APPENDIX

K

Aquatic Ecology Technical Report

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

INLAND RAIL

ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

IR_1534

Inland Rail (Border to Gowrie Project)

Appendix K: Aquatic Ecology Technical Report

Prepared for
Future Freight Joint Venture

2-0001-310-EAP-10-RP-0209

23 June 2020

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Abbreviations

Abbreviation	Description
ACA	Aquatic Conservation Assessment
ANZECC	Australian and New Zealand Environment and Conservation Council
ARTC	Australian Rail Track Corporation
AquaBAMM	Aquatic Biodiversity Assessment and Mapping Method
AusRivAS	Australian River Assessment System
CEMP	Construction Environmental Management Plan
DAF	Department of Agriculture and Fisheries
DEHP	Department of Environment and Heritage Protection
DES	Department of Environment and Science
DO	Dissolved Oxygen
EC	Electrical Conductivity
EIS	Environmental Impact Statement
ELA	Eco Logical Australia
EMP	Environmental Management Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPP	*Environmental Protection (Water and Wetland Biodiversity) Policy 2019*
EVNT	Endangered, Vulnerable or Near Threatened species
FFJV	Future Freight Joint Venture
GDE	Groundwater Dependent Ecosystem
MNES	Matter of National Environmental Significance
MSES	Matter of State Environmental Significance
NC Act	*Nature Conservation Act 1992* (Queensland)
PAH	Polycyclic Aromatic Hydrocarbons
PMST	EPBC Act Protected Matters Search Tool
SLC	Special Least Concern
TOR	Terms of Reference
TSS	Total Suspended Solids
WoNS	Weeds of National Significance

Definitions

Term	Description
Construction footprint	The area that would be directly affected by construction. It includes the location of proposal infrastructure, the area that would be directly disturbed by the movement of construction plant and machinery, and the location of the storage areas/compounds sites etc, that would be used to construct that infrastructure.
Impact assessment area	A 2 km wide corridor around the preliminary alignment, which encloses project infrastructure and the construction footprint. The Impact assessment area is the focus of the impact assessment for the aquatic ecology and surface water disciplines. This comprises the areas where the rail corridor intersects with waterways or other locations with aquatic ecology or surface water values, and adjacent areas which may be affected by the Project, including those located downstream of the rail alignment.
Rail alignment	The exact positioning of the track, accurately defined both horizontally and vertically, along which the rail vehicles operate.
Rail corridor	The corridor within which the rail tracks and associated infrastructure are located.
Watercourse	A watercourse is defined in the *Water Act 2000* as a river, creek or other stream which includes a stream in the form of an anabranch or a tributary where water flows either permanently or intermittently, regardless of flow frequency. In this report, reference to a 'watercourse' is generally made in relation to the management of water resources, consistent with the purpose of the *Water Act 2000.*
Waterway	A waterway is defined in the *Fisheries Act 1994* as a river, creek, stream, watercourse or inlet of the sea, including both permanent and ephemeral waterways, and drainage features. Waterways providing for fish passage are a Matter of State Environmental Significance, and works within a waterway may require a development application or must achieve compliance with accepted development requirements. Waterways are generally more widespread than defined watercourses, and are more relevant to the assessment of aquatic ecology values. Therefore, in addition to its statutory meaning under the *Fisheries Act 1994*, 'waterway' has been adopted in this report as the primary term when referring to aquatic ecology habitats (e.g. rivers, creeks and streams) of the impact assessment area.

Executive Summary

This technical report has been prepared to document aquatic ecology and surface water quality investigations for the Border to Gowrie section of Inland Rail (the Project).

The assessment involved a desktop review of existing information, three aquatic ecology field surveys in June 2018, November 2018 and May 2019, and four surface water field surveys in June 2018, November 2018, February 2019 and April 2019. Additional water quality data were collected at five sites in May 2019, to assist with the interpretation of macroinvertebrate data.

Between 31 and 35 sampling sites were assessed on each field trip, depending on land access arrangements. Many of the ephemeral waterways in the region were dry at the time of sampling, including at times following recent rainfall. In such instances, a habitat assessment was completed, and sampling of water quality and aquatic values occurred at larger waterways nearby. Between 14 and 18 sites had sufficient water during each field trip to collect samples for the analysis of water quality.

Field studies involved the assessment of surface water quality (physico-chemical, nutrients, chlorophyll *a* and dissolved metals), a physical habitat assessment, macroinvertebrate sampling per Queensland AusRivAS protocols and targeted fish surveys. Potential impacts of the Project were assessed by implementing a qualitative significance assessment, based on the sensitivity of environmental receptors to Project impacts and the expected magnitude of environmental impacts.

A number of protected species are known or have the potential to occur in the impact assessment area. This includes the sedge *Fimbristylis vagans* (potential to occur), and the Platypus (known to occur), which are listed as Vulnerable and Special Least Concern respectively under the *Nature Conservation Act 1992* (Qld). The Murray Cod, which is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), was confirmed to be present during the field assessments within both the Macintyre River and Macintyre Brook. The Agassiz's Glassfish was also confirmed to be present in the Macintyre River, with the western (i.e. Murray-Darling Basin) populations of this species listed as endangered under the NSW *Fisheries Management Act 1994*. Other listed flora and fauna species have been determined as unlikely to occur in the impact assessment area, including Silver Perch and Bell's Turtle for which there is no suitable habitat present within the impact assessment area.

Some mapped wetlands and groundwater dependent ecosystems occur throughout the impact assessment area, adjacent to the proposed rail alignment. Waterways to be intersected by the rail alignment are mostly ephemeral and were assessed to be in fair condition overall. Other land uses in the region, particularly agriculture, are likely to have resulted in some degradation of surface water quality and aquatic ecology values in local waterways.

The impact assessment identified that the sensitivity of aquatic ecology and surface water quality values to impacts from the Project ranged from negligible to moderate in scale, following the application of mitigation measures. The highest sensitivities (moderate) were associated with:

- Invasion of aquatic habitats by weed and pest species during the construction phase
- Declines in water and sediment quality from bank erosion, and the runoff of sediments and contaminants into waterways during the construction phase.

However, these risks can be effectively managed through a range of design features (e.g. bridges spanning waterways in preference to culverts) and through the development and implementation of detailed environmental management plans during detail design, pre-construction, construction and operation phases of the Project.

There is limited potential for cumulative impacts from other projects in the region that either currently exist or are planned in the future. Cumulative impacts were assessed to be limited to construction and operation phase activities that may influence water quality and aquatic ecology values downstream of the Project.

1 Introduction

1.1 Background

The Australian Rail Track Corporation (ARTC) proposes to transform the way freight is moved around the country through construction of the Inland Rail project. The Inland Rail project will augment the existing national freight network between Melbourne and Brisbane via regional Victoria, New South Wales (NSW) and Queensland (QLD). The new rail line will be the largest freight rail infrastructure project in Australia, with a proposed corridor length of 1,700 km.

The Project is 216.2 km in length and extends from the NSW/QLD border at Kurumbul, approximately 18 km south east of Goondiwindi, to Gowrie, west of Toowoomba, in Queensland.

For a full project description, reference should be made to Chapter 5: Project description in the Border to Gowrie Project draft Environmental Impact Statement (EIS).

1.2 Objectives and scope of works

The objectives of the aquatic ecology and surface water study were to contribute to the draft EIS by:

- Conducting an assessment of the existing environmental values of the impact assessment area in relation to aquatic ecology and surface water quality values
- Assessing the potential impacts of the Project on these values
- Detailing mitigation measures to avoid or reduce impacts
- Outlining monitoring requirements that are relevant to the management of aquatic ecology and surface water quality values.

Eco Logical Australia (ELA) was engaged by Future Freight Joint Venture (FFJV) to conduct the following scope of works to achieve the objectives of the study:

- Conduct three surveys of aquatic ecology values at selected sites along the rail corridor. Surveys were to include physical habitat assessment for the first field trip, with subsequent aquatic ecology surveys to include assessment of macroinvertebrates and fish
- Conduct four surveys of surface water values at selected sites along the rail corridor, with two surveys occurring at the same time as aquatic ecology surveys. Water quality assessments were to include assessment of a dissolved metals suite (eight metals), pH, total suspended solids, turbidity, speciated nitrogens (ammonia, nitrate, nitrite, organic nitrogen, oxidised nitrogen, total kjeldahl nitrogen, total nitrogen), total phosphorus, chlorophyll *a*, reactive phosphorus, polycyclic aromatic hydrocarbons (PAHs), electrical conductivity and salinity.
- Conduct an impact assessment to address the Terms of reference for an environmental impact statement: Inland Rail – Border to Gowrie project (ToR, November 2018; DSDMIP 2018).

Environmental studies of aquatic ecology and surface water and the associated impact assessments were conducted in accordance with the following:

- The ToR for the Project
- The AusRivAS Physical Assessment Protocol for the Assessment of Freshwater Streams (Parsons *et al*. 2002)
- ANZECC (2000) Water Quality Guidelines, which were updated during the assessment (ANZECC 2018)

- Queensland Water Quality Guidelines (DEHP 2013)
- Water Quality Monitoring and Sampling Manual (DES 2018a)
- Survey Guidelines for Australia's threatened fish (SEWPAC 2011).

1.3 Terms of reference

Sections of the ToR relevant to the assessment of aquatic ecology and surface water values are summarised in **Table 1**, along with notes on where these requirements are addressed in this report.

Table 1 Summary of ToR relevant to aquatic ecology and surface water (Coordinator General, 2018)

ToR Section	Summary of requirement	Where addressed in this report
11.26	Addresses listed threatened species and communities	Section 2.1, 2.2 and 4.4
11.29	List of potential listed threatened species and their status	Section 4.4, Appendix B
11.45	Describes potential impacts of in stream works on hydrology and water quality	Section 5.1
11.47	Addresses how water quality would be monitored and how impacts on water quality are to be avoided/minimised	Section 5.2
11.48	Describes appropriate management and mitigation strategies which include discharge of contaminants and sediments during construction	Section 5.2
11.50	Propose suitable measures to avoid or mitigate impacts of stream works on water quality and the stabilisation/rehabilitation of any works.	Section 5.2
11.54	Addresses local impacts to alterations of riparian vegetation, bank and channel morphology and groundwater dependent ecosystems	Section 5.1 and 5.2
11.94	Identifies and describes matters of state environmental significance, state, ecological areas, regionally significant biodiversity and natural environmental values or terrestrial and aquatic ecology likely to be impacted	Section 4.2, 4.3, 4.4 and 4.5
11.95	Describes likely impacts on biodiversity and natural environmental values of affected areas arising from construction and operation of project	Section 5.1
11.96	Describes any proposed measures to avoid, minimise or mitigate potential impacts on natural values, and enhance these values	Section 5.2
11.97	Addresses requirement for construction of fauna movement corridors with regard particularly to waterway barriers to fish movement	Section 5.2 and 5.3
11.100	Addresses the need and suitability to provide fauna passage between habitat fragmented by rail.	Section 5.2 and 5.3
11.102	Identifies current distribution of animal pests and weeds on the proposed alignment.	Section 4.4
11.103	Surveys of animal pests and weeds should be undertaken in those areas identified during the desktop assessment as containing listed flora, fauna or ecological communities of national or state environmental significance	Section 4.2

ToR Section	Summary of requirement	Where addressed in this report
11.104	Addresses the impact that the Project's construction and operation will have on the spread of pest animals, weed species and disease along the proposed alignment and surrounding lands	Section 4.2; 5.1
11.105	Addresses proposed measures to control and limit spread to pests, weeds and disease	Section 5.2 and 5.3
11.117	Describe the existing noise and vibration environment that may be affected by the Project in the context of the environmental values.	Section 5.1
11.120	Describes noise and vibration emissions (including fugitive sources) that may occur during construction, commissioning and operation.	Section 5.1
11.122	Discusses the Project components likely to present an impact on noise and vibration for the construction and operation phases of the Project	Section 5.1
11.124.	Describe how the proposed project would be managed to be consistent with best practice environmental management for the activity	Section 5.2 and 5.3
11.153	Describe strategies and methods to be used to prevent, manage or remediate any land contamination resulting from the Project, including but not limited to the management of any acid generation or management of chemicals and fuels to prevent spills or leaks.	Section 5.2

1.4 Overview of the Project

The Project includes the establishment of 216.2 km of new single track railway, consisting of 7.0 km of standard gauge rail (1,435 mm) and 209.2 km of dual gauge rail (standard (1,435 mm) and narrow (1,067 mm) gauge).

The 7.0 km of standard gauge rail is a continuation of track from the North Star to NSW/QLD Border project and extends from the NSW/QLD border to the tie-in point with the South Western Line at Kurumbul. The remainder of railway for the Project will be dual standard/narrow gauge to enable interoperability with the existing Queensland Rail network.

The Project is located in the local government areas of Goondiwindi and Toowoomba regional councils. The Project will ultimately accommodate trains up to 3,600 m long, but initially will be constructed for 1,800 m long train sets.

The Project commences at the NSW/QLD border, the median line of the Macintyre River, approximately 18 km to the south east of Goondiwindi near Kurumbul. From this crossing point the alignment heads in a northerly direction for approximately 6 km before joining the Queensland Rail South Western Line to the east of Kildonan. The South Western Line is followed through Yelarbon towards Inglewood before turning off and becoming a greenfield alignment near Whetstone. The alignment skirts the hills to the west of Inglewood and then follows a new corridor that is approximately parallel with Inglewood-Millmerran Road, until joining the Millmerran Branch Line between Millmerran and Yandilla.

The Millmerran Branch Line is disused in parts due to the 2011 flood impacts, however the line is regarded as operational. The Millmerran Branch Line crosses the Condamine River floodplain and associated watercourses and waterways. The alignment continues via Pampas and Brookstead and deviates to the north and around Pittsworth, following the northern side of the Gore Highway. The alignment follows the intent of this existing rail corridor through to Southbrook, although geometric constraints prevent it from remaining within the corridor.

From Southbrook the alignment is greenfield once again and traverses to the west of Toowoomba Wellcamp Airport. The alignment passes to the west of Gowrie Mountain and crosses the Warrego Highway before termination between Leeson Road and Draper Road, on the southern outskirts of Kingsthorpe.

A broad 2 km wide impact assessment area was identified, within which lies the rail corridor including rail tracks and associated infrastructure (**Figure 1**). The focus of the assessment for aquatic ecology and surface water is those parts of the rail corridor that intersect with watercourses, waterways or other aquatic ecology or surface water values, hereafter referred to as the impact assessment area. The impact assessment area comprises those aspects of the aquatic environment that may be directly impacted by the Project, and adjacent areas that may be subject to indirect impacts. While the distance over which indirect impacts may occur is variable, the impact assessment area is defined as the area located within a 2 km buffer from the proposed rail alignment.

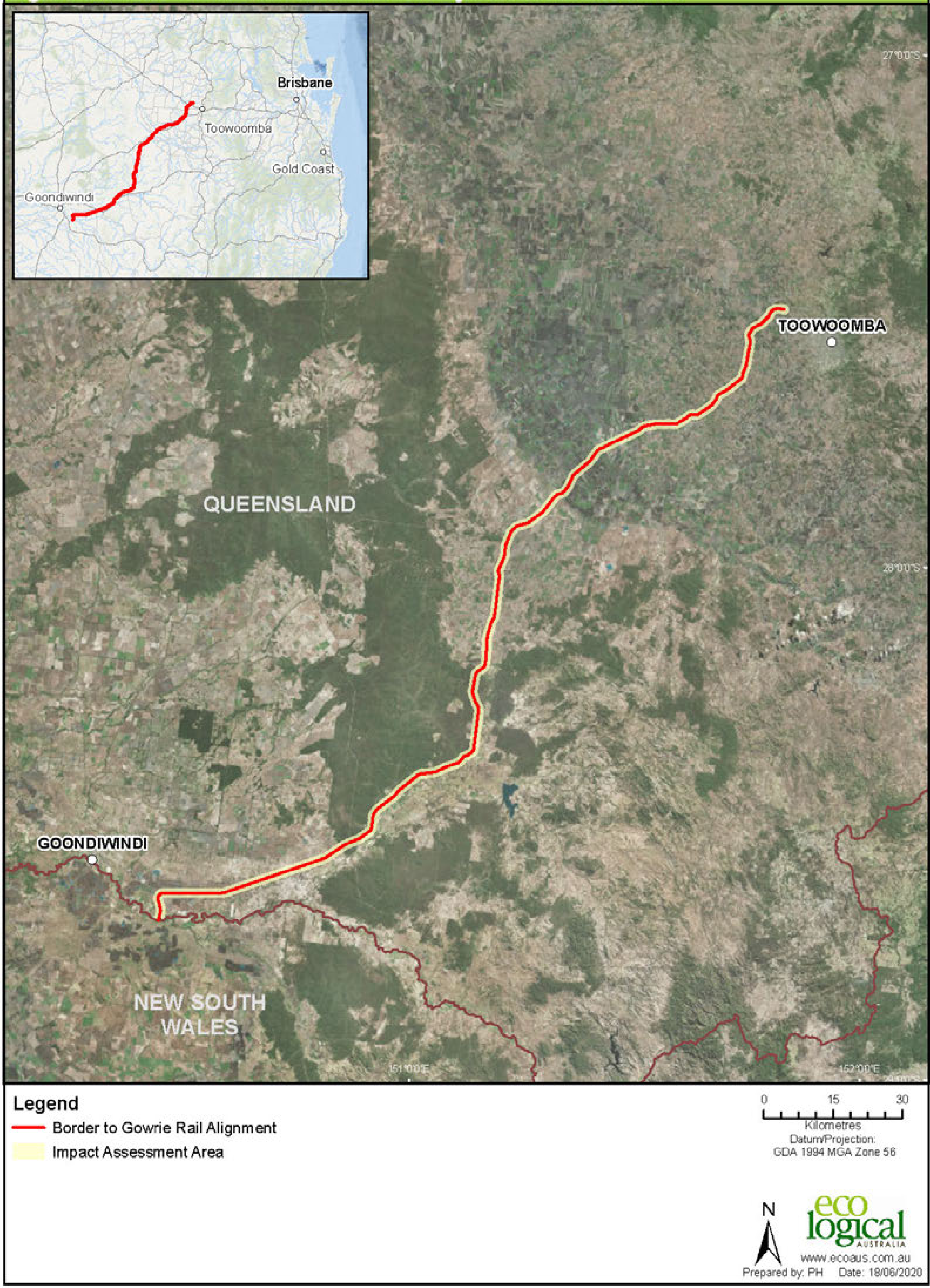


Fig 1. Border to Gowrie rail corridor and impact assessment area

2 Legislation and guidelines

This section provides an overview of legislation and guidelines that are relevant to the assessment of aquatic ecology and surface water.

2.1 Commonwealth legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth; EPBC Act) is the key piece of Commonwealth environmental protection legislation. The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places – defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The EPBC Act requires that proposals, or actions, that have the potential to significantly impact on MNES or the environment of Commonwealth land be referred to the Australian Minister for the Environment.

