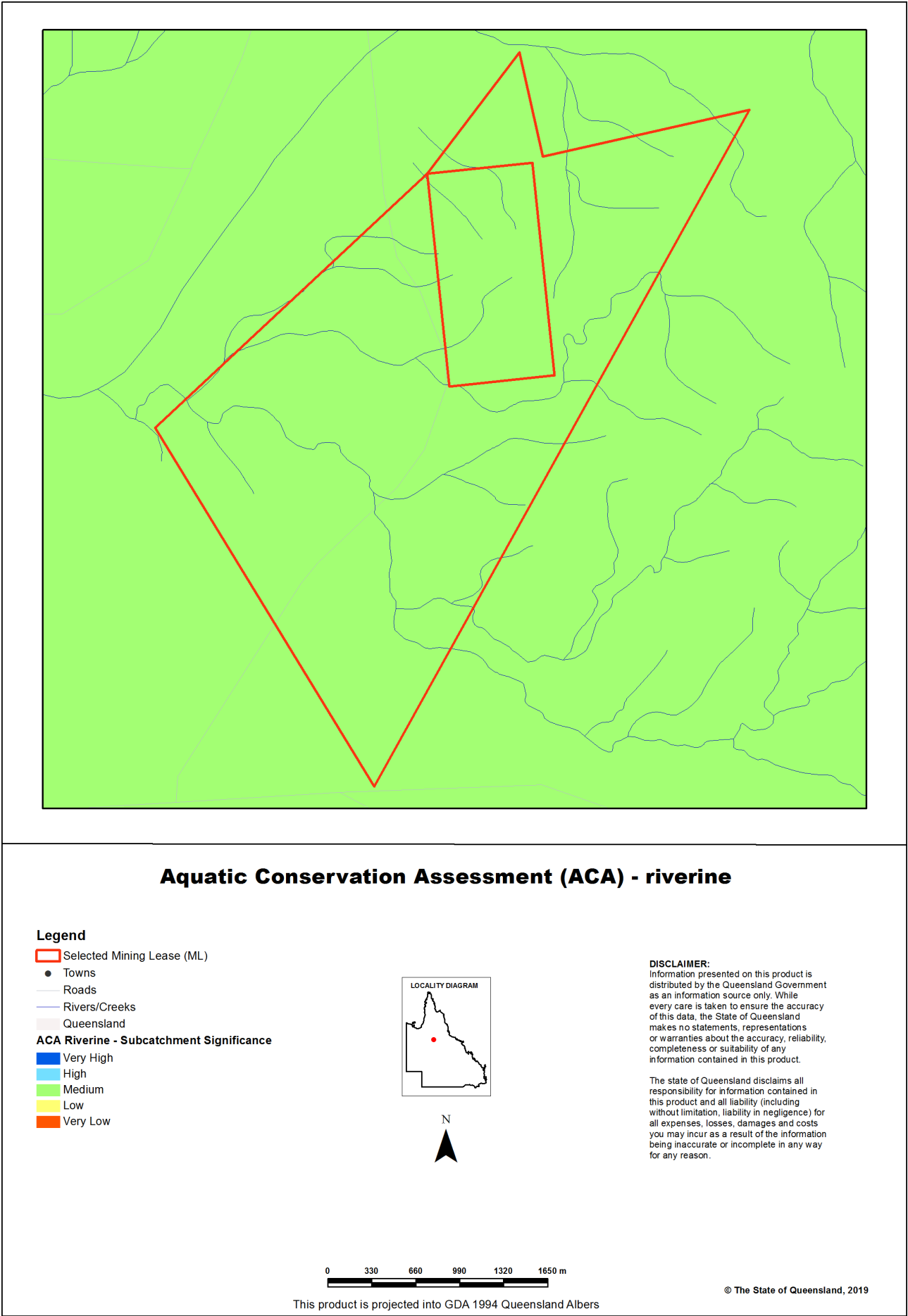
Map 3 - Corridors



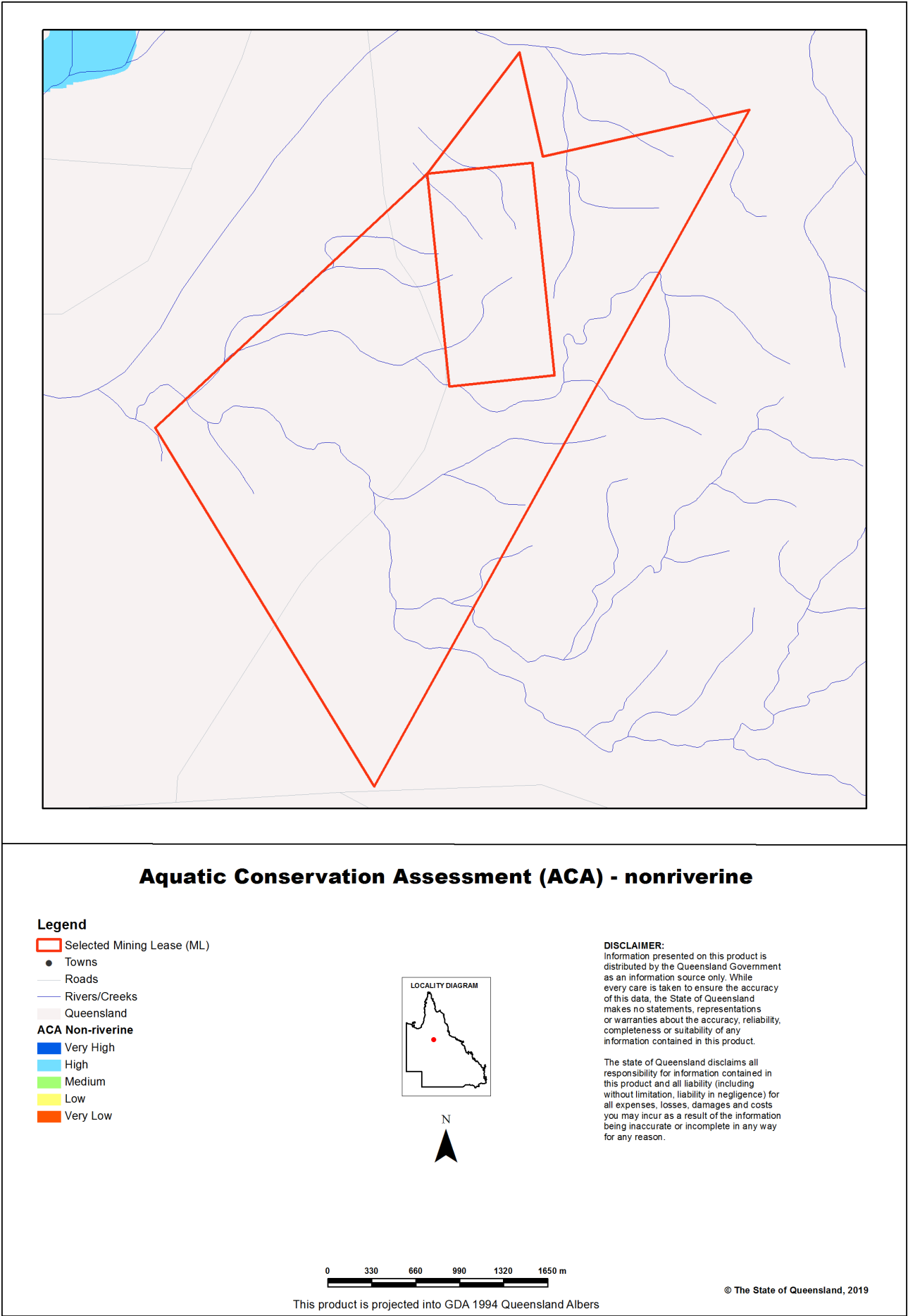
Map 4 - Wetlands and waterways



Map 5 - Aquatic Conservation Assessment (ACA) - riverine



Map 6 - Aquatic Conservation Assessment (ACA) - non-riverine



References

Clayton, P.D., Fielder, D.F., Howell, S. and Hill, C.J. (2006) *Aquatic biodiversity assessment and mapping method (AquaBAMM): a conservation values assessment tool for wetlands with trial application in the Burnett River catchment*. Published by the Environmental Protection Agency, Brisbane. ISBN 1-90928-07-3. Available at

<http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca/>

Environmental Protection Agency (2002) *Biodiversity Assessment and Mapping Methodology. Version 2.1, July 2002*. (Environmental Protection Agency, Brisbane).

Morton, S. R., Short, J. and Barker, R. D. with an Appendix by G.F. Griffin and G. Pearce (1995). *Refugia for Biological Diversity in Arid and Semi-arid Australia. Biodiversity Series*, Paper No. 4, Biodiversity Unit, Environment Australia.

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

Theme	Datasets
Aquatic Conservation Assessments Non-riverine*	Combination of the following datasets: Cape York Peninsula Non-riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Non-riverine v1.3 Lake Eyre and Bulloo Basins v1.1 QMDB Non-riverine ACA v1.4 Southeast Queensland ACA v1.1 WBB Non-riverine ACA v1.1
Aquatic Conservation Assessments Riverine*	Combination of the following datasets: Cape York Peninsula Riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Riverine v1.1 Lake Eyre and Bulloo Basins v1.1 QMDB Riverine ACA v1.4 Southeast Queensland ACA v1.1 WBB Riverine ACA v1.1
Biodiversity Planning Assessments*	Combination of the following datasets: Brigalow Belt BPA v2.1 Cape York Peninsula BPA v1.1 Central Queensland Coast BPA v1.3 Channel Country BPA v1.1 Desert Uplands BPA v1.3 Einasleigh Uplands BPA v1.1 Gulf Plains BPA v1.1 Mitchell Grass Downs BPA v1.1 Mulga Lands BPA v1.4 New England Tableland v2.3 Southeast Queensland v4.1
Statewide BPA Corridors*	Statewide corridors v1.4
Threatened Species	An internal DES database compiled from Wildnet, Herbrecks, Corveg, the QLD Museum, as well as other incidental sources.
BPA Priority Species	An internal DES database compiled from Wildnet, Herbrecks, Corveg, the QLD Museum, as well as other incidental sources.
ACA Priority Species	An internal DES database compiled from Wildnet, Herbrecks, Corveg, the QLD Museum, as well as other incidental sources.

*These datasets are available at:

<http://dds.information.qld.gov.au/DDS>

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
ACA	- Aquatic Conservation Assessment
AQUABAMM	- Aquatic Biodiversity Assessment and Mapping Methodology
BAMM	- Biodiversity Assessment and Mapping Methodology
BoT	- Back on Track
BPA	- Biodiversity Planning Assessment
CAMBA	- China-Australia Migratory Bird Agreement
DES	- Department of Environment and Science
EPBC	- <i>Environment Protection and Biodiversity Conservation Act 1999</i>
EVNT	- Endangered, Vulnerable, Near Threatened
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
JAMBA	- Japan-Australia Migratory Bird Agreement
NCA	- <i>Nature Conservation Act 1992</i>
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
ROKAMBA	- Republic of Korea-Australia Migratory Bird Agreement

WetlandMaps Report



For selected area of interest

Current as at 12/09/2019

Environmental Reports - General Information

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the Area of Interest(AOI) (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no matters of interest have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the mapping of water bodies and wetland regional ecosystems across Queensland. The Queensland wetland mapping was produced using existing information including water body mapping derived from Landsat satellite imagery, regional ecosystem mapping, topographic data, and a springs database. The result is a consistent wetland map for the whole of Queensland.

Ancillary data, such as higher resolution imagery (for example SPOT and aerial photographs), other vegetation and wetland mapping, geology, soil and land system mapping was also used in attributing and assessing the derived Queensland Wetlands Program wetland mapping products.

The wetland mapping was done in accordance with a detailed peer reviewed methodology which included quality assurance measures for all steps in the process. For more detailed information on how the Queensland Wetlands Program wetland mapping was produced, please see the [Wetland Mapping and Classification Methodology](#).

Disclaimer

The State of Queensland, as represented by this department, gives no warranty in relation to the data (including without limitation, accuracy, reliability, completeness or fitness for a particular purpose) hosted on this website.

The user accepts sole responsibility and risk associated with the use and results of department data hosted on this website, irrespective of the purpose to which such use or results are applied. It is recommended that users consider independently verifying any information obtained from this website.

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Summary Information

The following table provides an overview of the area of interest.

Table 1. Area of interest details

Size (ha)	92,974.87
Local Government(s)	Richmond Shire, Croydon Shire
Bioregion(s)	Gulf Plains
Subregion(s)	Claraville Plains, Gilberton Plateau
Catchment(s)	Flinders, Norman
Drainage sub-basin	Norman River, Flinders River, Saxby River

NRM Regions

The following NRM region(s) are in the area of interest:

Southern Gulf NRM

Northern Gulf Resource Management Group

Water Resource Plan Boundaries

The following Water Resource Plan(s) are in the area of interest:

Great Artesian Basin and Other Regional Aquifers

Gulf

Learn more about how Wetlands are mapped in Queensland:

Queensland Wetlands Mapping Definitions

Wetlands are areas of permanent or periodic/intermittent inundation, with water that is static or flowing fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6 metres. To be a wetland the area must have one or more of the following attributes:

- at least periodically the land supports plants or animals that are adapted to and dependent on living in wet conditions for at least part of their life cycle, or
- the substratum is predominantly undrained soils that are saturated, flooded or ponded long enough to develop anaerobic conditions in the upper layers, or
- the substratum is not soil and is saturated with water, or covered by water at some time.

Examples under this definition **include**:

- those areas shown as a river, stream, creek, swamp, lake, marsh, waterhole, wetland, billabong, pool or spring on the latest Sunmap 1:25,000, 1:50,000, 1:100,000 or 1:250,000 topographic map
- areas defined as wetlands on local or regional maps prepared with the aim of mapping wetlands
- wetland regional ecosystems (REs) as defined by the Queensland Herbarium (Environmental Protection Agency 2005a)
- areas containing recognised hydrophytes as provided by the Queensland Herbarium
- saturated parts of the riparian zone
- artificial wetlands such as farm dams
- water bodies not connected to rivers or flowing water such as billabongs and rock pools.

Examples under this definition **exclude**:

- areas that may be covered by water but are not wetlands according to the definition
- floodplains that are intermittently covered by flowing water but do not meet the hydrophytes and soil criteria

- riparian zone above the saturation level.

Wetland Systems

Riverine wetlands are all wetlands and deepwater habitats within a channel. The channels are naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water.

Palustrine wetlands are primarily vegetated non-channel environments of less than 8 hectares. They include billabongs, swamps, bogs, springs, soaks etc, and have more than 30% emergent vegetation.

Lacustrine wetlands are large, open, water-dominated systems (for example, lakes) larger than 8ha. This definition also applies to modified systems (for example, dams), which are similar to lacustrine systems (for example, deep, standing or slow-moving waters).

Marine wetlands include the area of ocean from the coastline or estuary, extending to the jurisdictional limits of Queensland waters (3 nautical mile limit). This definition differs from that in Ramsar, as it includes waters deeper than 6m below the lowest astronomical tide.

Estuarine wetlands are those with oceanic water sometimes diluted with freshwater run-off from the land.

Subterranean wetlands are wetlands occurring below the surface of the ground and that are fed by groundwater i.e. caves and aquifers. These wetlands provide water to groundwater dependent ecosystems.