The Project was referred to the Minister for the Environment on 16 February 2018 and was subsequently deemed to be a controlled action due to potentially significant impacts on listed threatened species and communities (Section 18 and 18A of the EPBC Act).

2.1.2 Water Act 2007

The *Water Act 2007* (Cth) provides the legislative framework for ensuring that Murray Darling Basin (Australia's largest water resource) is managed in accordance with Australia's national interests. Watercourses of the impact assessment area are located within the Murray Darling Basin and are subject to the Murray Darling Basin Plan – a strategic plan for the integrated and sustainable management of water resources in the Murray Darling Basin. The Queensland Government has prepared Healthy Waters Management Plans to meet accreditation requirements under the Commonwealth *Water Act 2007* – Basin Plan 2012 (Commonwealth of Australia 2012).

The Act recognises that Australian states in which the Murray Darling Basin is located continue to manage water resources within their jurisdictions. The Act:

- Establishes the Murray Darling Basin Authority with the functions and powers, including enforcement powers, needed to ensure that Basin water resources are managed in an integrated and sustainable way
- Establishes a Commonwealth Environmental Water Holder to manage the Commonwealth's environmental water to protect and restore the environmental assets of the Murray Darling Basin, and outside the Basin where the Commonwealth owns water
- Provides the Australian Competition and Consumer Commission with a key role in developing and enforcing water charge and water market rules along the lines agreed in the National Water Initiative
- Gives the Bureau of Meteorology water information functions that are in addition to its existing functions under the *Meteorology Act 1955*
- Gives the Productivity Commission a role in reporting on the effectiveness of the implementation of the Murray-Darling Basin Plan and water resource plans and the progress towards achieving the objectives and outcomes of the National Water Initiative.

The Project spans three catchments (**Figure 2**). Between the NSW/QLD border and Gowrie, the Project is located within the Macintyre River catchment and from Yelarbon to Millwood the Project is located in the Macintyre Brook catchment of the Queensland Border Rivers drainage basin. North of Millwood the Project is located within the Condamine River catchment of the Balonne-Condamine drainage basin. Both the Queensland Border Rivers and Balonne-Condamine drainage basins are situated within the Murray Darling Basin.

2.2 Queensland legislation

2.2.1 Planning Act 2016

The purpose of the *Planning Act 2016* (Qld) is to provide an efficient, effective, transparent, integrated, coordinated and accountable system of land use planning, development assessment and dispute resolution to facilitate the achievement of ecological sustainability. The Project will be likely to trigger approval requirements for some aspects of development under the *Planning Act 2016*, following completion of the EIS.

2.2.2 Environmental Protection Act 1994

The objective of the *Environmental Protection Act 1994* (Qld; EP Act) is to protect Queensland's environment by promoting ecologically sustainable development. The EP Act has been designed to achieve its objective by setting out a program for the identification and protection of environmental values and through a range of regulatory tools. The EP Act outlines a 'general environmental duty', which specifies that persons must not carry out an activity that causes, or is likely to cause, environmental harm, unless the person takes all reasonable and practical measures to prevent or minimise the harm.

The quality of Queensland waters is protected under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water and Wetland Biodiversity), which is a subordinate instrument to the EP Act. Environmental values and water quality objectives are being progressively determined for areas of Queensland under the EPP Water and Wetland Biodiversity. Healthy Waters Management Plans were published for the impact assessment area in 2019, specifying environmental values and water quality objectives for several water quality zones (see **Section 4.1**).

Post-EIS approvals may involve Environmentally Relevant Activities and will be regulated under the EP Act.

2.2.3 Water Act 2000

The *Water Act 2000* (Qld) (Water Act) provides the framework to deliver sustainable water planning, allocation management and supply processes to ensure security of water resources in Queensland. Water suppliers are the primary focus of the Water Act through the administration of the *Water Regulation 2016*. The Project involves works within watercourses that are defined under the Water Act, and may require a Riverine Protection Permit to excavate, place fill or disturb native vegetation in a watercourse.

2.2.4 Vegetation Management Act 1999

The *Vegetation Management Act 1999* (Qld) (VM Act) regulates and manages the process and impacts of native vegetation clearance, including riparian vegetation fringing watercourses. The objectives of the VM Act include conservation of remnant regional ecosystems, prevention of the loss of biodiversity, maintenance of ecological processes, and conservation of vegetation in areas of high nature conservation value or lands vulnerable to land degradation.

Generally, clearing of relevant remnant or regulated regrowth vegetation requires a development approval under the *Planning Act 2016*, subject to a number of exemptions, including for Government supported transport infrastructure.

2.2.5 Nature Conservation Act 1992

The object of the *Nature Conservation Act 1992* (Qld) *(*NC Act) is to conserve nature through an integrated and comprehensive conservation strategy for the whole of Queensland involving (but not limited to) the following:

- Gathering of information and community education
- Dedication and declaration of protected areas
- Management of protected areas
- Protection of native wildlife and its habitat
- Use of protected wildlife and areas to be ecologically sustainable
- Recognition of interest of Aboriginal people and Torres Strait Islanders in nature and their cooperative involvement in its conservation
- Cooperative involvement of landholders.

The NC Act requires permits for activities that include the taking of protected plants and the moving of protected animals, or activities in protected areas, which are likely to be required for the Project.

2.2.6 Biosecurity Act 2014

The *Biosecurity Act 2014* (Qld) ensures a consistent, modern, risk-based approach to biosecurity in Queensland. The *Biosecurity Act 2014* provides comprehensive biosecurity measures to safeguard Queensland's economy, agricultural and tourism industries and the environment from:

- Pests (e.g. Wild dogs and weeds)
- Diseases; and
- Contaminants

The *Biosecurity Regulation 2016* describes matters that are declared to be 'prohibited' or 'restricted' matters. There is a 'general biosecurity obligation' described under the *Biosecurity Act 2014*, which states that everyone is responsible for managing biosecurity risks that are under their control, or that they know about, or should reasonably be expected to know about. This Act is likely to apply to project activities such as the use of machinery for earthworks, and the dewatering of farm dams, which may result in the spread of weeds and pests, if practical precautions are not taken.

2.2.7 Fisheries Act 1994

Waterway barrier works are regulated under the *Fisheries Act 1994* and the *Planning Act 2016* when barriers to fish movement, including partial barriers, are installed across waterways. Barrier works include construction, raising of structures such as culvert crossings, bed level and low level crossings, weirs and dams, both permanent and temporary. The legislation allows for self-assessment for low impact, minor, temporary and some regularly rebuilt waterway barriers. Works that adhere to the standards and requirements of the Department of Agriculture and Fisheries (DAF) *Accepted development requirements for operational work that is constructing or raising waterway barrier works (1 October 2018*; Department of Agriculture and Fisheries 2018) are able to proceed without development approval. Also, some instream works and types of structures that comply with Fisheries Queensland's factsheet, "What is not a waterway barrier work? (DAF 2017a)" are not considered to be waterway barriers.

The Queensland Waterways for Waterway Barrier Works (WWBW) data set shows the extent of the *Fisheries Act 1994* interest in barrier works on waterways, including within the impact assessment area. This data layer also indicates whether waterway barrier works are likely to proceed under the relevant DAF self-assessable code or require a development approval.

2.3 Relevant guidelines, strategies and plans

2.3.1 ANZECC Guidelines (2000, 2018)

The *ANZECC Water Quality Guidelines* provide water managers with tools and guidance to assess, manage and monitor water quality. They include default guideline values, which if exceeded indicate that further analysis may be required to ensure aquatic ecosystems are adequately protected. These guidelines provide a starting point for assessing water quality, in conjunction with local guidelines.

2.3.2 Queensland Water Quality Guidelines

The *Queensland Water Quality Guidelines* (DEHP 2013) provide water quality guidelines values that are tailored to Queensland regions and water types, as well as outlining a framework for deriving and applying more locally-specific guidelines for waters in Queensland. However, there are no guidelines specified for the Murray Darling Basin of Queensland.

2.3.3 DES Water Monitoring and Sampling Manual

The *Monitoring and Sampling Manual* (DES 2018a) provides an overview of the common techniques, methods and standards for the collection, handling, quality assurance and control, custodianship and data management in relation to water quality samples. The manual helps to ensure that monitoring data are collected in a consistent and scientifically-accurate manner.

2.3.4 Queensland AusRivAS Sampling and Processing Manual

The *Queensland AusRivAS Sampling and Processing Manual* (DNRM 2001) describes a bioassessment methodology adopted by the Department of Natural Resources and Mines, with a focus on the assessment of macroinvertebrates in freshwater streams. It is the protocol used by the Queensland AusRivAS models and is adapted from the River Bioassessment Manual (Davies 1994).

2.3.5 AusRivAS habitat assessment protocol

The AusRivAS habitat assessment protocol (Parsons *et al*. 2002) describes a protocol for the physical assessment of stream and river condition. The protocol is a stand-alone method of physical and geomorphological assessment. However, it also provides for the biological assessment of stream condition using AusRivAS methods.

2.3.6 Local water quality guidelines

The *ANZECC Guidelines* (2000, 2018) recognise the importance of developing local water quality guidelines from regional data. In February 2019, the Department of Environment and Science (DES) published *Healthy Waters Management Plans for the Condamine River Basin* and *Queensland Border Rivers and Moonie River Basins* (DES 2019a, b) after a period of public consultation in 2018.

The Healthy Waters Management Plans have been prepared to meet accreditation requirements under the 'Commonwealth *Water Act 2007* – Basin Plan 2012'. The plans confirm the environmental values in terms of desired levels of aquatic ecosystem protection, water quality objectives and management responses under the EPP Water and Wetland Biodiversity*.* The plans therefore provide locally-relevant water quality guidelines for the assessment of surface water quality results obtained during field surveys for the Project.

2.3.7 Other guidelines

Several other guidelines were also consulted in relation to the assessment of fish passage at waterways at the NSW/QLD border, and the assessment of aquatic ecology values in Queensland:

- *Policy and guideline for fish habitat conservation and management* (NSW Government 2013)

- *Why do fish need to cross the road – fish passage requirements for waterway crossings* (Fairfull and Witheridge 2003)
- *What is a waterway?* (Queensland Government 2017)
- *Guidelines for groundwater dependent ecosystems* (Queensland Government 2018a)
- *Aquatic ecology – Assessment of aquatic ecological values* (Queensland Government 2018b)
- *What is a waterway barrier work?* (DAF 2017b) and *What is not a waterway barrier work?* (DAF 2017a)
- *Draft Biosecurity Plan for Invasive Plants and Animals* (TRC 2020)

3 Methods

3.1 Overview of the impact assessment area

The proposed rail alignment is shown in **Figure 2** and incorporates two major basins of the Murray Darling river system; the Condamine and the Queensland Border Rivers. Major watercourses within the impact assessment area include the Macintyre River, Pariagara Creek, Condamine River and Bringalily Creek. However, the majority of watercourses and waterways in the impact assessment area are ephemeral, holding water only during the wet season or following periods of heavy rainfall.

3.2 Desktop assessment

A desktop assessment was undertaken to identify potential aquatic ecological features and constraints that may occur within the impact assessment area. The following databases and maps were reviewed:

- EPBC Act Protected Matters Search Tool (PMST), undertaken with a 10 km buffer around the rail alignment (approximately digitised into the online tool)
- Wildlife Online Database Search, a rectangular area that encompassed the entire rail alignment for all aquatic fauna and flora species listed and individual records of listed species
- Atlas of Living Australia database using a 10 km buffer around the rail alignment for all aquatic flora and aquatic fauna species listed and for all aquatic fauna records
- Queensland Matters of State Environmental Significance (MSES) mapping (DILGP 2015) which includes wetlands, and waterways mapped as per the spatial data layer Queensland waterways for waterway barrier works.
- DES Protected Plants Flora Survey Trigger Area mapping (DEHP 2014b), as it applies to aquatic plants
- DES wetland mapping (DES 2018b)
- VMA stream order mapping (DNRM 2015)
- Aquatic Conservation Assessments (ACA) and Aquatic Biodiversity Assessment Mapping Method (AquaBAMM) of DES (Queensland Globe 2019)
- Aerial imagery.

Reference was also made to previous information of relevance to the selection of a route for the Project, as described in EIS Chapter 2: Project Rationale.

Environmental values and water quality objectives for the Condamine River Basin and the Queensland Border Rivers Basin were determined by reviewing the guideline documents listed in **Section 2.3**.

3.3 Likelihood of occurrence assessment

The likelihood of occurrence of each aquatic species identified in the desktop assessment that is listed as threatened under the EPBC Act or listed as Endangered, Vulnerable or Near Threatened (EVNT) or Special Least Concern (SLC) under the NC Act was assessed, based on the species' known distribution, habitat quality within the impact assessment area, species occurrence within the region and species occurrence within the impact assessment area. Each species was assessed as known, likely, possible or unlikely to occur within the impact assessment area based on the following criteria:

- **Known** – the species has been recorded within the impact assessment area

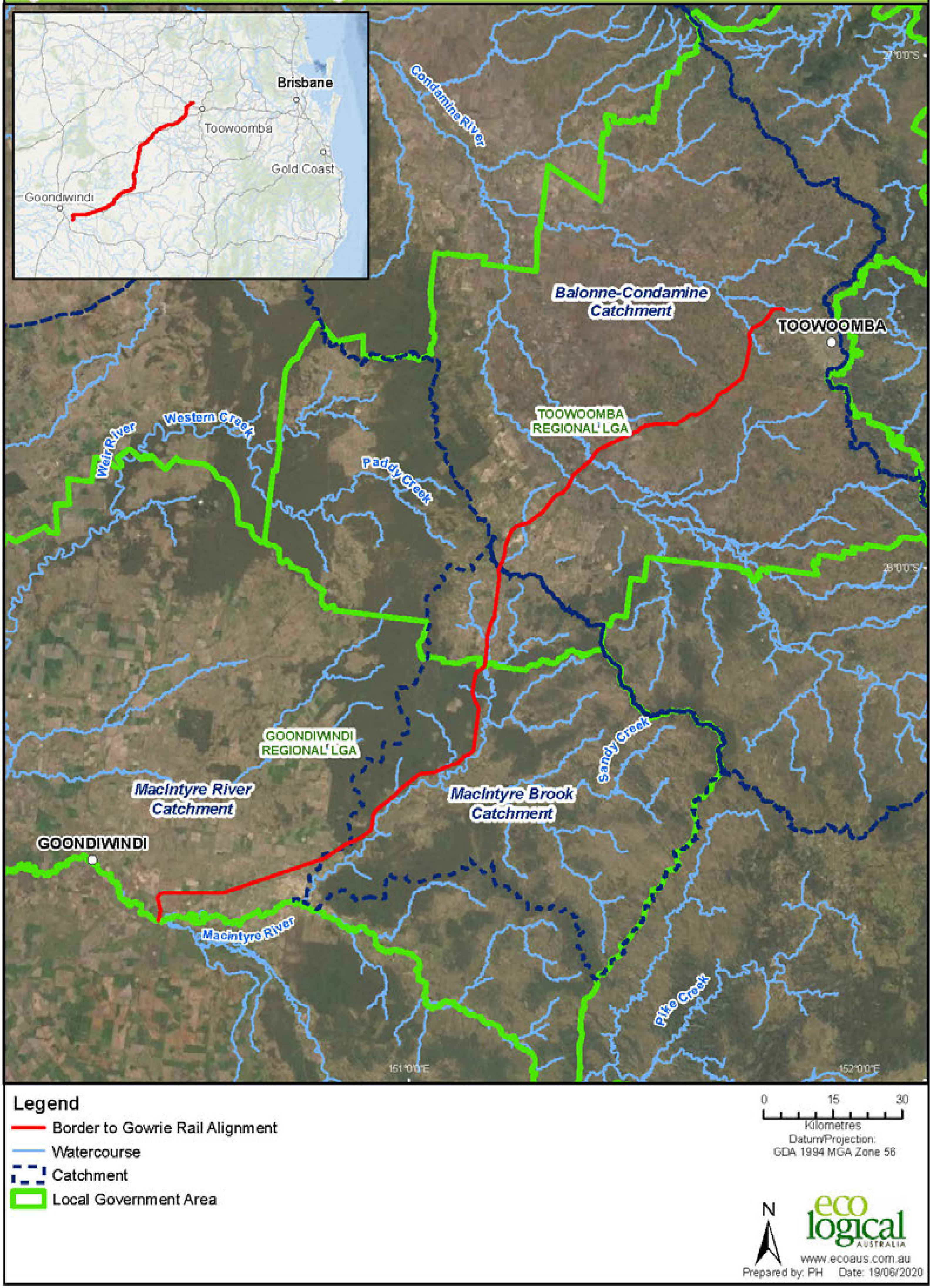
- **Likely** – the impact assessment area is within the species' known distribution; suitable good quality habitat occurs within the area and the species is known to occur within the region
- **Possible** - the impact assessment area is within the species' known distribution; marginal habitat occurs within the area and the species is known to occur within the region
- **Unlikely** – there is a low probability that the species will occur within the impact assessment area as it is outside the species known distribution, low quality habitat occurs within the area or the species is not known to occur within the region.

Likelihood assessments were initially conducted prior to undertaking field surveys, and then updated to include results post-field survey. Such updates were associated with:

- Changing the assessment of likelihood to 'known' in the event that a species was found to be present during the field surveys, or
- Reducing the likelihood of occurrence, based on an absence of habitat within the impact assessment area

The likelihood score was not downgraded in response to a failure to detect a species during field surveys, when habitat suitable for the species was identified within the impact assessment area. This approach accommodates natural changes in the distribution and abundance of some aquatic species over time, and was developed in acknowledgement of the limitations of field sampling methods, which may not capture all target species present at the time of sampling, particularly during dry periods.

Fig 2. Border to Gowrie Rail Alignment



3.4 Field surveys

3.4.1 General approach and timing of survey

A schedule of field activities was developed to determine the aquatic and surface water values of the impact assessment area. The focus of aquatic ecology assessments was to assess a representative number of sites along the rail alignment, with emphasis on habitat values at risk of disturbance.

In order to capture seasonal variation in the abundance of fish and macroinvertebrates, two aquatic ecology surveys were scheduled – one in June 2018 and one in November 2018. This timing was selected to be consistent with the *Queensland AusRivAS Sampling and Processing Manual* (DNRM 2001), which specifies that the preferred timing of surveys is May to July (referred to as the 'late wet') and October to December (referred to as the 'early wet'). Rainfall patterns across the Darling Downs are aligned with this survey timing, with highest rainfall generally occurring in the region between the months of October and March (BOM 2019). A delay between sampling and large rainfall events of at least four weeks is desirable, to allow macroinvertebrate communities to develop sufficiently following the disturbance associated with flood events (DNRM 2001).