Methodology and Wetland Classification: <https://wetlandinfo.des.qld.gov.au/wetlands/facts-maps/wetland-background/>

Links and support

Other sites that deliver wetland related information include:

WetlandSummary tool: <https://wetlandinfo.des.qld.gov.au/wetlands/facts-maps/>

Queensland Spatial Catalogue: <http://qldspatial.information.qld.gov.au/catalogue/custom/index.page>

Queensland Globe: <https://qldglobe.information.qld.gov.au/>

Environmental reports online: <https://environment.ehp.qld.gov.au/report-request/environment/>

Wetland on-line education modules: <https://wetlandinfo.des.qld.gov.au/wetlands/resources/training/>

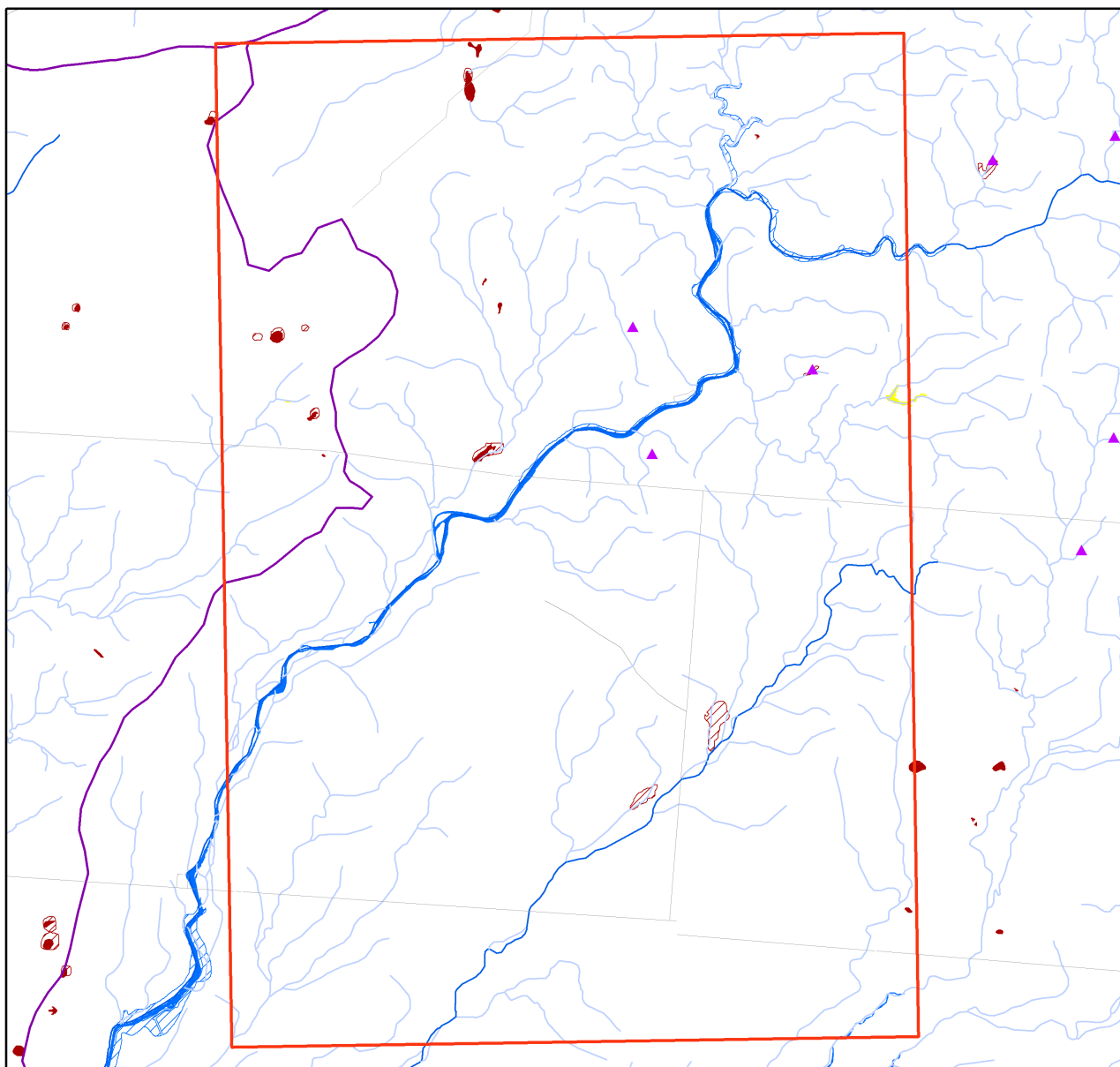
Regional Ecosystem Mapping information: :

<https://www.qld.gov.au/environment/plants-animals/plants/herbarium/mapping-ecosystems>

Aquatic Conservation Assessments: : <https://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca/>

Groundwater Dependant Ecosystems information:

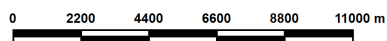
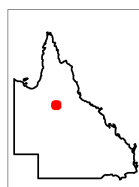
<https://wetlandinfo.des.qld.gov.au/wetlands/ecology/aquatic-ecosystems-natural/groundwater-dependent/>



Legend

- polygon
- ▲ Springs
- Dams and weirs
- Towns
- Highways
- Roads
- Cadastral boundaries
- Sub-basin
- Wetland Mapping**
- Wetland System - Water Bodies**
- Marine Waterbodies
- Estuarine Waterbodies
- Riverine Waterbodies
- Lacustrine Waterbodies
- Palustrine Waterbodies
- Wetland System - Regional Ecosystems**
- Marine RE
- Estuarine RE
- Riverine RE
- Lacustrine RE
- Palustrine RE
- RE 51_80% wetland (mosaic units)
- Riverine System Drainage Lines**
- Major
- Minor

Queensland Wetland Map

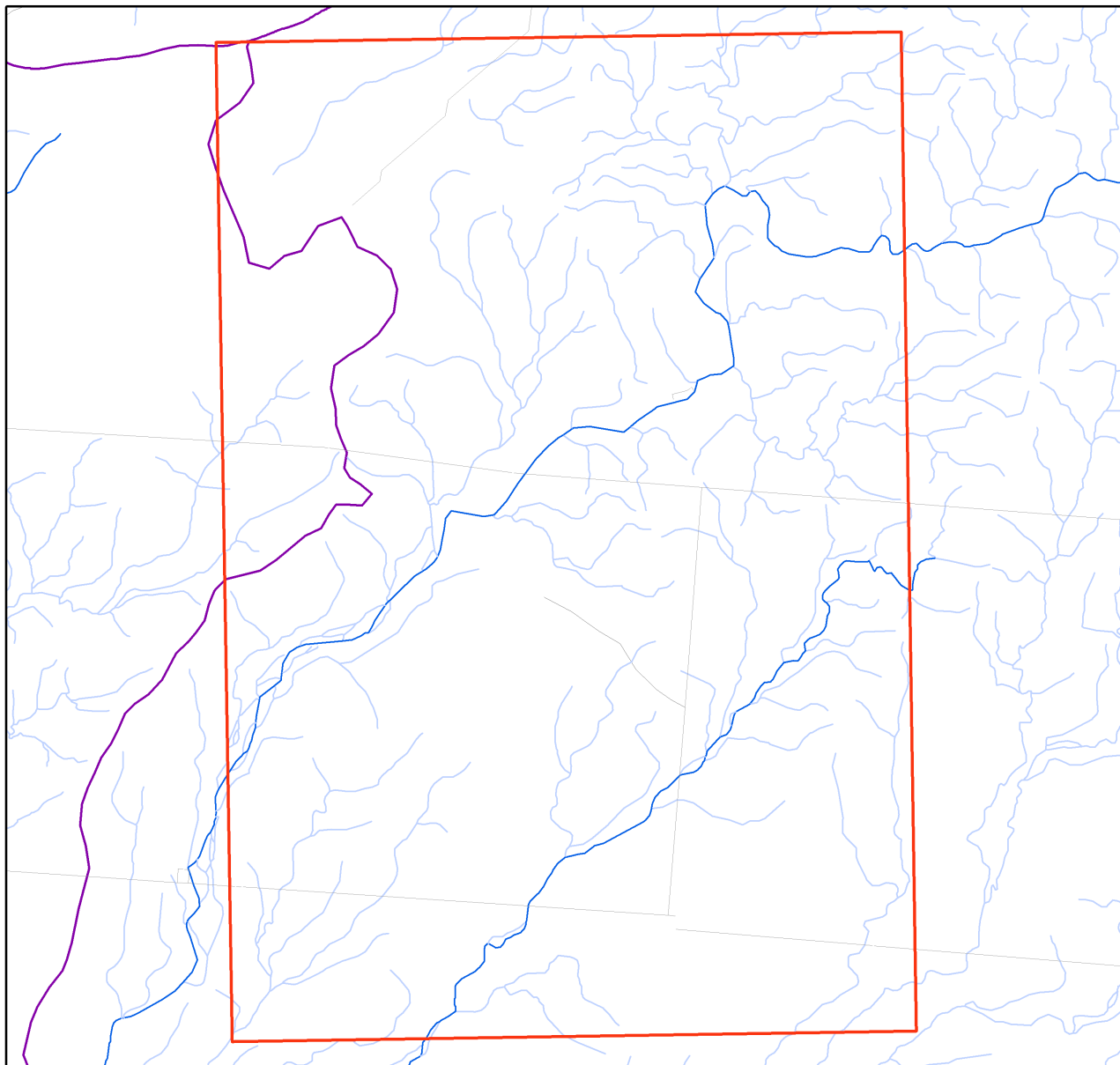


Horizontal Datum: Geographic Datum of Australia 1994 (GDA94)

This map was produced by the Queensland Wetlands Program, Department of Environment and Science, September 2019.

For further information contact: wetlands@des.qld.gov.au

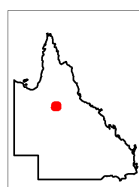
© The State of Queensland, 2019



Queensland Wetlands of Importance Map

Legend

- polygon
- Towns
- Cadastral boundaries
- Highways
- Roads
- Sub-basin
- Directory of Important Wetlands
- Ramsar Wetlands
- Riverine System Drainage Lines**
- Major
- Minor

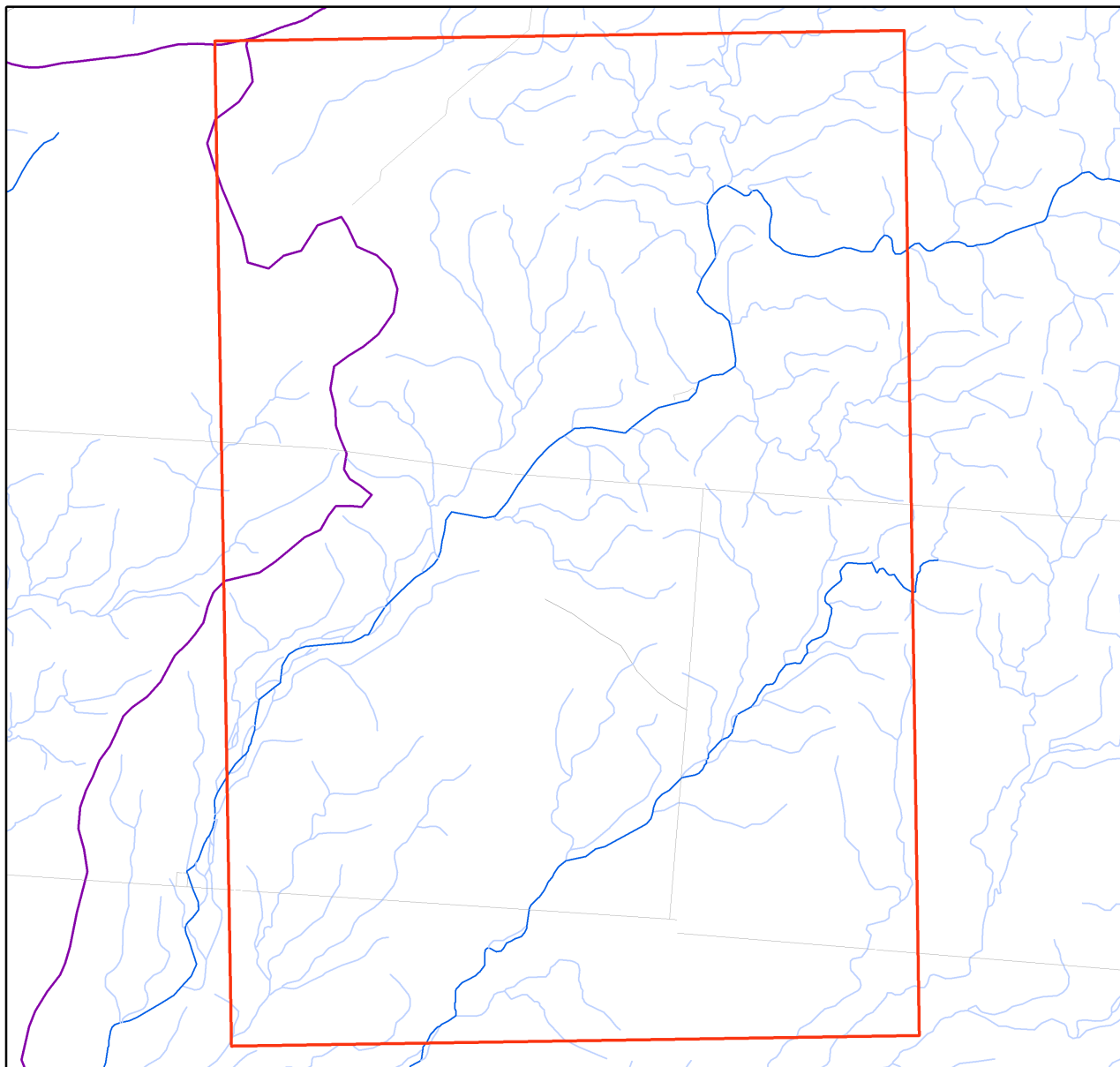


Horizontal Datum: Geographic Datum of Australia 1994 (GDA94)

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Legend

- polygon
- Towns
- Cadastral boundaries
- Highways
- Roads
- Sub-basin

Riverine System Drainage Lines

- Major
- Minor

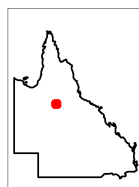
Protected Areas

- National Park
- National Park (Scientific)
- National Park (CYPAL)
- Conservation Park
- Resources Reserve
- Forest Reserve
- State Forest
- Timber Reserve

Marine Parks

- General Use Zone
- Habitat Protection Zone
- Estuarine Conservation Zone
- Conservation Park Zone
- Buffer Zone
- Scientific Research Zone
- Marine National Park Zone
- Preservation Zone

Queensland Protected Area Map



Horizontal Datum: Geographic Datum of Australia 1994 (GDA94)

This map was produced by the Queensland Wetlands Program, Department of Environment and Science, September 2019.

For further information contact: wetlands@des.qld.gov.au

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Wetland habitat types in the AOI. Total area: 1154.18ha

Wetland Class	Habitat type	Area (ha)
Riverine	Riverine	847.64
Palustrine	Arid/ Semi-arid non-floodplain (spring) swamps	124.94
Palustrine	Arid/ Semi-arid non-floodplain tree swamps	90.64
Palustrine	Arid/ Semi-arid floodplain tree swamps	58.68
Lacustrine	Artificial/ highly modified wetlands (dams, ring tanks, irrigation channel)	21.67
Palustrine	Arid/ Semi-arid floodplain grass, sedge, herb swamps	10.61

Queensland wetland habitat typology: Major wetland habitat types for wetland conceptual models and wetland management profiles

Wetland name	Conceptual model	Wetland profile
Mangrove Wetlands	Not developed	Mangrove Wetlands
Saltmarsh Wetlands	Not developed	Saltmarsh Wetlands
Coastal and subcoastal saline swamps of all substrates, water regimes, topographic types and vegetation communities	Coastal and subcoastal saline swamps	Coastal grass-sedge wetlands
Coastal and subcoastal non-floodplain tree swamps (Melaleuca and Eucalypt) of all substrates and water regimes	Coastal and subcoastal non-floodplain tree swamps - melaleuca and eucalypt	Coastal and subcoastal tree swamps
Coastal and subcoastal non-floodplain wet heath swamps of all substrates and water regimes	Coastal and subcoastal non-floodplain wet heath swamps	Coastal and subcoastal wet heath swamps
Coastal and subcoastal non-floodplain grass, sedge and herb swamps of all substrates and water regimes	Coastal and subcoastal non-floodplain grass, sedge and herb swamps	Coastal grass-sedge wetlands
Coastal and subcoastal spring swamps of all substrates, water types, water regimes and vegetation communities	Coastal and subcoastal spring swamps	Great Artesian Basin spring wetlands
Coastal and subcoastal floodplain tree swamps - melaleuca and eucalypt of all substrates and water regimes	Coastal and subcoastal floodplain tree swamps - melaleuca and eucalypt	Coastal and subcoastal tree swamps
Coastal and subcoastal floodplain wet heath swamps of all substrates and water regimes	Coastal and subcoastal floodplain wet heath swamps	Coastal and subcoastal wet heath swamps
Coastal and subcoastal floodplain, grass, sedge herb swamps of all substrates and water regimes	Coastal and subcoastal floodplain grass, sedge, herb swamps	Coastal grass-sedge wetlands
Coastal and subcoastal tree swamps - palm of all substrates, topographic types and water regimes	Coastal and subcoastal floodplain tree swamps - palm	Coastal Palm Swamps
Coastal and subcoastal Floodplain Lakes of all substrates, water types and water regimes	Coastal and subcoastal Floodplain Lakes	Coastal and subcoastal floodplain lakes and non-floodplain soil lakes
Coastal and subcoastal non-floodplain rock lakes of all water types and water regimes	Coastal and subcoastal non-floodplain rock lakes	Coastal and subcoastal non-floodplain rock lakes
Coastal and subcoastal non-floodplain sand lakes (window) of all water types and water regimes	Coastal and subcoastal non-floodplain sand lakes - window	Coastal non-floodplain sand lakes
Coastal and subcoastal non-floodplain sand lakes (perched) of all water types and water regimes	Coastal and subcoastal non-floodplain sand lakes - perched	Coastal non-floodplain sand lakes