Surface water quality values are likely to be more variable than those of aquatic ecology habitats, as they are influenced by runoff events from periods of rainfall and adjacent land use. Hence, four surface water field surveys were planned (as recommended in the AusRivAS manual) approximately three months apart, with two surveys undertaken at the same time as the aquatic ecology surveys and the remaining two surveys scheduled for September 2018 and February 2019.

However, the September 2018 water quality survey did not take place, due to dry conditions across the impact assessment area. Instead, two follow up water quality field assessments were scheduled for February and March 2019, when water was more likely to be present in local waterways. A final aquatic ecology survey was also scheduled for May 2019, to undertake further assessment of aquatic ecology values during the AusRivAS 'late wet' period. This approach resulted in the following five field surveys being completed:

- 11 to 20 June 2018 (aquatic ecology and surface water)
- 26 November to 3 December 2018 (aquatic ecology and surface water)
- 11 to 19 February 2019 (surface water only)
- 29 April to 2 May 2019 (surface water only)
- 15 to 19 May 2019 (aquatic ecology comprising macroinvertebrate and fish sampling). Water samples were also collected at the five aquatic ecology sites containing water during this survey, to assist with the interpretation of macroinvertebrate data

Field personnel undertaking the surveys were experienced in the assessment of aquatic ecology values and the collection and analysis of water quality samples. A principal level aquatic ecologist accredited in Queensland under the AusRivAS assessment method led and implemented all five field surveys.

3.4.2 Selection of sampling sites

Forty three sites adjacent to the rail alignment were initially selected as potentially suitable sampling sites. This number was significantly more than what was intended to be surveyed, but allowed for sites to be removed from the selection if land access proved to be problematic or if sites were found to be unsuitable when accessed in the field. The inclusion of a large number of potential sampling sites also provided greater certainty that sufficient water would be present at a representative selection of sites in the event that dry conditions were experienced.

Sites were positioned as close as possible to locations where the proposed rail alignment traversed watercourses, waterways or drainage features. Sites were nominally assigned into one of the following categories:

- Aquatic ecology site – where an assessment of aquatic ecology habitat values and surface water quality was to be undertaken
- Surface water quality site – where assessment of surface water quality only was to be undertaken

The distribution of aquatic ecology and surface water quality sites along the rail alignment was determined from a range of factors, including:

- Mapping and aerial photography products which provide information on aquatic habitat features, including DAF waterway barriers and DES aquatic habitat mapping
- Inclusion of waterways with a variety of stream orders along the rail corridor, ensuring waterways of varying size and complexity were sampled
- Representation of a variety of aquatic habitat types and surrounding land uses (e.g. areas where remnant riparian vegetation was intact, and areas that had been subject to disturbance from existing infrastructure or agricultural land uses)
- A relatively even spread of survey sites along the rail alignment, to determine spatial variability in aquatic and water quality values
- Practicality of access to the site and the safety of field teams

Where practical, aquatic ecology sites were located at the intersection of the rail alignment and the waterway. A surface water quality site was also generally located upstream and downstream of the aquatic ecology site, if access was possible and the waterway would provide information useful to the impact assessment. This design in the layout of sites in clusters facilitated assessment of surface water and aquatic ecology values in areas where direct disturbance is proposed, as well as adjacent upstream and downstream areas. This approach also provided additional data on the waterway in the instance that the location of the rail corridor changed within the 2 km wide impact assessment area, during the design process.

Consistent and reliable access was obtained for 34 sites that were suitable for the aquatic ecology and surface water assessments. These 34 sites consisted of 12 sites where aquatic ecology and surface water quality assessments were conducted and 22 sites where surface water quality assessments were conducted. A summary of all sites identified for potential sampling is provided in **Table 2** with their location along the rail alignment shown in **Figure 3**. More detailed maps showing the location of sites in clusters relevant to sub-catchments are provided in **Figure 4a-g**.

Sites were assigned a number in approximate numerical order from west to east. On some occasions when a site could not be accessed, an alternative site was identified on public land nearby and labelled with the site number and the letter ‘R’ (e.g. Site 20R). This allowed the assessment of water quality information from areas adjacent to the original site.

Table 2 Sampling sites targeted during the field surveys and associated water quality zone as specified in relevant basin plan (see Section 4.1 for a description of water quality zones)

Site	Assessment type	Waterway	Tenure
Macintyre Barwon Floodplain Water Quality Zone			
1#	Aquatic ecology and surface water	Macintyre River	Private land
2	Aquatic ecology and surface water	Macintyre River	Private land
Lower Macintyre Brook Water Quality Zone			

Site	Assessment type	Waterway	Tenure
3	Surface water	Macintyre Brook	Public land
4	Aquatic ecology and surface water	Unnamed	Public land
5	Aquatic ecology and surface water	Unnamed	Private land
6	Surface water	Macintyre Brook	Private land
7	Surface water	Macintyre Brook	Public land
8	Aquatic ecology and surface water	Unnamed	Private land
Canning Creek Water Quality Zone			
9	Aquatic ecology and surface water	Pariagara Creek	Private land
10	Surface water	Pariagara Creek	Private land
11	Surface water	Canning Creek	Private land
12	Aquatic ecology and surface water	Unnamed	Public land
13	Aquatic ecology and surface water	Cattle Creek	Public land
14	Surface water	Unnamed	Private land
15	Aquatic ecology and surface water	Unnamed	Private land
16	Aquatic ecology and surface water	Unnamed	Private land
17	Aquatic ecology and surface water	Unnamed	Private land
18	Surface water	Unnamed	Public land
19	Aquatic ecology and surface water	Nicol Creek	Public land
20	Surface water	Nicol Creek	Private land
Southern Condamine Water Quality Zone			
21#	Aquatic ecology and surface water	Unnamed	Private land
22#	Surface water	Unnamed	Public land
23	Surface water	Unnamed	Public land
24	Surface water	Grasstree Creek	Public land
25#	Aquatic ecology and surface water	Grasstree Creek	Private land
26#	Surface water	Grasstree Creek	Private land
Central Condamine Water Quality Zone			
27	Surface water	Condamine River	Public land
28	Aquatic ecology and surface water	Condamine River	Private land
29	Surface water	Unnamed	Public land
30	Surface water	Condamine River	Public land
31	Surface water	Condamine River (North Branch)	Public land
32	Aquatic ecology and surface water	Condamine River (North Branch)	Public land
33	Surface water	Condamine River (North Branch)	Public land
Oakey Creek Water Quality Zone			
34#	Aquatic ecology and surface water	Unnamed	Private land
35	Surface water	Unnamed	Public land
36	Surface water	Unnamed	Public land
37#	Surface water	Westbrook Creek	Private land
38#	Aquatic ecology and surface water	Westbrook Creek	Private land
39	Surface water	Westbrook Creek	Public land
40	Surface water	Dry Creek	Public land
41#	Aquatic ecology and surface water	Dry Creek	Private land
42	Surface water	Dry Creek	Public land
43	Aquatic ecology and surface water	Unnamed	Public land

# indicates that access to the site was not reliable for all field surveys or the site was found not to be suitable for assessment

Fig 3. Border to Gowrie Rail Alignment - Aquatic Sampling Sites

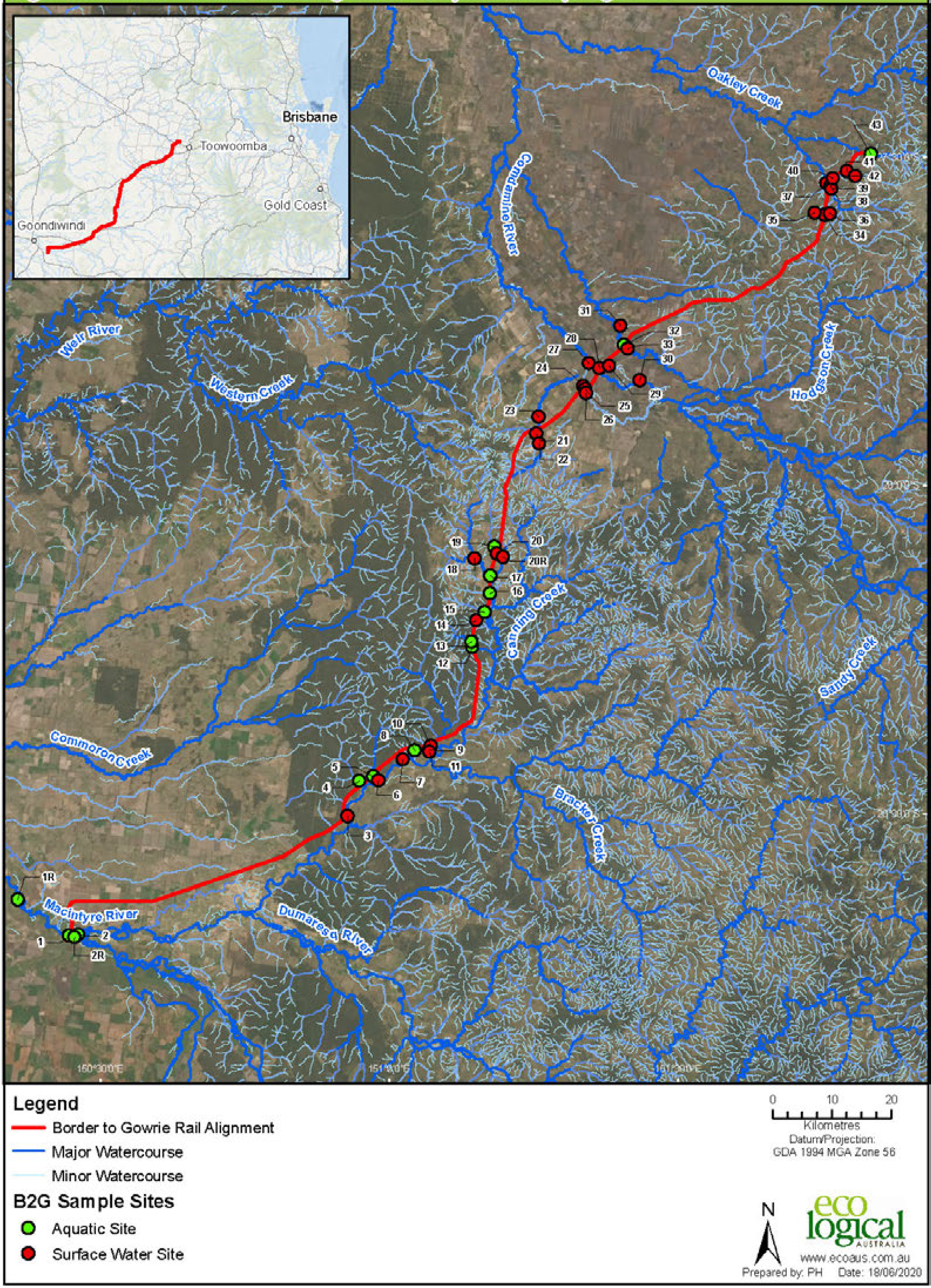


Fig 4a. Border to Gowrie Rail Alignment - Aquatic Sampling Sites

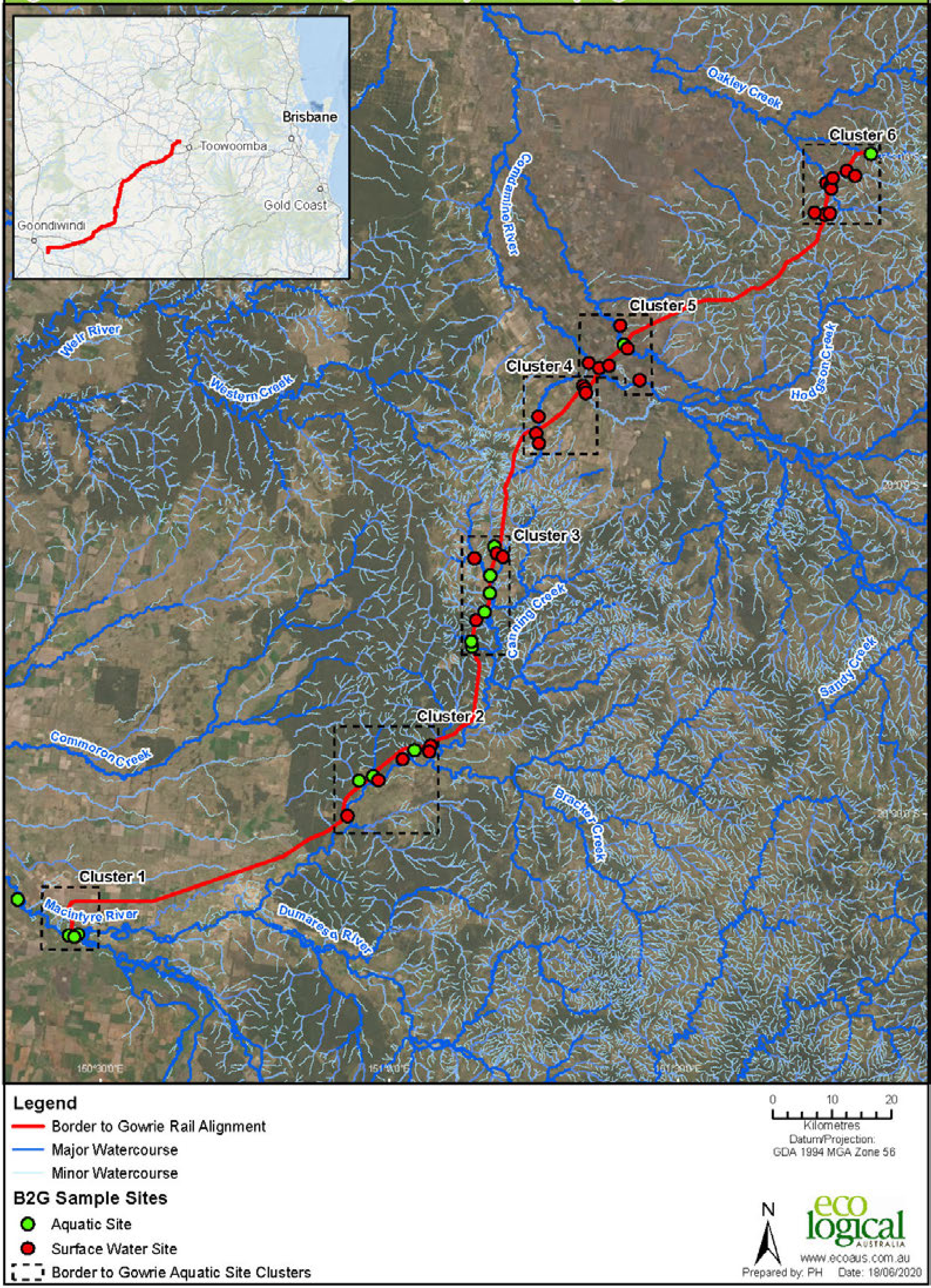


Fig 4b. Macintyre Barwon Floodplain Water Quality Zone (Cluster 1 of 6)

Legend

Border to Gowrie Rail Alignment

B2G Sample Sites

- Aquatic Site
- Surface Water Site

Watercourse

Stream Order

- 1
- 2
- 6
- 7
- 8
- 9

0 1 Kilometers

Datum/Projection: GDA 1994 MGA Zone 56

N

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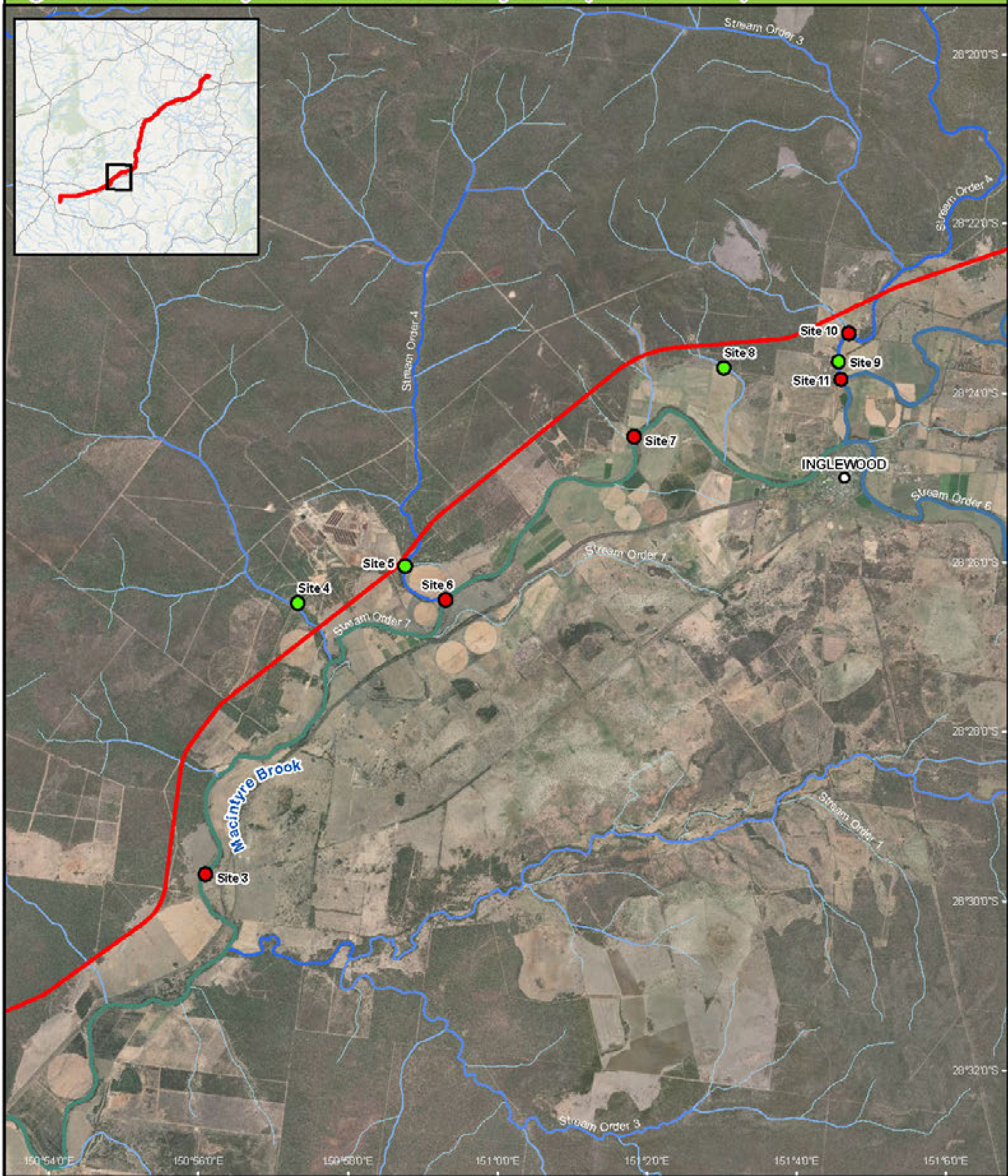
Fig 4c. Lower Macintyre Brook Water Quality Zone (Cluster 2 of 6)