Wetland name	Conceptual model	Wetland profile
Coastal and subcoastal non-floodplain soil lakes of all water types and water regimes	Coastal and subcoastal non-floodplain soil lakes	Coastal and subcoastal floodplain lakes and non-floodplain soil lakes
Arid and semi-arid saline swamps of all substrates, water regimes, topographic types and vegetation communities	Arid and semi-arid saline swamps	Semi-arid swamps
Arid and semi-arid fresh tree swamps of all substrates, and water regimes and topographic types	Arid and semi-arid tree swamps	Arid swamps Semi-Arid swamps
Arid and semi-arid lignum swamps of all substrates, and water regimes and topographic types	Arid and semi-arid lignum swamps	Arid swamps Semi-Arid swamps
Arid and semi-arid grass, sedge, herb swamps of all substrates, water regimes and topographic types	Arid and semi-arid grass, sedge, herb swamps	Arid swamps Semi-Arid swamps
Arid and semi-arid fresh non-floodplain tree swamps of all substrates and water regimes	Arid and semi-arid non-floodplain tree swamps	Arid swamps Semi-Arid swamps
Arid and semi-arid fresh non-floodplain lignum swamps of all substrates and water regimes	Arid and semi-arid non-floodplain lignum swamps	Arid swamps Semi-Arid swamps
Arid and semi-arid fresh non-floodplain grass, sedge, herb swamps of all substrates and water regimes	Arid and semi-arid non-floodplain grass, sedge, herb swamps	Arid swamps Semi-Arid swamps
Arid and semi-arid, non-floodplain swamps - springs of all substrates, water regimes and vegetation communities	Arid and semi-arid spring swamps	Great Artesian Basin spring wetlands
Arid and semi-arid, saline lakes of all substrates, topographic types and water regimes	Arid and semi-arid saline lakes	Arid and semi-arid lakes
Arid and semi-arid, floodplain lakes of all, substrates and water regimes	Arid and semi-arid floodplain lakes	Arid and semi-arid lakes
Arid and semi-arid, non-floodplain Lakes of all substrates and water regimes	Arid and semi-arid non-floodplain lakes	Arid and semi-arid lakes
Arid/ semi-arid, non-floodplain (clay pans) lakes of all substrates and water regimes	Arid and semi-arid fresh non-floodplain lakes (clay pans)	Arid and semi-arid lakes
Arid and semi-arid, Permanent Lakes permanently inundated lakes of all substrates, water types, topographic types and vegetation communities	Arid and semi-arid permanent lakes	Arid and semi-arid lakes

WildNet Records Species List

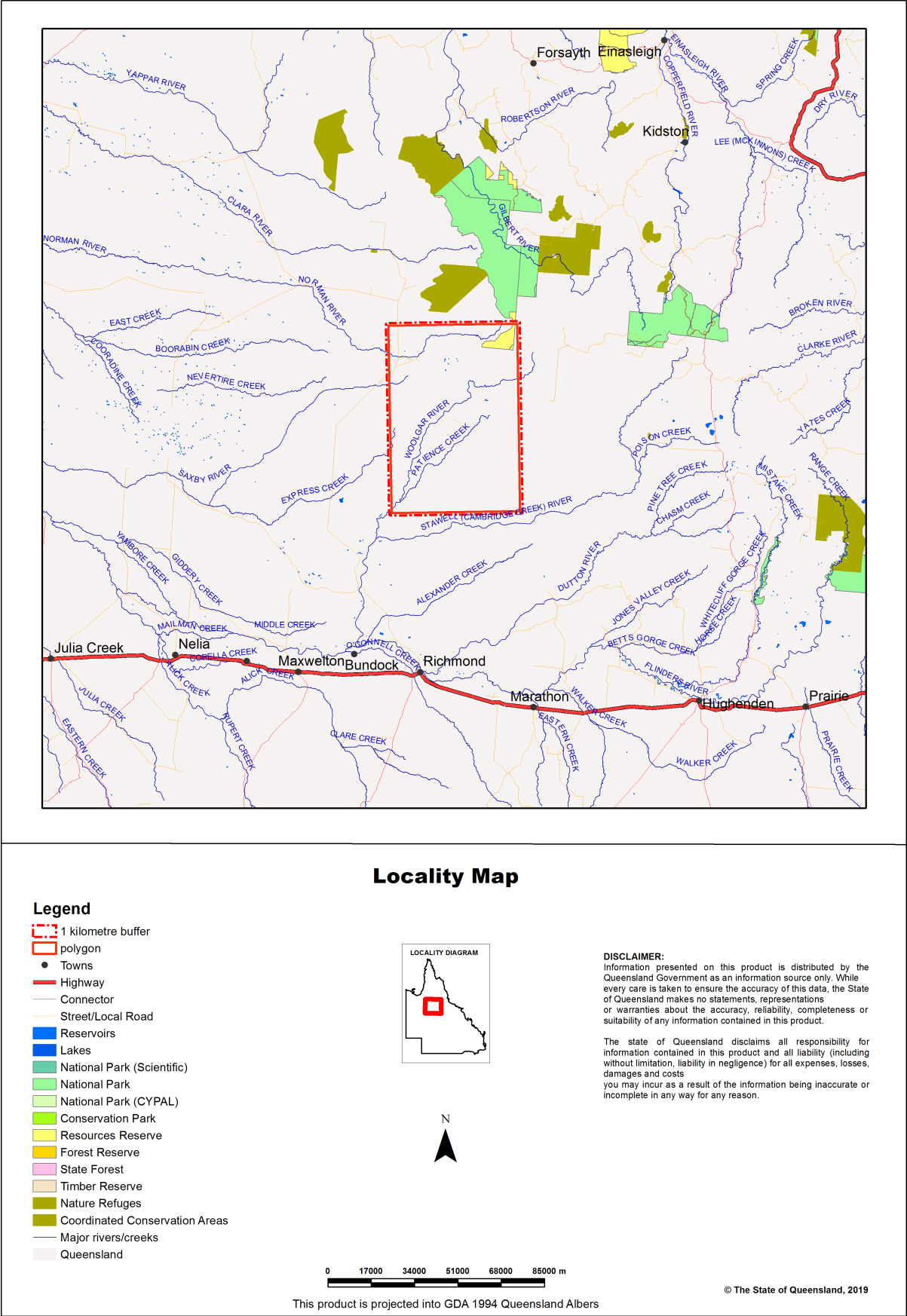


For the selected area of interest 371816.18ha

Current as at 12/09/2019

WildNetspecieslist

Map 1. Locality Map



Summary Information

The following table provides an overview of the area of interest .

Table 1. Area of interest details

Size (ha)	371,816.18
Local Government(s)	Richmond Shire, Croydon Shire
Bioregion(s)	Gulf Plains
Subregion(s)	Claraville Plains, Gilberton Plateau
Catchment(s)	Flinders, Norman

Protected Area(s)

The following estates and/or reserves are located in the area of interest:

Rungulla Resources
Reserve

World Heritage Area(s)

No World Heritage Areas are located within the area of interest.

Ramsar Area(s)

No Ramsar Areas are located within the area of interest.

Species List

Introduction

This Species List report is derived only from records from the WildNet database managed by the Department of Environment and Science. Other data sources may provide additional information on species occurrence.

The WildNet dataset is constantly being enhanced and the taxonomic and status information revised. If a species does not occur in the report, it does not mean it doesn't occur there and listed species may also no longer inhabit the area.