Legend

Border to Gowrie Rail Alignment

B2G Sample Sites

Aquatic Site

Surface Water Site

Watercourse

Stream Order

1
2
3
4
6
7

0 1 2 Kilometers

Datum/Projection: GDA 1994 MGA Zone 56

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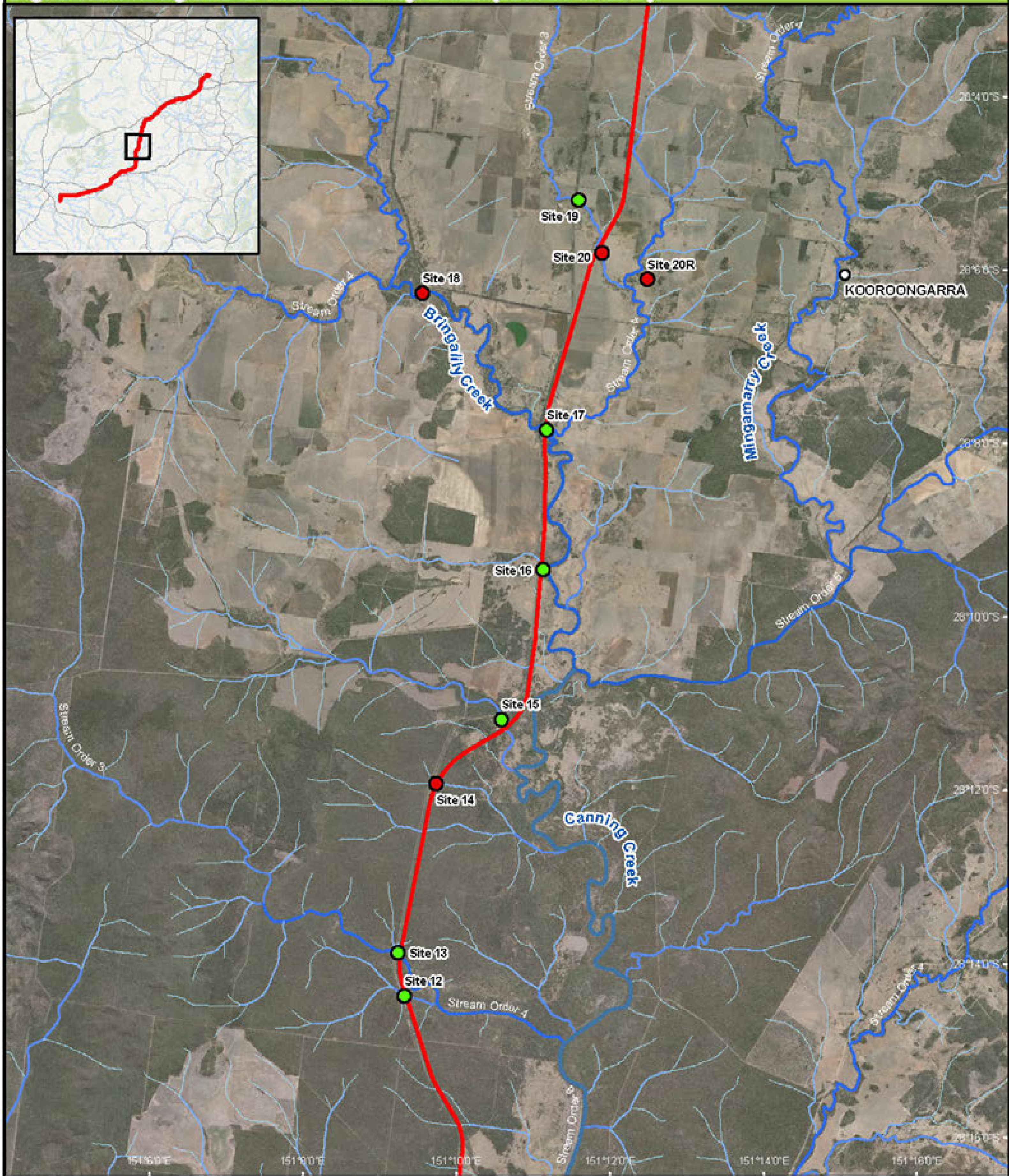
Fig 4d. Canning Creek Water Quality Zone (Cluster 3 of 6)



Legend

Border to Gowrie Rail Alignment

B2G Sample Sites

- Aquatic Site
- Surface Water Site

Watercourse

Stream Order

1
2
3
4
5
6

0 1 2
Kilometers
Datum/Projection:
GDA 1994 MGA Zone 56

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Fig 4e. Southern Condamine Water Quality Zone (Cluster 4 of 6)

Legend

Border to Gowrie Rail Alignment

B2G Sample Sites

- Aquatic Site
- Surface Water Site

Watercourse

Stream Order

1
2
3
4
5
6

0 1 2
Kilometers
Datum/Projection:
GDA 1994 MGA Zone 56

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Fig 4f. Central Condamine Water Quality Zone (Cluster 5 of 6)

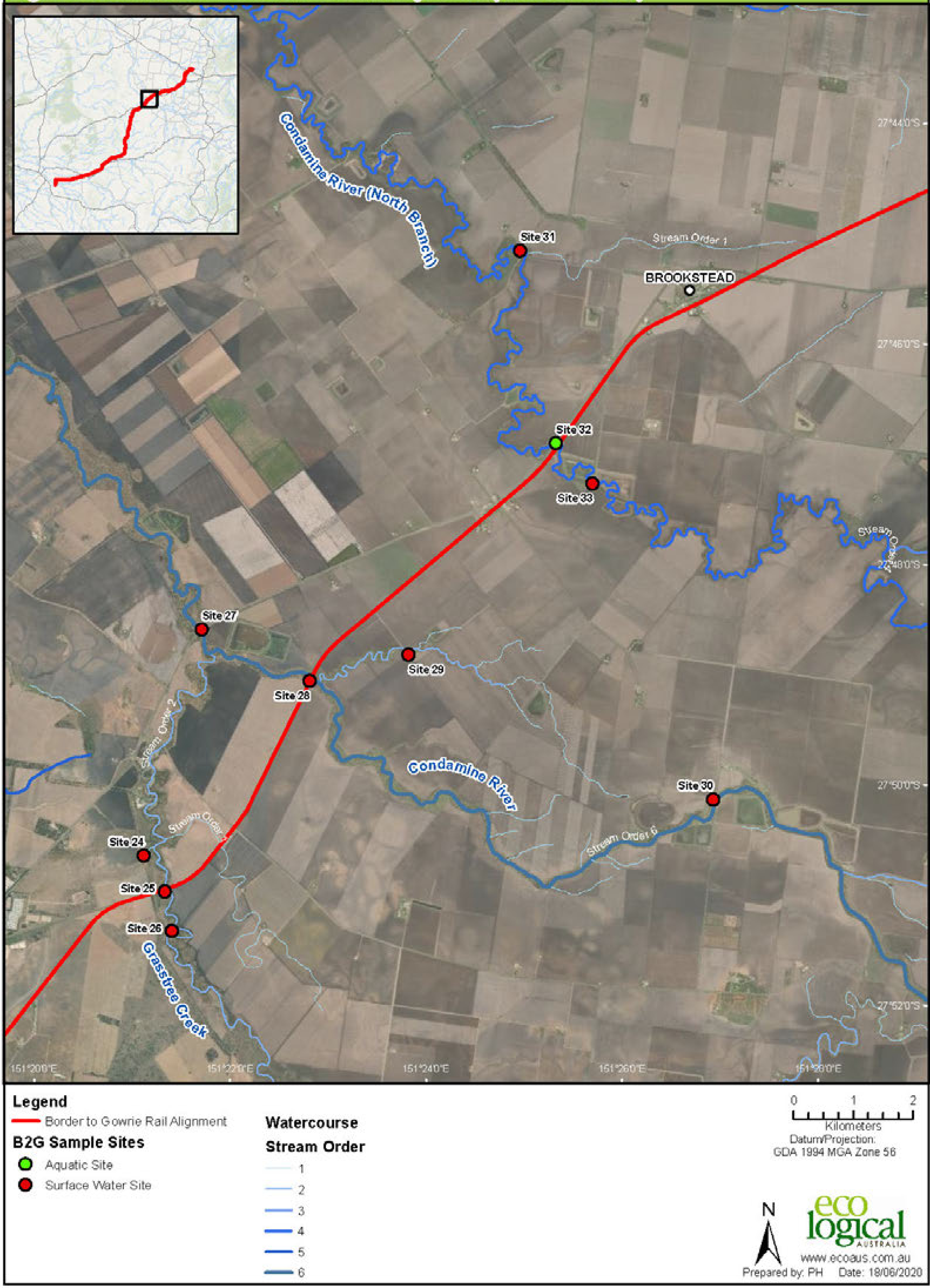
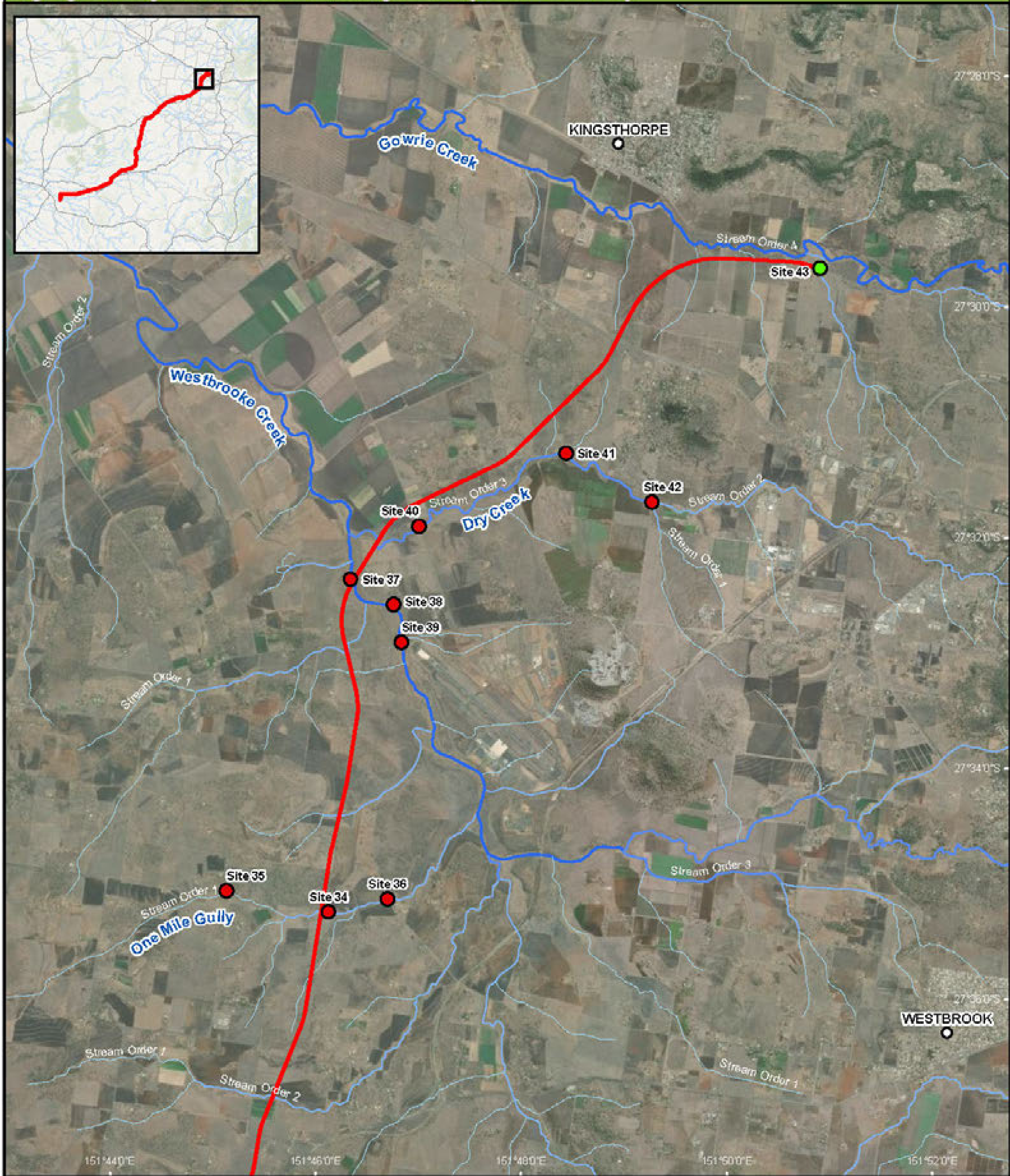


Fig 4g. Oakey Creek Water Quality Zone (Cluster 6 of 6)



Legend

Border to Gowrie Rail Alignment

B2G Sample Sites

- Aquatic Site
- Surface Water Site

Watercourse

Stream Order

1
2
3
4
5

0 1 2 Kilometers

Datum/Projection: GDA 1994 MGA Zone 56

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3.4.3 Aquatic ecology habitat assessment and sampling

Aquatic habitats were assessed at each aquatic ecology site in accordance with the AusRivAS physical habitat assessment protocol (Parsons *et al*. 2002). The following information was collected at each site:

- Site ID and name
- Date and time
- Location (latitude, longitude)
- Photographs in four directions aligned with the flow of water
- Planform sketch of the site
- Bank width and length of sampling site (100 m)
- Valley shape (steep, shallow, broad, gorge, symmetrical floodplain, asymmetrical floodplain)
- Local activities impacting on streams
- Floodplain features and local land uses
- Riparian zone composition including description of vegetation (trees >10 m in height, trees <10 m in height, shrubs and grasses/ferns/sedges)
- Shading of channel (<5 per cent, 6-25 per cent, 26-50 per cent, 51-75 per cent, >76 per cent)
- Extent of trailing bank vegetation (nil, slight, moderate, extensive)
- Native and exotic riparian vegetation (per cent composition)
- Regeneration of native woody vegetation
- Overall vegetation disturbance rating (extreme, very high, high, moderate, low or very low)
- Physical barriers to local fish passage (no passage, very restricted, moderately restricted, partly restricted, good passage, unrestricted passage)
- Type and extent of bars and dominant sediment particle size on bars
- Channel modifications, slope and shape
- Bank shape and slope
- Sediment and water oils
- Sediment and water odours
- Turbidity (visual assessment)
- Water level at time of sampling
- Artificial features of the sampling site
- Large woody debris
- Factors affecting bank stability
- Bedrock outcrops
- Artificial bank protection measures
- Extent of bedform features
- Macrophyte cover and composition
- Bed compaction
- Sediment matrix and angularity
- Bed stability
- Epifaunal substrate/available cover
- Pool substrate characterisation and variability
- Sediment deposition
- Channel alteration and sinuosity
- Bank stability
- Vegetative protection
- Riparian zone
- Filamentous algae, periphyton, moss and detritus cover

- Substrate composition
- Bank material
- Cross section sketch

The information collected was used to inform an assessment of the suitability of aquatic habitats for key species of interest, such as the Murray Cod, Silver Perch and Bell's Turtle. General site observations and photographs of aquatic habitats were also recorded.

3.4.4 Macroinvertebrate surveys

Macroinvertebrate sampling was undertaken in November 2018 and May 2019. Macroinvertebrate samples were collected in accordance with the Queensland AusRivAS assessment manual (DNRM 2001).

Freshwater macroinvertebrate sampling was undertaken to gain an improved understanding of the aquatic values, waterway health and trophic interactions occurring at each site. Samples were collected from aquatic ecology survey sites that exhibited wetted habitat at the time of assessment. Due to dry conditions, this was limited to Site 2 (Macintyre River) and Site 16 (Bringalily Creek) in November 2018, and Site 2 (Macintyre River), Sites 6R and 7 (Macintyre Brook), Site 18 Bringalily Creek and Site 42 (Dry Creek) in May 2019.

Sampling was overseen by an AusRivAS accredited ecologist following AusRivAS protocols for Queensland streams (DNRM 2001). AusRivAS specifies a standardised, qualitative, rapid bioassessment method that aims to consistently sample a wide diversity of macroinvertebrates within a defined timeframe.

The bed and edge habitats were sampled separately at each site. A standard sized dip net with 250 µm mesh was used to sample macroinvertebrates. Following collection, the samples were transferred to plastic sorting trays, where the contents were sorted and live-picked for 30 minutes. Picked specimens were placed into specimen jars with 70per cent ethanol.

Samples were identified to AusRivAS taxonomic level in the laboratory under stereomicroscope. AusRivAS taxonomic identification was primarily to Family level, with the exception of lower Phyla such as Porifera, Nematoda and Nemertea, Oligochaetes (freshwater worms), Acarina (mites), and microcrustacea such as Ostracoda, Copepoda and Cladocera. Chironomids (midges) were identified to sub-family taxonomic level.

3.4.5 Fish surveys

For the June 2018 field trip, a limited fish survey was implemented involving the deployment of baited box traps and dip-netting, targeting small fish at sites containing water. At each site, up to seven baited box traps were deployed for approximately one hour, followed by dip-netting waterway edge habitats for a period of approximately 10 minutes with an Environet®.

For subsequent field trips in December 2018 and May 2019, the scope of works was expanded and a range of additional survey techniques were applied to assess fish assemblages at aquatic ecology sites that were suitable. Targeted fish survey methods were selected from the Survey Guidelines for Australia's Threatened Fish (SEWPAC 2011), and included backpack electrofishing (where water depth was <0.5 m), seine netting (2 – 5 mm mesh) and use of fyke nets. Where fyke nets were used, two nets were deployed overnight (one 3 mm stretched mesh and one 4 mm stretched mesh). Nets were dual wing in design, with each wing 4 m in length with a 0.6 m drop. The survey methods were adapted to suit the local conditions of the waterway, with the primary considerations being the depth of water and presence of woody debris which may foul nets.

Fish were identified to species level, with the number of each species captured, and size range for each species recorded. After processing, native fish were returned to the water, and pest species were euthanised by lethal dose of AQUI-S solution, followed by pithing or exsanguination to confirm death, in accordance with Animal Ethics Committee approval.

All sampling activities were undertaken in accordance with relevant conditions of General Fisheries and Animal Ethics permits held by Eco Logical Australia (General Fisheries Permit 196796 and Animal Ethics CA2018/07/1214) and DPM Envirosciences (General Fisheries Permit 192554 and Animal Ethics CA2017/03/1043).

3.4.6 Macro-crustaceans

Macro-crustaceans (those that can be seen with the naked eye) were collected as by-catch using fish sampling techniques (**Section 3.4.5**). Additionally, macro-crustacean specimens collected during macroinvertebrate sampling were retained for identification. All macro-crustaceans collected using fishing apparatus were returned to the water following identification. Identifications were undertaken to species level.

3.4.7 Freshwater turtles

Information on freshwater turtles was collected during field surveys through observations of habitat suitability (**Section 3.4.3**) and from incidental observations of turtles during field surveys while targeting fish and invertebrates. Freshwater turtles listed as Least Concern are likely to be abundant throughout waterways and wetlands of the impact assessment area. Relevant species include the Eastern snake-necked turtle (*Chelodina longicollis*), Broad-shelled river turtle (*Chelodina expansa*) and Murray turtle (*Emydura macquarii macquarii*).