Table 2 lists the animals recorded within the area of interest and its one kilometre buffer.

Table 3 lists the plants recorded within the area of interest and its one kilometre buffer.

Table 4 lists the fungi recorded within the area of interest and its one kilometre buffer.

Table 5 lists the protists recorded within the area of interest and its one kilometre buffer.

Table 2. Animals recorded within the area of interest and its one kilometre buffer

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
1407	Aves	Acanthizidae	<i>Gerygone fusca</i>	western gerygone	C	None	0	1	26/07/2000
1396	Aves	Acanthizidae	<i>Gerygone olivacea</i>	white-throated gerygone	C	None	0	1	26/07/2000
1371	Aves	Acanthizidae	<i>Smicromis brevirostris</i>	weebill	C	None	0	4	26/07/2000
1721	Aves	Accipitridae	<i>Aviceda subcristata</i>	Pacific baza	C	None	0	1	26/07/2000
1658	Aves	Artamidae	<i>Artamus cinereus</i>	black-faced woodswallow	C	None	0	2	26/07/2000
1646	Aves	Artamidae	<i>Artamus minor</i>	little woodswallow	C	None	0	1	22/09/1986

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
1654	Aves	Artamidae	<i>Cracticus nigrogularis</i>	pied butcherbird	C	None	0	1	26/07/2000
1644	Aves	Artamidae	<i>Cracticus tibicen</i>	Australian magpie	C	None	0	2	26/07/2000
1636	Aves	Campephagidae	<i>Coracina novae hollandiae</i>	black-faced cuckoo-shrike	C	None	0	1	26/07/2000
1642	Aves	Campephagidae	<i>Lalage tricolor</i>	white-winged triller	C	None	0	1	26/07/2000
1628	Aves	Climacteridae	<i>Climacteris picumnus</i>	brown treecreeper	C	None	0	2	22/09/1986
1605	Aves	Corcoracidae	<i>Struthidea cinerea</i>	apostlebird	C	None	0	1	26/07/2000
1608	Aves	Corvidae	<i>Corvus coronoides</i>	Australian raven	C	None	0	1	26/07/2000
1609	Aves	Corvidae	<i>Corvus orru</i>	Torresian crow	C	None	0	1	26/07/2000
1767	Aves	Halcyonidae	<i>Dacelo novaeguineae</i>	laughing kookaburra	C	None	0	1	26/07/2000
1761	Aves	Halcyonidae	<i>Todiramphus pyrrhopygius</i>	red-backed kingfisher	C	None	0	1	22/09/1986
1292	Aves	Megaluridae	<i>Cincloramphus mathewsi</i>	rufous songlark	C	None	0	1	26/07/2000
1496	Aves	Meliphagidae	<i>Gavicalis virescens</i>	singing honeyeater	C	None	0	3	26/07/2000
1497	Aves	Meliphagidae	<i>Lichmera indistincta</i>	brown honeyeater	C	None	0	1	26/07/2000
1499	Aves	Meliphagidae	<i>Manorina flavigula</i>	yellow-throated miner	C	None	0	1	26/07/2000
1493	Aves	Meliphagidae	<i>Philemon citreogularis</i>	little friarbird	C	None	0	2	26/07/2000
1764	Aves	Meropidae	<i>Merops ornatus</i>	rainbow bee-eater	C	None	0	2	22/09/1986
1589	Aves	Monarchidae	<i>Grallina cyanoleuca</i>	magpie-lark	C	None	0	3	26/07/2000
1600	Aves	Monarchidae	<i>Myiagra inquieta</i>	restless flycatcher	C	None	0	1	22/09/1986
1611	Aves	Nectariniidae	<i>Dicaeum hirundinaceum</i>	mistletoebird	C	None	0	3	26/07/2000
1453	Aves	Neosittidae	<i>Daphoenositta chrysoptera</i>	varied sittella	C	None	0	1	22/09/1986
1449	Aves	Pachycephalidae	<i>Colluricincla harmonica</i>	grey shrike-thrush	C	None	0	3	26/07/2000
1431	Aves	Pachycephalidae	<i>Oreoica gutturalis</i>	crested bellbird	C	None	0	2	22/09/1986
1437	Aves	Pachycephalidae	<i>Pachycephala rufiventris</i>	rufous whistler	C	None	0	6	26/07/2000
1390	Aves	Pardalotidae	<i>Pardalotus rubricatus</i>	red-browed pardalote	C	None	0	1	26/07/2000
1392	Aves	Pardalotidae	<i>Pardalotus striatus</i>	striated pardalote	C	None	0	5	26/07/2000
1339	Aves	Petroicidae	<i>Microeca fascians</i>	jacky winter	C	None	0	2	26/07/2000

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
1263	Aves	Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	little black cormorant	C	None	0	1	26/07/2000
1318	Aves	Pomatostomidae	<i>Pomatostomus temporalis</i>	grey-crowned babbler	C	None	0	3	26/07/2000
1136	Aves	Psittacidae	<i>Platycercus adscitus</i>	pale-headed rosella	C	None	0	1	26/07/2000
1575	Aves	Rhipiduridae	<i>Rhipidura albiscapa</i>	grey fantail	C	None	0	1	26/07/2000
1576	Aves	Rhipiduridae	<i>Rhipidura leucophrys</i>	willie wagtail	C	None	0	1	22/09/1986
1071	Mammalia	Canidae	<i>Vulpes vulpes</i>	red fox	None	None	0	1	31/12/1936
78	Reptilia	Varanidae	<i>Varanus gouldii</i>	sand monitor	C	None	1	1	31/12/1932

Table 3. Plants recorded within the area of interest and its one kilometre buffer

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
14367	Equisetopsida	Acanthaceae	<i>Nelsonia campestris</i>	None	C	None	1	2	31/12/2000
12115	Equisetopsida	Araliaceae	<i>Hydrocotyle grammatocarpa</i>	None	C	None	1	1	02/06/1999
12285	Equisetopsida	Asteraceae	<i>Blumea saxatilis</i>	None	C	None	0	1	31/12/2000
10999	Equisetopsida	Asteraceae	<i>Olearia xerophila</i>	None	C	None	1	1	02/06/1999
15131	Equisetopsida	Asteraceae	<i>Pterocaulon sphacelatum</i>	applebush	C	None	1	1	25/07/2010
17819	Equisetopsida	Blechnaceae	<i>Blechnum orientale</i>	None	C	None	1	2	31/12/2000
29613	Equisetopsida	Byttneriaceae	<i>Seringia collina</i>	None	C	None	1	1	03/06/1999
15922	Equisetopsida	Byttneriaceae	<i>Waltheria indica</i>	None	C	None	1	1	25/07/2010
10918	Equisetopsida	Caesalpiniaceae	<i>Bauhinia variegata</i>	None	None	None	1	1	15/09/2001
15335	Equisetopsida	Caesalpiniaceae	<i>Erythrophleum chlorostachys</i>	None	C	None	1	1	25/07/2010
13851	Equisetopsida	Caesalpiniaceae	<i>Labichea brassii</i>	None	NT	None	2	2	07/11/2014
14421	Equisetopsida	Caesalpiniaceae	<i>Lysiphyllum cunninghamii</i>	None	C	None	1	1	15/09/2001
15064	Equisetopsida	Caesalpiniaceae	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	None	C	None	1	1	01/06/1999
8346	Equisetopsida	Campanulaceae	<i>Wahlenbergia tumidifructa</i>	None	C	None	1	1	25/07/2010
16385	Equisetopsida	Caryophyllaceae	<i>Polycarpaea corymbosa</i> var. <i>corymbosa</i>	None	C	None	1	1	30/04/2016
35535	Equisetopsida	Convolvulaceae	<i>Bonamia multiflora</i>	None	C	None	1	1	01/06/1999
10540	Equisetopsida	Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	None	C	None	1	1	30/04/2016
16881	Equisetopsida	Convolvulaceae	<i>Jacquemontia paniculata</i> var. <i>tomentosa</i>	None	C	None	1	1	30/04/2016
7569	Equisetopsida	Convolvulaceae	<i>Polymeria lanata</i>	None	C	None	1	1	25/07/2010
17854	Equisetopsida	Cyperaceae	<i>Baumea rubiginosa</i>	soft twigrush	C	None	1	2	31/12/2000
17510	Equisetopsida	Cyperaceae	<i>Cyperus aquatilis</i>	None	C	None	0	1	31/12/2000