3.4.8 Surface water quality sampling

Surface water quality data was collected at accessible aquatic ecology and surface water sampling sites in accordance with the DES Monitoring and Sampling Manual (DES 2018a). Information about site characteristics was recorded using the '*Water Quality Sampling Field Sheet'* (DNRM 2002).

The following values were recorded at each site:

- Site ID and name
- Date and time
- Sampling location (latitude, longitude and reach orientation looking downstream)
- Weather (rain in the past week, cloud cover, wind)
- Observations at water sampling site (within 2 m of sampling point or on closest bank) including:
  - Shading (per cent)
  - Water odour
  - Water surface condition
  - Algae (per cent) (on substrate, in water column)
  - Macrophytes (per cent) (emergent, submerged, floating, fringing)
  - Impact (per cent) (human, pastoral animals, non-pastoral animals)
- Percent of habitat types in 100 m reach
- Reach observations (of 100 m stream length). Reach observations include:
  - Upstream land use
  - Adjacent land use of left and right banks
  - Local catchment erosion

  - Water colour
  - Sediment deposits
  - Algae cover
  - Water odour
  - Substrate colour
  - Water surface
  - Variety of habitat
  - Bars
  - Flow level
- Riparian zone characteristics and values (to a maximum 100 m width) which include:
  - Width of riparian zone (left and right bank)
  - Bare ground (per cent)
  - Grass (per cent)
  - Shrubs (per cent)
  - Trees <10 m high (per cent)
  - Trees >10m high (per cent)
  - Presence of exotic riparian species
  - Width of continuous tree zone from bank
  - Description of dominant riparian species
- Macrophytes (per cent) (native and exotic)

A multi-probed, battery operated water quality meter (YSI Professional Plus) was used to measure physio-chemical parameters. The device was calibrated in the field prior to the collection of data (**Appendix C**) and used to take measurements of the following parameters:

- Dissolved oxygen (DO) (mg/L) and saturation (per cent)
- pH
- Electrical conductivity (EC) (µs/cm)
- Temperature (°C)
- Turbidity (NTU)
- Total dissolved solids (TDS) (ppm)
- Oxidation reduction potential (ORP) (mV).

Water quality samples were collected using sampling containers prepared and provided by the National Association of Testing Authorities accredited laboratory Australian Laboratory Services (ALS). Nitrile gloves were worn during sampling and field teams maintained best practice protocols to assist in prevention of on-site contamination.

Water samples collected for the purpose of analysis for dissolved metals were filtered in the field through a 0.45 µm filter using a sterile syringe. Once collected, samples were immediately placed in a refrigerator or on ice in an esky and delivered with Chain of Custody forms to ALS for analysis of the following analytes:

- Conductivity and salinity
- Total suspended solids
- Total hardness as $CaCO_3$ (Alkalinity)
- Nutrient suite (ammonia, nitrite, nitrate, total nitrogen, total kjeldahl nitrogen (TKN), nitrogen oxides (NOx), reactive phosphorus (P) and total P)
- Organic nitrogen

- Dissolved metals (eight metals suite: arsenic, cadmium, chromium, copper, nickel, lead, zinc and mercury)
- PAHs
- Chlorophyll *a*

Field surveys involving both aquatic ecology and surface water quality investigations were planned for a period of nine consecutive days, with those surveys involving only surface water quality investigations planned for six consecutive days. The impact assessment area is located approximately four hours' drive from the laboratory. In order to avoid a breach of holding times for some analytes, the following approach was taken to the delivery of samples to the laboratory:

- A mid-field trip consignment of all samples collected to date was dropped at the laboratory by the field team for analysis
- Water samples for chlorophyll *a* were filtered through a glass fibre filter in the field, with the filter paper double wrapped in aluminium foil and stored in a freezer, as described in DES (2018c). Application of this method extended the laboratory holding time for Chlorophyll *a* from two days to 28 days.

A range of quality assurance processes were implemented during sampling. These included the following:

- At one monitoring site for each field trip, a second suite of water samples (duplicates) were taken and labelled DUP. This sample was a 'blind duplicate' of another site (unknown to the laboratory) and provided an opportunity to determine within-laboratory variation in the results between samples collected from the same location. The relative percent difference was calculated for duplicate samples, with a criterion of <35% applied for further investigation.
- For each field trip, a container of distilled water was transported into the field, and alongside collection of relevant site water samples, laboratory sampling containers were filled with this water (including filtration of dissolved metals samples). The samples were labelled 'Blank' and maintained and assessed alongside relevant site water quality samples, providing an opportunity to identify if the sample collection and/or storage procedures resulted in contamination of the samples.

3.5 Weather conditions and site access

Conditions were generally dry in the months prior to the aquatic ecology and surface water field surveys in June and November 2018. More frequent rainfall preceded the surface water surveys of February and April 2019 and aquatic ecology survey of May 2019, resulting in a higher proportion of sampling sites containing water.

The BoM weather station at Leyburn, Queensland, is located approximately mid-way along the alignment, and provides an indication of rainfall patterns in the region during the survey. It recorded 348 mm of rain in the twelve month period from 1 April 2018 to 1 April 2019, a majority of which fell between July and December (**Figure 5**). In comparison with historical data available for the Leyburn local area (2000 to 2018), average annual rainfall is 535.9 mm ranging from 273 to 1,022 mm. During the twelve-month period in which the study took place, Leyburn received approximately 35% less rainfall than is generally expected in an average year.

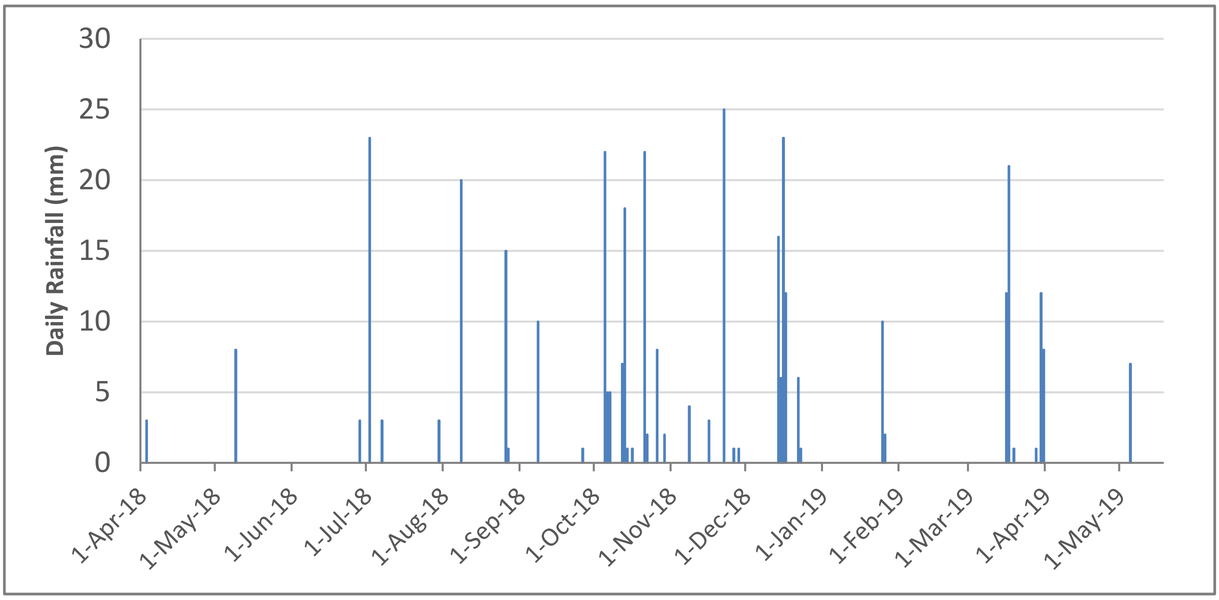


Figure 5 Rainfall data from Leyburn weather station from 1 April 2018 to 1 April 2019

The sampling sites assessed during the June 2018, November 2018, February 2019 and April 2019 field surveys are summarised in **Table 3**. In summary, the total number of sites assessed on each trip ranged from 31 to 35. Differences in sites visited among field trips related to difficulties in obtaining access to private land.

A majority of the sites were dry at the time of sampling in June and November 2018. In February 2019 approximately 50% of sites assessed contained water, increasing to 60% in April 2019. If dry sites were encountered, physical site characteristics were recorded.

Table 3 Sampling sites assessed during the four primary rounds of field surveys (- indicates not assessed)

Site	Assessment type	Waterway	June 2018 Survey date	Water Present?	November 2018 Survey date	Water Present?	February 2019 Survey date	Water Present?	April 2019 Survey date	Water Present?
1R	Surface water	Macintyre River	16/06/2018	Yes	-	-	-	-	-	-
2	Aquatic ecology	Macintyre River	-	-	29/11/2018	Yes	11/02/2019	Yes	29/04/2019	Yes
2R	Surface water	Macintyre River	16/06/2018	Yes	27/11/2018	Yes	11/02/2019	Yes	29/04/2019	Yes
3	Surface water	Macintyre Brook	17/06/2018	Yes	27/11/2018	Yes	12/02/2019	Yes	30/04/2019	Yes
4	Aquatic ecology and surface water	Unnamed	16/06/2018	No	27/11/2018	No	12/02/2019	No	30/04/2019	No
5	Aquatic ecology and surface water	Unnamed	16/06/2018	No	27/11/2018	No	12/02/2019	No	30/04/2019	No
6	Surface water	Macintyre Brook	16/06/2018	Yes	27/11/2018	Yes	12/02/2019	Yes	30/04/2019	Yes
7	Surface water	Macintyre Brook	17/06/2018	Yes	27/11/2018	Yes	12/02/2019	Yes	30/04/2019	Yes
8	Aquatic ecology and surface water	Unnamed	17/06/2018	No	28/11/2018	No	12/02/2019	No	30/04/2019	No
9	Aquatic ecology and surface water	Pariagara Creek	15/06/2018	No	28/11/2018	No	13/02/2019	No	30/04/2019	No
10	Surface water	Pariagara Creek	15/06/2018	No	28/11/2018	No	13/02/2019	No	30/04/2019	No
11	Surface water	Canning Creek	15/06/2018	Yes	28/11/2018	Yes	13/02/2019	Yes	30/04/2019	Yes
12	Aquatic ecology and surface water	Unnamed	17/06/2018	No	28/11/2018	No	12/02/2019	No	30/04/2019	No
13	Aquatic ecology and surface water	Cattle Creek	14/06/2018	No	28/11/2018	No	12/02/2019	No	30/04/2019	No
14	Surface water	Unnamed	14/06/2018	Yes	28/11/2018	Yes	13/02/2019	Yes	01/05/2019	Yes
15	Aquatic ecology and surface water	Unnamed	14/06/2018	No	29/11/2018	No	13/02/2019	No	01/05/2019	No
16	Aquatic ecology and surface water	Unnamed	13/06/2018	Yes	28/11/2018	Yes	13/02/2019	Yes	01/05/2019	Yes
17	Aquatic ecology and surface water	Unnamed	17/06/2018	No	28/11/18	No	13/02/2019	No	01/05/2019	No
18	Surface water	Unnamed	14/06/2018	No	30/11/2018	No	12/02/2019	Yes	01/05/2019	Yes

Site	Assessment type	Waterway	June 2018 Survey date	Water Present?	November 2018 Survey date	Water Present?	February 2019 Survey date	Water Present?	April 2019 Survey date	Water Present?
19	Aquatic ecology and surface water	Nicol Creek	13/06/2018	No	30/11/2018	No	12/02/2019	No	01/05/2019	No
20	Surface water	Nicol Creek	14/06/2018	No	-	-	-	-	-	-
20R	Surface water	Nicol Creek	-	-	30/11/2018	No	12/02/2019	No	01/05/2019	Yes
23	Surface water	Unnamed	13/06/2018	No	26/11/2018	No	12/02/2019	Yes	01/05/2019	Yes
24	Surface water	Grasstree Creek	18/06/2018	Yes	30/11/2018	Yes	13/02/2019	Yes	-	-
27	Surface water	Condamine River	15/06/2018	Yes	26/11/2018	No	13/02/2019	Yes	02/05/2019	Yes
28	Surface water	Unnamed	-	--	-	-	13/02/2019	Yes	01/05/2019	Yes
29	Surface water	Unnamed	15/06/2018	No	26/11/2018	No	13/02/2019	No	01/05/2019	Yes
30	Surface water	Condamine River	14/06/2018	Yes	01/12/2018	Yes	14/02/2019	Yes	02/05/2019	Yes
31	Surface water	Condamine River (North Branch)	14/06/2018	No	30/11/2018	No	14/02/2019	No	02/05/2019	No
32	Aquatic ecology and surface water	Condamine River (North Branch)	14/06/2018	No	01/12/2018	No	14/02/2019	Yes	-	-
33	Surface water	Condamine River (North Branch)	14/06/2018	No	26/11/2018	Yes	14/02/2019	No	-	-
35	Surface water	Unnamed	12/06/2018	No	01/12/2018	No	14/02/2019	No	02/05/2019	No
36	Surface water	Unnamed	12/06/2018	No	01/12/2018	No	14/02/2019	No	02/05/2019	No
39	Surface water	Westbrook Creek	15/06/2018	Yes	01/12/2018	Yes	14/02/2019	Yes	02/05/2019	Yes
40	Surface water	Dry Creek	12/06/2018	Yes	01/12/2018	Yes	14/02/2019	No	02/05/2019	Yes
42	Surface water	Dry Creek	15/06/2018	Yes	01/12/2018	Yes	14/02/2019	Yes	02/05/2019	Yes
43	Aquatic ecology and surface water	Unnamed	12/06/2018	No	01/12/2018	No	14/02/2019	No	02/05/2019	No

3.6 Survey limitations

Field surveys were undertaken during a period of long-term, below average rainfall across the impact assessment area. The local government areas of Toowoomba and Goondiwindi regional councils were subject to a drought declaration by DAF during the period of field surveys and associated impact assessment (DAF 2019), reflecting the dry conditions throughout the region. Results of the field surveys may therefore not be representative of environmental conditions during periods of average or above average rainfall. Surveys during dry conditions have the potential to yield different water quality results than those during wet periods. For example, water runoff containing sediments, nutrients and metals can be low or absent during dry conditions, resulting in good water quality. However, poor water quality can also arise in dry conditions due to high water temperatures reducing dissolved oxygen concentrations, and high evaporation rates causing the concentration of salts and other parameters in water. The quality of aquatic habitats also has the potential to be underestimated when assessed during dry conditions. These limitations have been considered in the interpretation of results.

A total of 21 of the proposed sampling sites were located on or required access through privately owned land. ARTC and FFJV coordinated access to private properties with the agreement of landholders. However, in some cases, access to private properties could not be negotiated or facilitated in the timeframes of the survey. In three cases, alternative sampling sites located on public land nearby were selected, where such areas provided suitable aquatic habitat and/or surface water values.

The laboratory holding times for some water quality analytes (e.g. reactive phosphorus, nitrite and nitrate: two days) were shorter than was practical for the transport of samples to the laboratory. The number of parameters affected was minimised by transporting samples to the laboratory every three to four days during field trips and using alternative methods for the preservation of samples where possible (e.g. chlorophyll *a* filter paper method; DES 2018c). Consequently, results for some parameters were obtained outside of the recommended holding times, and this has been considered when interpreting the results.

3.7 Data collation and analysis

3.7.1 Aquatic ecology physical habitat

The AusRivAS Physical Assessment Protocol is a standardised approach to assess various aquatic habitat parameters. A rating of either poor, fair, good or excellent was assigned to each habitat parameter from data recorded in the field, with an overall habitat rating calculated for low gradient streams (Parsons *et al*. 2002). The suitability of aquatic habitat for EVNT species was also determined, based on the results of the desktop assessment and field surveys.

3.7.2 Aquatic ecology macroinvertebrate communities

Macroinvertebrate data was used to calculate multiple community descriptors as described in the following sections.

Taxonomic richness

Taxonomic richness was calculated from the number of taxa present in each sample, providing an indication of community diversity at the site, with richness typically increasing with ecological condition.

PET

The Plecoptera, Ephemeroptera and Trichoptera (PET) richness was calculated from the number of taxa belonging to the three PET orders, in accordance with the method described in DNRM (2001). These three orders are widely accepted as being most sensitive to environmental change, such as habitat degradation and pollution. A low PET richness score suggests that a site may be impacted by degradation or pollution, due to the absence of these pollution-sensitive taxa. Conversely, a high PET richness suggests a system free from degradation or pollution.

SIGNAL2

SIGNAL2 (Stream Invertebrate Grade Number – Average Level Version 2) indices were calculated, with each taxon allocated a score from 1 to 10 based on the method prescribed by Chessman (2003). Taxa with a low score are most tolerant of a range of environmental conditions, and those with a high score are more sensitive to pollution. The presence/absence data of each taxon were used to calculate the SIGNAL2 average for the site, in accordance with the protocols described by Chessman (2003).

Tolerant taxa

The percentage of tolerant taxa was calculated using the SIGNAL2 sensitivity grades derived from aquatic macroinvertebrate taxa at the Family level. Tolerant taxa are those with a SIGNAL2 score of 3 or less. Macroinvertebrate families in this group are expected to be able to tolerate changes to their environment, including habitat degradation and some pollution. An absence of the more sensitive taxa suggests environmental conditions may be too harsh for more sensitive taxa (those with SIGNAL2 score above 3) to tolerate.

AusRivAS

The macroinvertebrate and predictor variables (habitat) data was entered into the AusRivAS macroinvertebrate predictive modelling program – Version 3.2.2 (eWater 2017). The Queensland Regional Western spring and autumn models for bed and edge habitats were used (**Table 4** and **Table 5** respectively).

Table 4 AusRivAS habitat predictor model variables for QLD Regional Western November 2018 sampling

Code	Description	Input value for site	
		Site 2	Site 16
QLD Regional – Western – Spring – Edge habitat			
ALKALINITY	Total carbonates, Hardness as $CaCO_3$ (mg/L)	70	100
DISTANCE FROM SOURCE	Distance from source (km)	180	30
LATITUDE	Latitude of site (decimal degrees)	-28.6642	-28.1563
LONGITUDE	Longitude of site (decimal degrees)	150.4678	151.1875
PROCESS ZONE	Process zone category (2 = erosional; 1 = transport; 0 = depositional)	1	1
QLD Regional – Western – Spring – Pool/Bed habitat			
BOULDER	Percent boulder (>256 mm) in habitat (%)	0	0
COBBLE	Percent cobble (64-256 mm) in habitat (%)	0	0
WETR	Range in wet season monthly rainfall means (mm)	33.8	35.1

Notes: Meteorology data for Site 2 derived from the ‘New Kildonan TM’ BoM monitoring station 41507 (approximately 2.5 km west). Meteorology data for Site 16 derived from the ‘Duddawarra’ BoM monitoring station 41543 (approximately 9 km north).

Table 5 AusRivAS habitat predictor model variables for QLD Regional Western May 2019 sampling

Code	Description	Input value for site				
		2	6R	7	18	42
QLD Regional – Western – Autumn – Edge habitat						
DRYRANGE	Range in dry season monthly rainfall means (mm)	7.5	7.5	7.5	7.5	11.0
LATITUDE	Latitude of site (decimal degrees)	-28.6631	-28.4459	-28.4075	-28.1032	-27.5277
MINTEMP	Mean daily minimum temperature (˚C)	11.5	11.5	11.5	11.5	11.9
MWMR	Mean wet season monthly rainfall (mm)	71.5	71.5	71.5	71.5	87.4
STORDER	Stream order	9	7	7	5	3
WETPERCENT	Percentage rainfall in wet season (%)	65.2	65.2	65.2	65.2	72.9
QLD Regional – Western – Autumn – Pool/Bed habitat						
PROCESS ZONE	Process zone category (2 = erosional; 1 = transport; 0 = depositional)	1	1	1	1	2
STORDER	Stream order	9	7	7	5	3
WETR	Range in wet season monthly rainfall means (mm)	32.2	32.2	32.2	32.2	38.9

Notes: Meteorology data for Sites 2, 6R, 7 and 18 derived from the 'Texas Post Office' BoM monitoring station 41100 (being the nearest station that records both rainfall and daily minimum temperature). Meteorology data for Site 42 derived from the 'Toowoomba Airport' BoM station 41529 (approx. 9 km east) for the period 1996-2019.

3.7.3 Surface water quality

This section describes the approach to the collation and analysis of surface water quality data, with particular emphasis on the potential influence of surface water quality on aquatic ecology values. A separate Surface Water Quality Technical Report (Appendix P of the draft EIS) has also been prepared and provides additional consideration of surface water quality information relevant to the Project.

Water quality results were compared with relevant environmental values and water quality objectives. Environmental values and water quality objectives (target values; annual medians) for the Condamine River Basin and the Queensland Border Rivers Basin have been developed by the DES, in collaboration with the Queensland Murray Darling Committee and other stakeholders (DES 2019a, b).

Where a specific parameter/trigger value was not available for the Condamine River Basin and the Queensland Border Rivers Basin, the ANZECC Guidelines (2000, 2018) were used (95 per cent level of protection for slightly to moderately disturbed ecosystems). The Queensland Water Quality Guidelines (DEHP 2013) were also used to guide the assessment, but do not include any guidelines for sections of the Murray Darling Basin within Queensland. Hence, assessment of water quality was generally based on the ANZECC Guidelines (2000, 2018) and local Guidelines (DES 2019a, b).

It is well established that there are several abiotic factors that can modify the toxicity and bioavailability of some metals to aquatic organisms (ANZECC 2018). The ANZECC Guidelines (2000) provide a formula to adjust water quality trigger levels to account for the reduced toxicity of these metals to biota with increasing water hardness. However, the more recent ANZECC Guidelines (2018) identify limitations to this approach, particularly for copper. Therefore, hardness and dissolved metals results from the impact assessment area have been presented for comparison with relevant guideline values, without the calculation of hardness corrected trigger levels. Discussion of the potential for high hardness concentrations at some sites to reduce the toxicity of metals is provided in **Section 4.3**.

3.8 Approach to impact assessment

A qualitative assessment is the most appropriate method for aquatic ecology and surface water quality impacts, through application of a significance assessment, as described in EIS Chapter 4: Assessment methodology of the draft EIS. This method is preferred where an impact will occur, and the sensitivity or vulnerability of the environmental values and the magnitude of the impact are important. Sensitivity criteria, magnitude criteria and a significance matrix were established to facilitate the assessment (**Tables 6-9)**, and facilitate the assessment of Project impacts before and after the implementation of mitigation measures, to minimise the duration, intensity or extent of impacts.

The impact assessment method follows the mitigation hierarchy, which has the following sequential steps:

1. Avoidance (measures taken to avoid creating impacts, for example through the placement of infrastructure outside areas of key habitat)
2. Minimisation (measures to taken to reduce the duration, intensity or extent of impacts that cannot be avoided, i.e., mitigation measures)
3. Rehabilitation (measures taken to improve the environment following exposure to impacts that cannot be completely avoided or minimised)
4. Offset (measures taken to compensate for any residual adverse impacts after implementation of the previous three steps in the mitigation hierarchy.

For each potential impact, a pre-mitigation and post-mitigation scenario was assessed and a significance ranking determined. The initial assessment of potential impact (pre-mitigation) was undertaken assuming mitigation methods associated with Concept Assessment and reference design phases of the Project had been implemented (Phases 1 and 2). Following this assessment of impact significance, additional mitigation measures associated with future project phases (Project Assessment, Project Approval, Project Implementation and Project Close-out; Phases 3-6) were then considered. These additional mitigation measures align with the detail design, pre-construction, construction and operation phases of the Project. The need to offset or compensate for residual impacts that could not be avoided through adoption of reasonable mitigation measures was also considered.

Consideration was also given to the benefits of monitoring water quality and aquatic ecology values during various stages of the Project, with recommendations provided in **Section 5.2**.

Table 6 Sensitivity criteria

Sensitivity	Description
Major	• The environmental value is listed on a recognised or statutory state, national or international register as being of conservation significance and/ or • The environmental value is entirely intact and wholly retains its intrinsic value and/ or • The environmental value is unique to the environment in which it occurs. It is isolated to the affected system/area, which is poorly represented in the region, state, country or the world and/ or • It has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the environmental value. • Project activities would have an adverse effect on the value.
High	• The environmental value is listed on a recognised or statutory state, national or international register as being of conservation significance and/ or • The environmental value is intact and retains its intrinsic value and/ or • The environmental value is unique to the environment in which it occurs. It is isolated to the affected system/area, which is poorly represented in the region and/ or • It has not been exposed to threatening processes, or they have not had a noticeable impact on the integrity of the environmental value. • Project activities would have an adverse effect on the value.
Moderate	• The environmental value is recorded as being important at a regional level, and may have been nominated for listing on recognised or statutory registers and/ or • The environmental value is in a moderate to good condition despite it being exposed to threatening processes. It retains many of its intrinsic characteristics and structural elements and/ or • It is relatively well represented in the systems/areas in which it occurs, but its abundance and distribution are exposed to threatening processes and/ or • Threatening processes have reduced its resilience to change. Consequently, changes resulting from project activities may lead to degradation of the prescribed value and/ or • Replacement of unavoidable losses is possible due to its abundance and distribution.
Low	• The environmental value is not listed on any recognised or statutory register. It might be recognised locally by relevant suitably qualified experts or organisations e.g. historical societies and/ or • The environmental value is in a poor to moderate condition as a result of threatening processes, which have degraded its intrinsic value and/ or • It is not unique or rare and numerous representative examples exist throughout the system / area and/ or • It is abundant and widely distributed throughout the host systems / areas and/ or • There is no detectable response to change or change does not result in further degradation of the environmental value and/ or • The abundance and wide distribution of the environmental value ensures replacement of unavoidable losses is achievable.
Negligible	• The environmental value is not listed on any recognised or statutory register and is not recognised locally by relevant suitably qualified experts or organisations and/ or • It is not unique or rare and numerous representative examples exist throughout the system / area and/ or • There is no detectable response to change or change does not result in further degradation of the environmental value.

Table 7 Magnitude criteria

Magnitude	Description
Major	An impact that is widespread, permanent and results in substantial irreversible change to the environmental value. Avoidance through appropriate design responses or the implementation of environmental management controls are required to address the impact.
High	An impact that is widespread, long lasting and results in substantial and possibly irreversible change to the environmental value. Avoidance through appropriate design responses or the implementation of site-specific environmental management controls are required to address the impact.
Moderate	An impact that extends beyond the area of disturbance to the surrounding area but is contained within the region where the Project is being developed. The impacts are short term and result in changes that can be ameliorated with specific environmental management controls.
Low	A localised impact that is temporary or short term and either unlikely to be detectable or could be effectively mitigated through standard environmental management controls.
Negligible	An extremely localised impact that is barely discernible and is effectively mitigated through standard environmental management controls.

Table 8 Significance matrix

Magnitude	Sensitivity				
	Major	High	Moderate	Low	Negligible
Major	Major	Major	High	Moderate	Low
High	Major	Major	High	Moderate	Low
Moderate	High	High	Moderate	Low	Low
Low	Moderate	Moderate	Low	Negligible	Negligible
Negligible	Moderate	Low	Low	Negligible	Negligible

Table 9 Significance classifications

Significance	Description
Major	Arises when an impact will potentially cause irreversible or widespread harm to an environmental value that is irreplaceable because of its uniqueness or rarity. Avoidance through appropriate design responses is the only effective mitigation.
High	Occurs when the proposed activities are likely to exacerbate threatening processes affecting the intrinsic characteristics and structural elements of the environmental value. While replacement of unavoidable losses is possible, avoidance through appropriate design responses is preferred to preserve its intactness or conservation status.
Moderate	Results in degradation of the environmental value due to the scale of the impact or its susceptibility to further change even though it may be reasonably resilient to change. The abundance of the environmental value ensures it is adequately represented in the region, and that replacement, if required, is achievable.
Low	Occurs where an environmental value is of local importance and temporary or transient changes will not adversely affect its viability provided standard environmental management controls are implemented.
Negligible	Does not result in any noticeable change and hence the proposed activities will have negligible effect on environmental values. This typically occurs where the activities are located in already disturbed areas.

3.9 Assessment of cumulative impacts

Projects with spatial and/or temporal overlap can result in cumulative impacts. Cumulative impacts may:

- Differ from those of an individual project when considered in isolation
- Be positive or negative
- Differ in severity and duration depending on the spatial and temporal overlap of projects occurring in an area.

It is a requirement of the ToR for this Project that the potential for cumulative impacts be considered. This section provides details of the methods for the assessment of cumulative impacts in relation to aquatic ecology values.

Cumulative impacts of the Project were qualitatively assessed. A list of applicable projects and operations for consideration in the cumulative impact assessment was developed for assessment by all EIS disciplines (**Table 10**). The potential for spatial and temporal overlap between the Project and other projects was considered, in relation to potential impacts on aquatic ecology and surface water quality values.

The approach used to identify and assess potential cumulative impacts of the Project was as follows:

- A review of the potential impacts identified within the draft EIS assessments. The environment at the time of the ToR is the baseline, prior impacts from past land use has not be considered
- A register of assessable projects was collated with timelines to demonstrate the temporal relationship between projects. This included:

  - Only ‘state significant’ or ‘strategic’ projects (i.e. coordinated projects under the SDPWO Act) that are in the public domain as being planned, constructed or operated at the time of the ToR were considered
  - Additional projects were considered where they were deemed to be of local significance, as occurring through consultation with community groups and stakeholders. These included:
  - Projects listed in Goondiwindi Regional Council and Toowoomba Regional Council Development Application databases
  - Development within Priority Development Areas and State Development Areas
  - Economic Development Queensland development projects
  - Community Infrastructure Designation projects
  - Projects within the public register of environmental authorities
  - Department of Transport and Main Roads infrastructure projects
  - Private infrastructure facilities
  - Development in accordance with Regional Planning Interests
  - The Inland Rail projects immediately adjacent to the Project, being the North Star to NSW/QLD Border and Gowrie to Helidon projects
- Identification and mapping of the assessable projects and the areas of influence. Current operational projects and commercial or agricultural operations that are in the area of influence around the Project are accounted for in the baseline assessment
- Where there is a potential overlap in impacts (either spatially or temporally), a cumulative impact assessment was undertaken to determine the nature of the cumulative impact. This includes:
  - Where possible the assessment method has been quantitative in nature however qualitative assessment has also been undertaken for certain environmental values
  - Where quantitative assessment has been possible, the significance of impact has been assessed in comparison to the same criteria or guidelines as adopted by the relevant technical impact assessments
  - Where impacts are expressed qualitatively, the probability, duration, and magnitude/intensity of the impacts have been considered as well as the sensitivity and value of the receiving environmental conditions

Some of the other projects in **Table 10** were in an operational phase at the time that the Border to Gowrie Project ToR were issued. Therefore, these other projects were influencing the existing environment at the time that the desktop and field assessments were carried out for the Border to Gowrie Project. The potential for the impacts of these operational projects to act cumulatively with those of the Project is therefore inherent within the impact assessment, which predicts the additional effects of the Project on the environmental baseline. Operational projects were therefore not carried forward to the assessment of cumulative impacts (refer **Section 5.4**).

Table 10 Projects identified for consideration in the cumulative impact assessment for aquatic ecology

Projects	Status#	Description
Wetalla Water Pipeline (north of the Project)	Completed	This is part of the New Acland Coal Mine – Stage 3 expansion. A 45 km underground water pipeline to supply up to 5,500 ML of treated wastewater to the New Acland coal mine, which is earmarked for expansion.
New Acland (approximately 25 km northwest of the Project)	Approved with conditions	Expansion of the existing New Acland open-cut coal mine to up to 7.5 Mtpa.
Australia Pacific LNG Project (Walloons gas fields is approximately 20 km west of Millmerran)	Approved with conditions	Integrated liquefied natural gas (LNG) project. The Walloons gas fields area is the component closest to the Project.
Toowoomba Bypass (previously the Toowoomba Second Range Crossing)	Construction at time of ToR being issued Became operational in September 2019	DTMR has delivered a second range crossing that takes heavy vehicle highway traffic around north of Toowoomba rather than through it. The 41 km long bypass route runs from the Warrego Highway at Helidon Spa in the east to the Gore Highway at Athol in the west, via Charlton.
InterLink SQ – Global Logistics Centre and Industrial Park (located 8 km from Wellcamp International Airport)	Construction	InterLink SQ has two components, The InterLink Industrial Park, and the InterLink Global Logistics Centre (rail/road terminal). The Industrial Park is a master-planned logistics, warehousing and industrial estate that will provide opportunities for companies to co-locate in a logistics hub. The 140-hectare industrial park is approved, and construction has started. The InterLink Global Logistics Centre is an open access, intermodal terminal linking rail, road, sea and air. The 60 hectare site will include a three kilometre frontage along the Inland Rail route and will incorporate grain and commodities storage, processing and loading facilities, rail maintenance and provisioning, and a large container handling and storage area. The precinct will move 250,000 Import Export TEU's per year.
Toowoomba Wellcamp Airport (located 17 km west of Toowoomba CBD, and immediately south of Inland Rail corridor)	Operational – subject to expansion	The airport operates as an international cargo hub connecting Australia's leading primary producers and processors with growing consumer markets across the globe. The airport was constructed over 19 months from 2012 to 2014 and is the first major greenfield public airport development in Australia in over 50 years.

Projects	Status[#]	Description
Wellcamp Business Park	Operational – subject to continuing construction and expansion	Part of the Toowoomba Enterprise Hub. 500 hectare industrial and commercial estate surrounds Brisbane West Wellcamp Airport and is fast becoming the commerce and industry hub of Toowoomba and regional south east Queensland.
Witmack Industry Park and Charlton Logistics Park	Operational – subject to continuing construction and expansion	Part of the Toowoomba Enterprise Hub. Witmack Industry Park and Charlton Logistics Park – Witmack Industry Park is one of Toowoomba's largest industrial land developments and offers large size industrial land parcels from 2 to 5 hectares. Charlton Logistics Park is the most recent addition to the Toowoomba Enterprise Hub and provides level and fully serviced 2 hectare sites. Due to its Warrego Highway location combined with easy access to the Second Range Crossing, Charlton Logistics Park is well suited for transport and logistics operators.
Commodore Mine and Millmerran Power Station (south of Millmerran)	Operational	The Commodore Mine is an open pit coal mine, located in the Surat Basin and began supplying coal to the 850 MW Millmerran Power Station in February 2003. Millmerran Power Station is a coal-fired power station that supplies base-load power and came on line early in 2003. It supplies enough electricity to power approximately 1.1 million homes.
Pittsworth Industrial Precinct and PIP Enabling Project (Pittsworth)	Construction	New road and sewerage infrastructure at Pittsworth Industrial Precinct will open up industrial land for industries servicing agriculture and the wider region.
Doug Hall Poultry (Millmerran)	Operational	Poultry farm with approximately 200 employees producing caged, cage free, free range and organic eggs. Operations include egg grading, a feed mill with output of 1,500 tonnes per week, piggery, cropping and solar farm.
Yarranbrook Feedlot (Inglewood)	Operational	Feedlot currently licensed for 25,000 head. Operations include pivot farms.
Sapphire Feedlot (Kildonan)	Operational	Cattle feedlot and grain production. The 6,000 head Sapphire Feedlot has capacity to grow to 8,700 head with the development to be rolled out in future.
Wyemo Piggery (Texas-Yelarbon Rd, Glenarbon)	Planned	Intensive animal industries – 55,000 standard pig units Environmentally relevant activities – 8,000 standard pig units
Yarranlea Solar	Approved with conditions	100 MW solar farm located at Yarranlea.
Goondiwindi Abattoir	Approved with conditions	Proposed beef processing of 72,000 tonnes per year.
Asterion Medicinal Cannabis Facility, Wellcamp	Planned	A medicinal cannabis cultivation, research and manufacturing facility, involving construction of a 40 ha glasshouse to produce 20,000 plants per day at full capacity. Medicinal grade cannabis grown at the facility will be manufactured into a range of medicinal products. Projected capital expenditure is $450 million.

Projects	Status#	Description
North Star to Border (Inland Rail)	Reference design and EIS	The North Star to NSW/QLD Border section of the Inland Rail is a new freight rail corridor approximately 30 km in length. The new rail corridor will connect North Star (NSW) to the Queensland Rail South Western Line near Yelarbon just north the NSW/QLD border.
Gowrie to Helidon (Inland Rail)	Draft EIS being prepared	This project comprises 26 km of new dual gauge track between Gowrie (north-west of Toowoomba) and Helidon (east of Toowoomba). It crosses the two Local Government Areas of Toowoomba and Lockyer Valley. The Gowrie to Helidon section of Inland Rail will include a new 6.38 km tunnel to create an efficient route through the steep terrain of the Toowoomba Range.
Helidon to Calvert (Inland Rail)	Reference design and EIS	New 47 km dual gauge rail line connecting Helidon (east of Toowoomba) with Calvert (near Ipswich), via Placid Hills, Gatton, Forest Hill, Laidley and Grandchester, extending through the LGAs of Lockyer Valley and Ipswich City. The project includes a 1.1 km tunnel to create an efficient route through the steep terrain of the Little Liverpool Range.
Calvert to Kagaru (Inland Rail)	Reference design and EIS	New 53 km dual gauge track from Calvert to Kagaru to provide convenient access for freight to major proposed industrial developments at Ebenezer in the City of Ipswich, and at Bromelton near Beaudesert in the Scenic Rim Region. The project includes a 1.1 km tunnel through the Teviot Range.
Kagaru to Acacia Ridge (Inland Rail)	Reference design and EIS	Enhancements to, as well as commissioning of, dual gauge operations along the existing interstate track between Kagaru and Acacia Ridge. The project involves 49 km of existing track to be enhanced enabling double-stacking capability along the existing interstate route both south from Kagaru to Bromelton and north from Kagaru to Brisbane's major intermodal terminal at Acacia Ridge. It extends across three LGAs of Scenic Rim, Logan and Brisbane.
Cross River Rail	Construction	New 10.2 km passenger rail line from Dutton Park to Bowen Hills, which includes 5.9 km of tunnel under the Brisbane River and the CBD. The Project will include four new underground stations at Boggo Road, Woolloongabba, Albert Street and Roma Street, and upgrades to Dutton Park and Exhibition stations.