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
10520	Equisetopsida	Cyperaceae	<i>Cyperus cristulatus</i>	None	C	None	1	1	01/06/1999
17515	Equisetopsida	Cyperaceae	<i>Cyperus difformis</i>	rice sedge	C	None	0	2	31/12/2000
9443	Equisetopsida	Cyperaceae	<i>Cyperus haspan</i>	None	C	None	0	2	31/12/2000
10209	Equisetopsida	Cyperaceae	<i>Cyperus holoschoenus</i>	None	C	None	0	2	31/12/2000
12420	Equisetopsida	Cyperaceae	<i>Cyperus polystachyos</i>	None	C	None	0	1	31/12/2000
27260	Equisetopsida	Cyperaceae	<i>Fimbristylis blakei</i>	None	C	None	2	3	24/06/2019
11968	Equisetopsida	Cyperaceae	<i>Fimbristylis caespitosa</i>	None	C	None	1	1	25/07/2010
11040	Equisetopsida	Cyperaceae	<i>Fimbristylis littoralis</i>	None	C	None	0	2	31/12/2000
14510	Equisetopsida	Cyperaceae	<i>Fimbristylis nuda</i>	None	C	None	1	1	02/06/1999
17109	Equisetopsida	Cyperaceae	<i>Fimbristylis nutans</i>	None	C	None	0	2	31/12/2000
17130	Equisetopsida	Cyperaceae	<i>Fuirena ciliaris</i>	None	C	None	0	3	31/12/2000
17077	Equisetopsida	Cyperaceae	<i>Fuirena umbellata</i>	None	C	None	1	2	31/12/2000
22320	Equisetopsida	Eriocaulaceae	<i>Eriocaulon athertonense</i>	None	C	None	1	1	30/11/2015
17289	Equisetopsida	Erythroxylaceae	<i>Erythroxylum ellipticum</i>	None	C	None	1	1	05/06/1999
25985	Equisetopsida	Fabaceae	<i>Hovea apiculata</i>	None	C	None	1	1	02/06/1999
10982	Equisetopsida	Fabaceae	<i>Jacksonia odontoclada</i>	None	C	None	2	2	05/06/1999
15259	Equisetopsida	Fabaceae	<i>Jacksonia ramosissima</i>	None	C	None	2	2	01/06/2000
13737	Equisetopsida	Fabaceae	<i>Zornia adenophora</i>	None	C	None	1	1	03/06/1999
17057	Equisetopsida	Goodeniaceae	<i>Goodenia armitiana</i>	None	C	None	2	2	25/07/2010
26456	Equisetopsida	Goodeniaceae	<i>Goodenia redacta</i>	None	C	None	1	1	01/06/1999
17000	Equisetopsida	Haemodoraceae	<i>Haemodorum coccineum</i>	None	C	None	1	1	01/06/1999
16846	Equisetopsida	Juncaceae	<i>Juncus usitatus</i>	None	C	None	1	2	31/12/2000
9823	Equisetopsida	Lindsaeaceae	<i>Lindsaea ensifolia</i>	None	C	None	0	1	31/12/2000
14456	Equisetopsida	Lindsaeaceae	<i>Lindsaea ensifolia</i> subsp. <i>ensifolia</i>	None	C	None	1	1	30/04/2016
11979	Equisetopsida	Lythraceae	<i>Ammannia multiflora</i>	jerry-jerry	C	None	0	1	31/12/2000
22202	Equisetopsida	Malvaceae	<i>Abutilon fraseri</i> subsp. <i>fraseri</i>	None	C	None	1	1	27/03/2003
17068	Equisetopsida	Malvaceae	<i>Gossypium australe</i>	None	C	None	1	1	25/07/2010
16151	Equisetopsida	Malvaceae	<i>Sida</i>	None	C	None	1	1	01/06/1999
22289	Equisetopsida	Malvaceae	<i>Sida rohlenae</i> subsp. <i>rohlenae</i>	None	C	None	1	1	27/03/2003
29908	Equisetopsida	Malvaceae	<i>Sida</i> sp. (Gordonbrook Station E.J.Thompson+ MUT46)	None	C	None	1	1	01/06/1999
15787	Equisetopsida	Mimosaceae	<i>Acacia chisholmii</i>	None	C	None	1	1	01/06/1999
14904	Equisetopsida	Mimosaceae	<i>Acacia crombiei</i>	pink gidgee	V	V	2	2	30/11/1990
22883	Equisetopsida	Mimosaceae	<i>Acacia delicatula</i>	None	C	None	1	1	03/06/1999
15748	Equisetopsida	Mimosaceae	<i>Acacia galioides</i>	None	C	None	1	1	03/06/1999
15751	Equisetopsida	Mimosaceae	<i>Acacia hammondii</i>	None	C	None	1	1	03/06/1999
15753	Equisetopsida	Mimosaceae	<i>Acacia hemignosta</i>	None	C	None	1	1	03/06/1999
15763	Equisetopsida	Mimosaceae	<i>Acacia lazaridis</i>	None	C	None	1	1	21/11/1985
15721	Equisetopsida	Mimosaceae	<i>Acacia melleodora</i>	None	C	None	1	1	03/04/2000

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
15738	Equisetopsida	Mimosaceae	<i>Acacia platycarpa</i>	None	C	None	1	1	25/07/2010
15703	Equisetopsida	Mimosaceae	<i>Acacia tenuissima</i>	None	C	None	1	1	01/06/1999
15706	Equisetopsida	Mimosaceae	<i>Acacia torulosa</i>	None	C	None	1	1	02/06/1999
34114	Equisetopsida	Mimosaceae	<i>Vachellia farnesiana</i>	None	None	None	1	1	20/09/2010
17144	Equisetopsida	Moraceae	<i>Ficus opposita</i>	None	C	None	1	1	15/09/2001
17761	Equisetopsida	Myrtaceae	<i>Calytrix exstipulata</i>	None	C	None	1	1	25/07/2010
17763	Equisetopsida	Myrtaceae	<i>Calytrix leptophylla</i>	None	C	None	2	2	03/06/1999
6578	Equisetopsida	Myrtaceae	<i>Corymbia confertiflora</i>	None	C	None	1	2	31/12/2000
6532	Equisetopsida	Myrtaceae	<i>Corymbia polycarpa</i>	long-fruited bloodwood	C	None	1	1	15/09/2001
27688	Equisetopsida	Myrtaceae	<i>Corymbia serendipita</i>	None	C	None	1	1	24/03/2003
6421	Equisetopsida	Myrtaceae	<i>Corymbia terminalis</i>	None	C	None	1	1	12/11/1999
17247	Equisetopsida	Myrtaceae	<i>Eucalyptus camaldulensis</i>	None	C	None	0	2	31/12/2000
32977	Equisetopsida	Myrtaceae	<i>Eucalyptus camaldulensis</i> subsp. <i>obtus</i>	None	C	None	1	1	27/03/2003
17218	Equisetopsida	Myrtaceae	<i>Eucalyptus leptophleba</i>	Molloy red box	C	None	2	2	12/11/1999
17226	Equisetopsida	Myrtaceae	<i>Eucalyptus microneura</i>	Gilbert River box	C	None	2	2	15/09/2001
17205	Equisetopsida	Myrtaceae	<i>Eucalyptus tetrodonta</i>	Darwin stringybark	C	None	1	1	05/06/1999
14551	Equisetopsida	Myrtaceae	<i>Eucalyptus whitei</i>	White's ironbark	C	None	2	2	15/09/2001
14441	Equisetopsida	Myrtaceae	<i>Leptospermum polygalifolium</i>	tantoon	C	None	2	2	07/11/2014
16730	Equisetopsida	Myrtaceae	<i>Lophostemon suaveolens</i>	swamp box	C	None	0	1	31/12/2000
13427	Equisetopsida	Myrtaceae	<i>Melaleuca citrolens</i>	None	C	None	1	1	05/06/1999
16689	Equisetopsida	Myrtaceae	<i>Melaleuca leucadendra</i>	broad-leaved tea-tree	C	None	0	1	31/12/2000
13828	Equisetopsida	Myrtaceae	<i>Melaleuca nervosa</i>	None	C	None	1	1	03/06/1999
31375	Equisetopsida	Myrtaceae	<i>Melaleuca viminalis</i>	None	C	None	1	1	15/09/2001
13420	Equisetopsida	Onagraceae	<i>Ludwigia octovalvis</i>	willow primrose	C	None	0	3	31/12/2000
16660	Equisetopsida	Pentapetaceae	<i>Melhania oblongifolia</i>	None	C	None	1	1	03/06/1999
13598	Equisetopsida	Phrymaceae	<i>Mimulus uvedaliae</i>	None	C	None	2	2	02/06/1999
30852	Equisetopsida	Phyllanthaceae	<i>Phyllanthus</i> sp. (<i>Alexandra River R.Pullen 8936</i>)	None	C	None	1	1	25/07/2010
34043	Equisetopsida	Phyllanthaceae	<i>Sauropus elachophyllus</i> var. <i>elachophyllus</i>	None	C	None	1	1	02/06/1999
16503	Equisetopsida	Picrodendraceae	<i>Petalostigma banksii</i>	None	C	None	1	1	20/11/1985
11132	Equisetopsida	Poaceae	<i>Aristida sciurioides</i>	None	C	None	1	1	25/07/2010
15634	Equisetopsida	Poaceae	<i>Arundinella nepalensis</i>	reedgrass	C	None	0	1	31/12/2000
14567	Equisetopsida	Poaceae	<i>Echinochloa colona</i>	awnless barnyard grass	None	None	0	2	31/12/2000
15440	Equisetopsida	Poaceae	<i>Ectrosia leporina</i>	None	C	None	1	1	02/06/1999
19840	Equisetopsida	Poaceae	<i>Ectrosia schultzei</i>	None	C	None	1	1	01/06/2000

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
15397	Equisetopsida	Poaceae	<i>Elionurus citreus</i>	lemon-scented grass	C	None	1	1	25/07/2010
10339	Equisetopsida	Poaceae	<i>Enneapogon</i>	None	C	None	1	1	25/07/2010
10335	Equisetopsida	Poaceae	<i>Enneapogon nigricans</i>	niggerheads	C	None	1	1	20/07/1992
15374	Equisetopsida	Poaceae	<i>Eragrostis spartinoides</i>	None	C	None	1	4	31/12/2000
7143	Equisetopsida	Poaceae	<i>Eriachne mucronata forma</i> (Alpha C.E.Hubbard 7882)	None	C	None	1	1	24/03/2003
10655	Equisetopsida	Poaceae	<i>Panicum robustum</i>	None	C	None	1	1	25/07/2010
13798	Equisetopsida	Poaceae	<i>Paspalum longifolium</i>	None	C	None	0	1	31/12/2000
15136	Equisetopsida	Poaceae	<i>Paspalum scrobiculatum</i>	ditch millet	C	None	1	1	31/07/2000
15056	Equisetopsida	Poaceae	<i>Schizachyrium fragile</i>	firegrass	C	None	1	1	01/06/1999
15028	Equisetopsida	Poaceae	<i>Setaria apiculata</i>	None	C	None	1	1	25/07/2010
15027	Equisetopsida	Poaceae	<i>Thaumastochloa pubescens</i>	None	C	None	1	1	30/04/2016
17027	Equisetopsida	Proteaceae	<i>Grevillea decora subsp. decora</i>	None	C	None	2	2	01/04/2004
17031	Equisetopsida	Proteaceae	<i>Grevillea glauca</i>	bushy's clothes peg	C	None	1	1	14/07/2001
17039	Equisetopsida	Proteaceae	<i>Grevillea parallela</i>	None	C	None	1	1	14/07/2001
16498	Equisetopsida	Proteaceae	<i>Persoonia falcata</i>	None	C	None	1	1	25/07/2010
16382	Equisetopsida	Psilotaceae	<i>Psilotum nudum</i>	skeleton fork fern	C	None	1	1	30/04/2016
14319	Equisetopsida	Pteridaceae	<i>Platyzoma microphyllum</i>	braid fern	C	None	2	2	25/07/2010
31347	Equisetopsida	Rhamnaceae	<i>Cryptandra pogonoloba subsp. pogonoloba</i>	None	C	None	1	1	01/04/2004
14129	Equisetopsida	Rhamnaceae	<i>Ziziphus mauritiana</i>	Indian jujube	None	None	1	1	31/07/2000
8213	Equisetopsida	Rubiaceae	<i>Synaptantha tillaeacea var. tillaeacea</i>	None	C	None	1	1	03/06/1999
17832	Equisetopsida	Rutaceae	<i>Boronia bowmanii</i>	None	C	None	1	1	02/06/1999
11957	Equisetopsida	Rutaceae	<i>Drummondita calida</i>	None	V	None	1	1	01/04/2004
14612	Equisetopsida	Sapindaceae	<i>Dodonaea</i>	None	C	None	1	1	02/06/1999
17373	Equisetopsida	Sapindaceae	<i>Dodonaea filifolia</i>	None	C	None	1	1	30/04/2016
13658	Equisetopsida	Sapindaceae	<i>Dodonaea physocarpa</i>	None	C	None	2	2	02/06/2000
9373	Equisetopsida	Scrophulariaceae	<i>Eremophila acrida</i>	None	C	None	1	1	02/06/1999
29815	Equisetopsida	Solanaceae	<i>Solanum crebrispinum</i>	None	C	None	2	2	30/11/2015
12612	Equisetopsida	Sparrmanniaceae	<i>Corchorus</i>	None	C	None	1	1	02/06/1999
29771	Equisetopsida	Sparrmanniaceae	<i>Corchorus sericeus subsp. densiflorus</i>	None	C	None	1	1	01/06/1999
29758	Equisetopsida	Sparrmanniaceae	<i>Corchorus sidoides subsp. vermicularis</i>	None	C	None	1	1	01/06/1999
12561	Equisetopsida	Stylidiaceae	<i>Stylidium rotundifolium</i>	None	C	None	1	2	31/12/2000
17504	Equisetopsida	Thelypteridaceae	<i>Cyclosorus interruptus</i>	None	C	None	1	1	31/05/1986
15896	Equisetopsida	Xyridaceae	<i>Xyris complanata</i>	yellow-eye	C	None	1	2	25/07/2010

Table 4. Fungi recorded within the area of interest and its one kilometre buffer
Department of Environment and Science

No species found within the area of interest and its one kilometre buffer.

Table 5. Protists recorded within the area of interest and its one kilometre buffer

No species found within the area of interest and its one kilometre buffer.

Species table headings and codes

Taxon Id: Unique identifier of the taxon from the WildNet database.

NCA: Queensland conservation status of the taxon under the *Nature Conservation Act 1992* (Endangered (E), Extinct in the Wild (PE), Vulnerable (V), Near Threatened (NT), Special Least Concern (SL) and Least Concern(C)).

EPBC: Australian conservation status of the taxon under the *Environment Protection and Biodiversity Conservation Act 1999* (Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V)).

Specimens: The number of specimen-backed records of the taxon.

Records: The total number of records of the taxon.

Last record: Date of latest record of the taxon.

Links and Support

Other sites that deliver species information from the WildNet database include:

- [Species profile search](#) - access species information approved for publication including species names, statuses, notes, images, distribution maps and records
- [Species lists](#) - generate species lists for Queensland protected areas, forestry areas, local governments and areas defined using coordinates
- [Biomaps](#) - view biodiversity information, including species information approved for publication, and generate reports
- [Old wildlife data API](#) - access species information approved for publication such as notes, images and records etc.
- [WetlandMaps](#) - view species records, survey locations etc. approved for publication
- [WetlandSummary](#) - view wildlife statistics, species lists for a range of area types, and access species profiles
- [Generalised distribution and densities of Queensland wildlife](#) - Queensland species distributions and densities generalised to a 10 km grid resolution
- [Conservation status of Queensland wildlife](#) - access current lists of priority species for Queensland including nomenclature and status information
- [Queensland Confidential Species](#) - the list of species flagged as confidential in the WildNet database.

Other useful sites for accessing biodiversity data include:

- [Queensland Government Data](#)
- [Atlas of Living Australia](#)
- [OZCAM - Online Zoological Collections of Australian Museums](#)
- [AVH - Australia's Virtual Herbarium](#)
- [Protected Matters Search Tool](#)

Please direct queries about this report to the [WildNet Team](#).

Disclaimer

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