Operational projects were not carried forward to the assessment of cumulative impacts

For those future projects with potential for cumulative impacts, further assessment was made by considering the probability and duration of impact, and the sensitivity of the receiving environment, which were all ranked on a scale of Low, Medium or High. An assessment matrix method (further detailed within **Table 11** and **Table 12**) was used to determine the significance of cumulative impacts with respect to beneficial or detrimental effects.

Following the identification of each potential cumulative impact, a relevance factor score of Low, Medium and High was determined in consideration of the impacts, in accordance with the assessment matrix given in **Table 11**. The significance of the impact was determined by using professional judgement to select the most appropriate relevance factor for each aspect in **Table 11**.

The sum of the relevance factors determined the impact significance and consequence which are summarised in **Table 12**. For example if an environmental value was considered to have a probability of impact of 2, duration of impact of 3, magnitude/intensity of impact of 1 and a sensitivity of receiving environment of 1, the significance of impact would be Medium (2+3+1+1 = 7).

If cumulative impacts were deemed to be of 'medium' or 'high' significance, additional mitigation measures were proposed, beyond those already proposed by the relevant technical impact assessments.

Table 11 Assessment matrix for assessment of cumulative impacts

Aspect	Relevance factor		
	Low	Medium	High
Probability of impact	1	2	3
Duration of impact	1	2	3
Magnitude/Intensity of impact	1	2	3
Sensitivity of receiving environment	1	2	3

Table 12 Impact significance criteria for cumulative impacts

Impact significance	Sum of relevance factors	Consequence
Low	1-6	Negative impacts need to be managed by standard environmental management practices. Monitoring to be part of general project monitoring program.
Medium	7-9	Mitigation measures likely to be necessary and specific management practices to be applied. Targeted monitoring program required, where appropriate.
High	10-12	Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Targeted monitoring program necessary, where appropriate.

4 Existing aquatic and surface water values

4.1 Environmental values and water quality objectives

A common approach to describing the existing condition of aquatic environments is to describe their environmental values and compare the results of water quality monitoring with relevant water quality guidelines. The *ANZECC Guidelines* (2000, 2018) provide water quality guidelines for some parameters, with a particular focus on biologically available (dissolved) metals. The slightly to moderately disturbed classification (95 per cent level of protection) is most appropriate to the waterways of the impact assessment area, due to their existing level of disturbance from adjacent land uses. However, the guidelines also encourage the development and application of local guidelines, based on water quality data collected from the region.

DES has published two reports relevant to the Project and the application of local water quality guidelines:

- *Healthy Waters Management Plan: Queensland Border Rivers and Moonie River Basins* (DES 2019a) and
- *Healthy Waters Management Plan: Condamine River Basin* (DES 2019b).

The Healthy Waters Management Plans have been prepared to meet accreditation requirements under the Commonwealth *Water Act 2007* – Basin Plan 2012 (Commonwealth of Australia 2012). Each plan has been adopted following a period of public consultation in 2018, and confirms the environmental values, desired levels of aquatic ecosystem protection, water quality objectives and management responses under the EPP Water and Wetland Biodiversity.

The Project intersects six sub-catchments recognised in the local guidelines for the development of environmental values, comprising:

- Macintyre Barwon Floodplain (Queensland Border Rivers Basin; sites 1 to 2);
- Lower Macintyre Brook (Queensland Border Rivers Basin; sites 3 to 8);
- Canning Creek (Queensland Border Rivers Basin; sites 9 to 20);
- Condamine River (Condamine River Basin; sites 21 to 30);
- Condamine River North Branch (Condamine River Basin; sites 31 to 33); and
- Upper Oakey (Condamine River Basin; sites 34 to 43).

The environmental values (DES 2019a, b) attributed to each of these sub-catchments are identified in **Table 13**. 'Aquatic ecosystems' is an environmental value common across all six sub-catchments.

The water quality objectives (DES 2019a and 2019b) most relevant to the Project relate to moderately disturbed surface water ecosystems described in the local guidelines; and the default ANZECC Guidelines (2000, 2018) for pesticides, heavy metals and other contaminants for slightly to moderately disturbed ecosystems (95% level of protection). The Project intersects six *Basin Plan* water quality zones comprising:

- Macintyre Barwon Floodplain (Queensland Border Rivers Basin; Sites 1 to 2);
- Lower Macintyre Brook (Queensland Border Rivers Basin; Sites 3 to 8);
- Canning Creek (Queensland Border Rivers Basin; Sites 9 to 20);
- Southern Condamine (Condamine River Basin; Sites 21 to 26);

- Central Condamine (Condamine River Basin; Sites 27 to 33); and
- Oakey Creek (Condamine River Basin; Sites 34 to 43).

The water quality objectives differ for each of the six *Basin Plan* water quality zones and are summarised in **Table 14**.

Table 13 Environmental values for surface waters intersected by the Project (DES 2019a, b)

Environmental Values	Aquatic Ecosystems	Irrigation	Farm Supply	Stock water	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Drinking water	Industrial use	Cultural, spiritual and ceremonial values
Condamine River Basin Sub-Catchment												
Upper Oakey (sites 34 to 43)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Condamine River North Branch (sites 31 to 33)	✓	✓	✓						✓	✓	✓	✓
Condamine River South Branch (sites 21 to 30)	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓
Queensland Border Rivers Basin Sub-Catchment												
Canning Creek (sites 9 to20)	✓	✓		✓					✓			✓
Lower Macintyre Brook (sites 3 to 8)	✓	✓	✓	✓		✓	✓		✓	✓		✓
Macintyre Barwon Floodplain (sites 1 to 2)	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓

Table 14 Water quality objectives (annual median) for moderately disturbed surface water ecosystems intersected by the Project (DES 2019a, b)

Basin Plan Water Quality Zone		Water quality target																
		Turbidity	**Total phosphorus**	**FRP**	**Chlorophyll *a***	**Total nitrogen**	**Oxidised nitrogen**	**Ammonium nitrogen**	**Dissolved oxygen**		**pH**	**EC**	**Salinity**	**Sulphate as SO_4**	**Temperature**	**TSS**	**Alkalinity**	**Pesticides, heavy metals and other toxic contaminants**
		NTU	**µg/L**	**µg/L-P/L**	**µg/L**	**µg/L**	**µg/L-N/L**	**µg/L-N/L**	**mg/L**	**% Sat**		**µS/cm**	**mg/L**	**mg/L**	**ºC**	**mg/L**	**mg/L as $CaC0_3$**	
Condamine River Basin																		
Oakey Creek (Sites 34 to 43)	Low flow	13	110	45	5	1,000	5	10	ID	60 to 110	7.7 to 8.3	510	NA	7	20:80 percentiles of natural monthly water temperature	14	125	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow	55	340	90	ID	1,280	ID	ID			7.4 to 8.1	380		7		65	85	
Central Condamine (Sites 27 to 33)	Low flow	25	170	20	9	860	4	4			7.4 to 8.3	890		5		25	350	
	High flow	220	950	500	4	2,200	480	ID			7.0 to 7.6	290		4		130	100	
Southern Condamine (Sites 21 to 26)	Low flow	9	45	15	5	590	3	6			7.2 to 7.9	170		3		8	45	
	High flow	25	60	20	ID	830	ID	ID			7.0 to 7.6	160		2		17	35	
Queensland Border Rivers Basin																		
Canning Creek (Sites 9 to 20)	Low flow	35	30	8	ID	520	6	10	ID	60 to 110	7.2 to 7.8	200	NA	2	20:80 percentiles of natural monthly water temperature	25	80	ANZECC default trigger values that apply to slightly-moderately disturbed systems must not be exceeded.
	High flow	50	40	ID	ID	600	ID	ID			6.9 to 7.9	165		3		60	ID	
Lower Macintyre Brook (Sites 3 to 8)	Low flow	11	55	11	ID	710	18	8			7.4 to 8.0	370		10		10	90	
	High flow	25	70	ID	ID	910	ID	ID			7.2 to 8.0	250		10		25	95	
Macintyre Barwon Floodplain (Sites 1 to 2)	Low flow	30	70	20	3	575	10	20			7.4 to 8.0	240		7		25	55	
	High flow	110	150	ID	ID	900	195	ID			7.0 to 7.5	180		6		70	55	

4.2 Results of desktop assessment

The desktop study identified one EVNT aquatic flora, four ENVT aquatic fauna and nineteen introduced aquatic flora which potentially could occur within the impact assessment area. In addition, important waterways and wetlands were also identified as meeting criteria for listing as MSES. These results are summarised in the following sections, and **Appendix B** provides a detailed table describing the likelihood of occurrence for EVNT listed aquatic flora and fauna.

4.2.1 EVNT aquatic flora

The Wetland*Info* database identifies 136 wetland indicator plant species as having previously been recorded from the Queensland Border Rivers drainage basin and 180 wetland indicator plant species as having previously been recorded from the Condamine River drainage sub-basin (DES 2018b). Of these, one is an EVNT species, being the Endangered (NC Act) fringing rush (*Fimbristylis vagans*), recorded from the Condamine River drainage sub-basin (DES 2018b), which has potential to occur in the impact assessment area (**Appendix B**).

4.2.2 Introduced aquatic flora

The Commonwealth Government recognises 32 weeds of national significance (WoNS) across Australia, based on their:

- invasiveness and impact characteristics;
- current distribution and potential area of spread; and
- current primary industry, environmental and socio-economic impact.

The *Biosecurity Act 2014* (Qld) lists Prohibited and Restricted biosecurity matters (including weed species) for Queensland.

There are 22 introduced wetland indicator plant species known from the Balonne-Condamine drainage basin (EHP 2016). Those invasive species, including WoNS and other introduced plants, considered to pose a particular threat to aquatic biodiversity, and that could potentially occur within the impact assessment area, are listed in **Table 15**.

Table 15 Introduced wetland indicator plants known to occur in the Balonne-Condamine drainage basin, and potential to occur in the impact assessment area

Scientific name	Common name	National status^	BA status*	Basin / sub-basin	
				Condamine	Border Rivers
Arundo donax	-			✓	✓
Berula erecta	Water parsnip			✓	
Cyperus eragrostis	-			✓	✓
Cyperus esculentus	Yellow nutgrass			✓	
Cyperus involucratus	-			✓	
Cyperus papyrus	Papyrus			✓	
Diplachne fusca var. uninervia	-			✓	
Echinochloa colona	Awnless barnyard grass			✓	✓
Echinochloa crus-galli	Barnyard grass			✓	✓
Eclipta prostrata	White eclipta			✓	✓
Egeria densa	Dense waterweed			✓	
Eichhornia crassipes	Water hyacinth	WoNS	R3		✓
Juncus articulatus	Jointed rush			✓	✓
Juncus bufonius	Toad rush			✓	✓

Scientific name	Common name	National status^	BA status*	Basin / sub-basin	
				Condamine	Border Rivers
Pistia stratiotes	Water lettuce		R3	✓	
Polypogon monspeliensis	Annual beardgrass			✓	✓
Salix babylonica	Weeping willow			✓	✓
Salvinia molesta	Salvinia	WoNS	R3		✓
Rorippa nasturtium-aquaticum	Watercress			✓	

Notes:

^ Species listed as WoNS; * species listed under the Queensland *Biosecurity Act 2014* (R3 = Category 3 Restricted Matter).

4.2.3 EVNT aquatic fauna

The Wetland*Info* database identifies 17 native fish species that have previously been recorded from the Queensland Border Rivers drainage basin and 27 native fish species from the Condamine drainage sub-basin (DES 2018b). Of these, two species are listed as EVNT (see **Appendix B** for further details) and have historically been recorded from both catchments:

- Murray Cod (*Maccullochella peelii*) – Vulnerable (EPBC Act); and
- Silver Perch (*Bidyanus bidyanus*) – Critically Endangered (EPBC Act).

The Murray Cod occurs naturally within the Condamine and Queensland Border Rivers drainage basins and is found within Queensland and other Australian states. This species prefers deep water with in-stream habitat such as boulders, logs, and overhanging vegetation, and are sensitive to habitat alterations, such as altered flow regimes and overfishing (Allen *et al*. 2002). Suitable habitat for the Murray Cod occurs within the impact assessment area, including sites on the Macintyre River, Macintyre Brook, Canning Creek and the Condamine River. Bringalily Creek represents marginal habitat for the Murray Cod. The Murray Cod is known to occur within the impact assessment area (**Appendix B**), including the Macintyre River and Macintyre Brook (**Section 4.4.5**). The species also has potential to occur in the impact assessment area within large river systems such as the Condamine River. Draft referral guidelines for the Murray Cod identify that important populations of the species are present in the Macintyre River and Macintyre Brook (DotE 2016).

The Silver Perch prefers faster-flowing water, including rapids and races, and more open sections of river throughout the Murray Darling Basin (TSSC 2013). The Silver Perch was assessed as unlikely to occur in the impact assessment area, due to a lack of recent records from the region, and the presence of only small areas of habitat that may be suitable for the species (**Appendix B**).

The Wetland*Info* database identifies five turtle species that have previously been recorded from the Queensland Border Rivers drainage basin and six turtle species from the Condamine drainage sub-basin (DES 2018b). Of these, two are listed as EVNT:

- Bell's turtle (*Wollumbinia belli*) – Vulnerable (EPBC Act and NC Act) – Queensland Border Rivers drainage basin; and
- Southern snapping turtle (*Elseya albagula*) – Critically Endangered (EPBC Act); Endangered (NC Act) – Condamine drainage sub-basin.

The Bell's turtle inhabits narrow sections of rivers in granite country in northern NSW on the New England Tablelands, and in south-east Queensland near Stanthorpe, at the headwaters of the Queensland Border

Rivers catchment (DES 2018d). It is considered unlikely to occur in the impact assessment area (refer to **Appendix B**).

Southern snapping turtles are not typically found in the Condamine drainage sub-basin, but are generally found throughout the Fitzroy, Burnett, and Mary Rivers to the north. This species prefers flowing waters (Cogger 2014) but has been captured by the study team in a variety of habitats including deep, isolated, yet permanent, pools in both the Fitzroy and Burnett River catchments. The southern snapping turtle's appearance is superficially very similar to that of the Least Concern saw-shelled turtle (*Wollumbinia latisternum*), being differentiated by the intergular scutes on their plastron (underside of shell). It is suspected that multiple database records may be misidentifications by less experienced observers who have not handled and carefully inspected the plastron of suspected southern snapping turtles. It is unlikely that the southern snapping turtle occurs within the Condamine drainage sub-basin, and even less likely that it occurs within the impact assessment area.

The Wetland*Info* database (DES 2018b) identifies the Platypus (*Ornithorhynchus anatinus*) as having previously been recorded from both the Queensland Border Rivers drainage basin and the Condamine drainage sub-basin. This species is listed as SLC, for cultural reasons, under the NC Act, and is known to occur in the impact assessment area (**Appendix B**).

A detailed description of EVNT species including information on their distribution, life history and habitat requirements is provided in Appendix L of the draft EIS (Matters of National Environmental Significance Technical Report).

4.2.4 Introduced fishes

The Wetland*Info* database identified four introduced fish species that have previously been recorded from the catchments intersected by the Project. The mosquitofish (*Gambusia holbrooki*), goldfish (*Carassius auratus*) and European carp (*Cyprinus carpio*) have been recorded from both the Queensland Border Rivers drainage basin and the Condamine drainage sub-basin (DES 2018b). The guppy (*Poecilia reticulata*) has been recorded from the Condamine drainage sub-basin only (DES 2018b).

Introduced fishes can cause a variety of issues within the aquatic environment, such as competing with native fish for food and habitat, preying on native species, habitat disturbance and introduction of disease. Typically, established introduced species have a wide range of environmental tolerances, habitat requirements and food requirements. In addition, they tend to have high reproductive rates and be early maturing, allowing populations to become readily established. These attributes often allow introduced fishes to be more adaptable to changes in the environment, whether natural or manmade, than some native fish species.

4.2.5 MSES wetlands, watercourses and groundwater dependent ecosystems

The Queensland Mapping and Classification project is a system which provides maps displaying Queensland's wetland data. Within this classification system there are five wetland types identified:

- Marine: Consists of an open ocean overlying the continental shelf and associated high energy coastline
- Estuarine: Are wetlands with oceanic water that is occasionally diluted with freshwater run off from the land
- Riverine: Are systems which include all wetlands and deep water habitats contained within a channel
- Lacustrine: Are systems which are typically extensive areas of deep water habitat and wetlands (excluding those dominated by trees)

- Palustrine: Consists of all non-tidal wetlands which are dominated by trees, shrubs and persistent emergent, emergent mosses or lichens.

The Queensland Wetland Classification Mapping identifies several wetland types and values along and within 10 km of the rail alignment (**Figure 6** and **Figure 7**). These include riverine, palustrine and lacustrine wetland systems as well as mapped Regional Ecosystems (REs) that potentially contain wetland values. Riverine wetlands and REs which potentially contain riverine wetland values are common throughout the alignment as are palustrine wetlands and their RE counterparts. Lacustrine wetlands are also mapped within proximity to the alignment however these water bodies are relatively small. For the majority, areas consisting of a mosaic of REs containing a small proportion of potential wetland values (1 to 50 per cent) frequently intersect the alignment.

Multiple palustrine wetlands and some REs (11.3.4 and 11.3.5) with potential riverine wetland values along the alignment have been identified in the Queensland Referable Wetland Mapping as of High Ecological Significance (HES) as recognised under the *Environmental Protection Regulation 2008*. However, none of these mapped wetlands occur within mapped High Ecological Value waters as outlined in the EPP (Water and Wetland Biodiversity). The closest HES wetland mapped within High Ecological Value waters is approximately 25 km east of the Gowrie end of alignment.

Similarly, many of the wetlands (palustrine, lacustrine and mosaic) mapped along the alignment are also mapped as wetlands under the *Vegetation Management Act 1999* (VM Act). These wetlands predominantly occur in the eastern and western extents of the alignment.

There are mapped VM Act watercourses that intersect the alignment, with stream orders ranging from 1 to 9 as follows:

- Stream order 9: one watercourse
- Stream order 6: one watercourse
- Stream order 5: two watercourses
- Stream order 4: six watercourses
- Stream order 3: seven watercourses
- Stream order 2: 22 watercourses
- Stream order 1: 49 watercourses

The mapped VM Act watercourses that are also recognised under the *Water Act 2000* and intersect the alignment include:

- Westbrook Creek
- Condamine River
- Grasstree Creek
- Macintyre River
- Pariagara Creek
- Back Creek
- Bringalily Creek
- Nicol Creek
- Dry Creek

A watercourse determination may be required for works affecting watercourses that are not mapped under the *Water Act 2000.* ARTC is an approved entity for the purpose of the DNRME Riverine Protection Permit exemption requirements, and works can be undertaken providing that they meet the guidelines of the exemption.

Fish waterways relevant to waterway barrier works have been identified along the alignment, with maps provided in **Appendix F**. These waterways reflect areas that provide fish passage, and are defined under the *Fisheries Act 1994*. The number of waterway intersections with the centre of the rail alignment by risk classification are as follows:

- Low risk (green) – 43 waterways
- Moderate risk (amber) – 28 waterways
- High risk (red) – 7 waterways
- Major risk (purple) – 10 waterways

The level of risk relating to each waterway will be considered by the design team responsible for the design of infrastructure such as culverts, bridges and other potential barriers to fish movement. This will occur during the detail design stage of the Project.

Groundwater-dependent ecosystems (GDEs) are ecosystems that rely upon groundwater for their continued persistence. Some GDEs are entirely dependent on groundwater resources while others may utilise this intermittently. There are three types of GDEs:

- Aquatic GDEs: surface ecosystems dependent on the surface expression of groundwater
- Terrestrial GDEs: surface ecosystems dependent on the subsurface presence of groundwater
- Subterranean GDEs: include caves and aquifers

Both aquatic and terrestrial GDEs have been mapped by DES along the alignment from approximately halfway along the section to the NSW/QLD border. The mapping is suitable for use at a regional scale, and is produced from an assessment of vegetation mapping, wetland mapping, expert knowledge and the results of existing research.

Terrestrial GDEs are most dominant and concentrated in the mid-section, while aquatic GDEs are scattered towards the NSW/QLD border end of alignment. The terrestrial GDEs are associated with Canning Creek and Macintyre Brook, both of which intercept the rail alignment.

Several ephemeral springs (sourced from bedrock aquifer systems) have been mapped by DES adjacent to the Gowrie end of the alignment, and include:

- Leigh Spring
- Stone Spring
- Springside Spring
- Jimna Springs
- Wellcamp Spring
- Eustondale Spring
- Merigandan Creek.

4.2.6 AquaBAMM / Aquatic Conservation Assessments

The Aquatic Biodiversity Assessment and Mapping Method (AquaBAMM) is a methodology developed by the Department of Environment and Science to assess conservation values of aquatic ecosystems in Queensland (DEHP 2015). The method combines a multitude of different criterion scores related to biodiversity and species richness, presence of threatened species or community, presence of priority species or ecosystem, ecosystem complexity (e.g. uniqueness of geomorphology) and landscape connectivity (Clayton et.al 2006). A summary score (AquaScore) is produced and classified into one of five rankings;

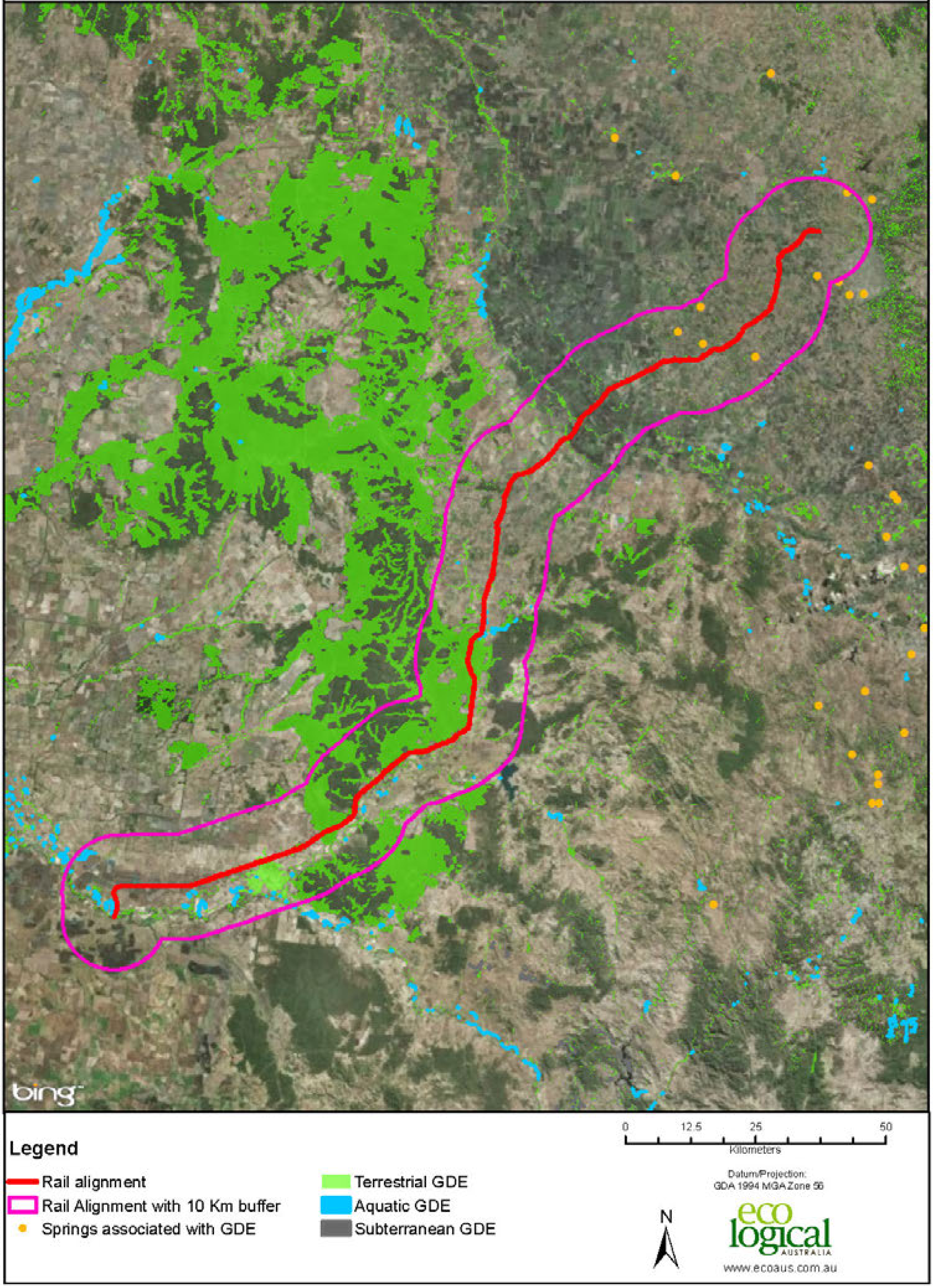
- Very High
- High
- Medium
- Low
- Very Low

The rail alignment passes through a diversity of aquatic systems which have been assessed and mapped according to available AquaBAMM spatial data and reporting (Queensland Globe 2019). The results of assessment are presented in **Table 16**. The vast majority of sites have an AquaScore of Medium or higher, indicating that aquatic ecosystems of the impact assessment area are in relatively good condition.

Table 16 AquaBAMM / ACA score for survey sites

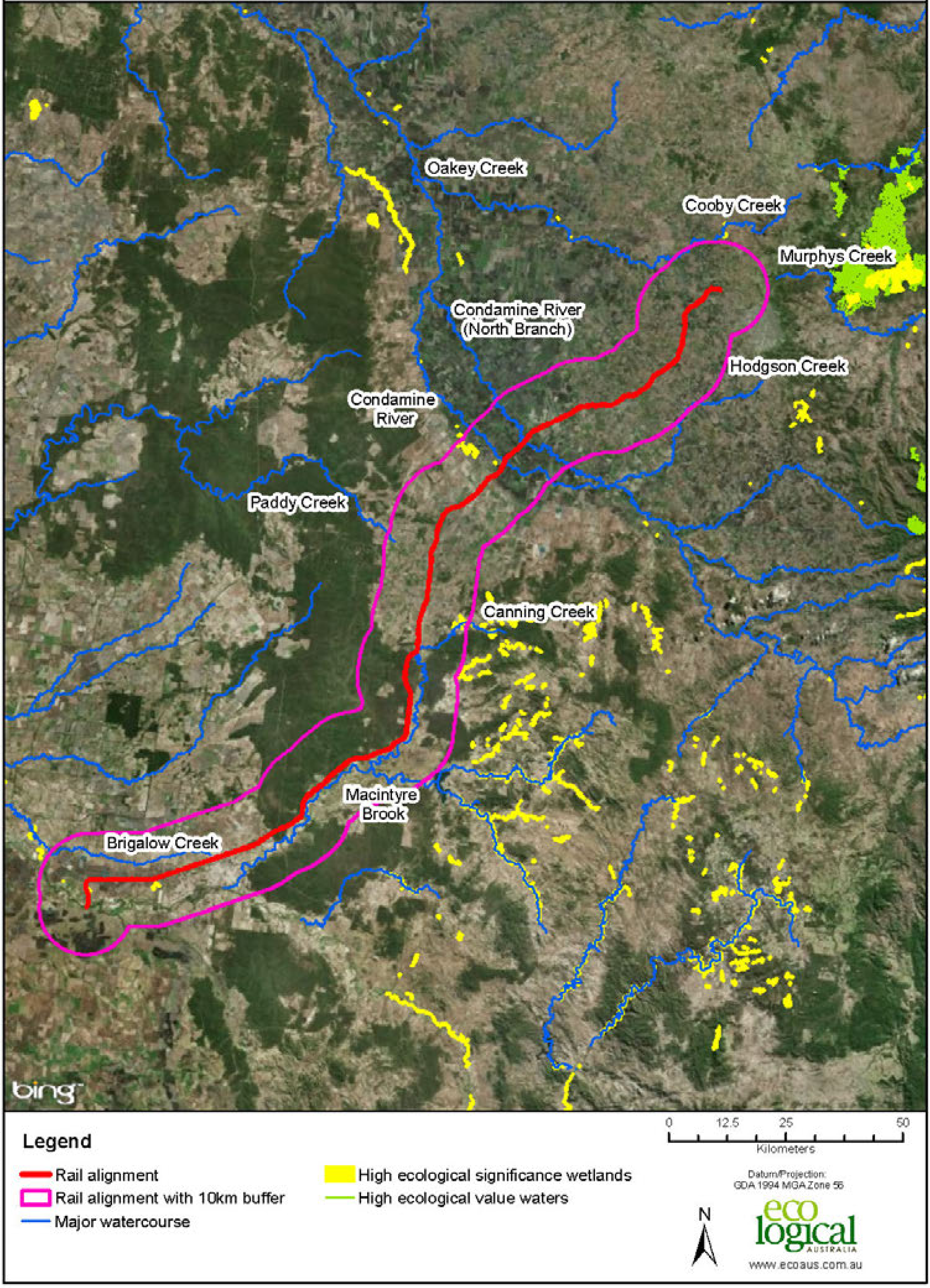
AquaScore for Conservation Value	Survey Site Number
Very High	1R, 2, 2R, 3, 4, 5, 6, 7, 8, 9, 10, 11, 29, 30
High	12, 13, 14, 15
Medium	18,19, 20, 20R, 21, 22, 23, 24, 25, 26, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43
Low	16, 17, 27
Very Low	-

Figure 6. Groundwater Dependent Ecosystem (GDE) values along alignment



Prepared by: TI

Figure 7. Wetland and watercourse values along alignment



Prepared by: TI

4.2.7 Endangered ecological community (NSW)

The aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River is listed as an endangered ecological community (EEC) under the New South Wales *Fisheries Management Act 1994*. The lowland catchment of the Darling River has been greatly modified since European settlement, with many aquatic habitats degraded, and native species in decline (NSW DPI 2007).

The listed ecological community includes the Border Rivers, including the Macintyre River, which is traversed by the rail alignment at the southern extent of the impact assessment area. The Macintyre River provides habitat typical of the listed ecological community, which includes meandering channels, deep channels, pools, wetlands, gravel beds and flood plains. A Priority Actions Statement has been developed for the EEC (NSW DPI 2019), involving a range of recovery actions including habitat protection, rehabilitation of disturbed areas and pest control.

4.3 Results of surface water field surveys

Water quality results are presented in the following sections and are grouped to facilitate assessment of sites consistent with the six sub-catchments in the local water quality guidelines (DES 2019a, b). Water quality results outside (i.e. exceeding a maximum guideline or below a minimum guideline) both the local guideline (which is an annual median) and the ANZECC (2000, 2018) guideline (for slightly to moderately disturbed ecosystems; 95 per cent level of protection) were highlighted as being ‘outside the guideline’. A median value has been calculated for each site. The median should be interpreted cautiously at sites where there is a small number of data points.

Laboratory certificates of analysis are provided in **Appendix D**.

4.3.1 Macintyre Barwon Floodplain (Queensland Border Rivers Basin; sites 1 to 2)

Water quality at sites within the Macintyre Barwon Floodplain was relatively good, with a slightly alkaline pH and low EC (**Table 17**). Local guidelines for turbidity and total suspended solids during low flow conditions were exceeded in November 2018. Nutrient levels were below local water quality guidelines, with the exception of reactive phosphorus. Chlorophyll *a* concentrations were also slightly elevated across most sampling surveys, including during November 2018 despite the turbid water conditions (**Table 18**).

Dissolved metal concentrations were generally low, with only one exceedance of the *ANZECC Guideline* (2018) for copper at Site 2 in November 2018 (**Table 19**). Hardness concentrations were consistently at or above 60 mg/L and may provide some protection to biota from the toxic effects of some metals, which reduce with increased hardness (see Table 3.4.4 of the ANZECC Guidelines 2000).

The concentration of PAHs was below the laboratory level of detection at all sites for all surveys.

Table 17 Water quality results for Sites 1R, 2 and 2R in the Macintyre Barwon Floodplain – physico-chemical

Physico-chemical		pH units	Temp (ºC)	DO (% Sat)	EC (µS/cm)	Salinity (g/kg)	Turbidity (NTU)	TSS (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Hardness (mg/L)
Limit of Reporting		0.01	0.1	0.1	1	0.01	0.1	5	1	1	1
ANZECC		6.5 to 7.5		90 to 110	30 to 350		2 to 25				
Basin Plan Low flow High flow		 7.4 to 8.0 7.0 to 7.5		 60 t0 110 60 to 110	 240 180		 30 110	 25 70			
Site	Field Trip										
1R	Jun 2018	7.45	13.5	52.5	283	0.14	25.9	28	13	11	78
2	Jun 2018	Not sampled									
	Nov 2018	7.74	25.5	83.8	224	0.10	53.2	27	12	10	71
	Feb 2019	6.77	28.7	101.6	211	0.11	22.9	23	13	11	78
	Apr 2019	7.23	21.6	76.2	216	0.10	11.2	10	16	13	93
	May 2019	7.76	16.8	84.6	299	0.14	13.0	12	15	8	70
	Median	**7.49**	**23.55**	**84.2**	**220**	**0.11**	**18.0**	**17.5**	**14**	**10.5**	**74.5**
2R	Jun 2018	7.61	14.0	57.5	239	0.12	13.4	<5	10	8	58
	Nov 2018	7.27	25.0	90.2	223	0.1	96.0	43	12	9	67
	Feb 2019	7.31	28.9	89.5	211	0.11	25.7	24	13	11	78
	Apr 2019	7.68	22.3	71.6	215	0.10	12.2	7	16	13	93
	Median	**7.46**	**23.65**	**80.55**	**219**	**0.11**	**19.6**	**24**	**12.5**	**10**	**72.5**

Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise.

Table 18 Water quality results for Sites 1R, 2 and 2R in the Macintyre Barwon Floodplain – nutrients

Nutrients (mg/L)		Ammonia	Nitrite	Nitrate	NOx	Organic N	TKN	Total N	Total P	Reactive P	Chlorophyll *a* (µg/l)
Limit of Reporting		0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.01	0.01	1
ANZECC		0.013			0.015				0.03	0.015	-
Basin Plan Low flow High flow		 0.02 ID			 0.010 0.195			 0.575 0.9	 0.07 0.15	 0.02 ID	 3 ID
Site	Trip										
1R	Jun 2018	0.02	<0.01	<0.01	<0.01	0.6	0.6	0.6	0.1	<0.01	<2
	Nov 2018	Not sampled									
	Feb 2019	Not sampled									
	Apr 2019	Not sampled									
	Median	**0.02**	**<0.01**	**<0.01**	**<0.01**	**0.60**	**0.60**	**0.60**	**0.10**	**<0.01**	**<2**
2	Jun 2018	Not sampled									
	Nov 2018	<0.01	<0.01	<0.01	<0.01	0.5	0.5	0.5	0.12	0.04	9
	Feb 2019	0.07	<0.01	0.17	0.17	0.5	0.6	0.8	0.16	0.13	2
	Apr 2019	0.03	<0.01	<0.01	<0.01	0.5	0.5	0.5	0.08	0.04	5
	May 2019	0.02	<0.01	<0.01	0.02	0.7	0.7	0.7	0.03	<0.01	7
	Median	**0.03**	**<0.01**	**<0.01**	**0.01**	**0.50**	**0.55**	**0.6**	**0.1**	**0.04**	**6**
2R	Jun 2018	0.02	<0.01	<0.01	<0.01	0.5	0.5	0.5	0.05	0.01	<1
	Nov 2018	<0.01	<0.01	0.02	0.02	0.5	0.5	0.5	0.015	0.04	5
	Feb 2019	0.03	<0.01	0.16	0.16	0.6	0.6	0.8	0.16	0.13	2
	Apr 2019	0.02	<0.01	<0.01	<0.01	0.4	0.4	0.4	0.06	0.03	4
	Median	**0.02**	**<0.01**	**0.09**	**0.09**	**0.50**	**0.50**	**0.50**	**0.06**	**0.04**	**4**

Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise.

Table 19 Water quality results for Sites 1R, 2 and 2R in the Macintyre Barwon Floodplain – dissolved metals

Dissolved metals (mg/L)		Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Limit of Reporting		0.001	0.0001	0.001	0.001	0.001	0.001	0.005	0.0001
ANZECC		0.024	0.0002	0.0033#	0.0014	0.0034	0.011	0.008	0.00006
Basin Plan									
Site	Trip								
1R	Jun 2018	0.002	<0.0001	<0.001	<0.001	<0.001	0.002	<0.005	<0.0001
	Nov 2018	Not sampled							
	Feb 2019	Not sampled							
	Apr 2019	Not sampled							
	Median	**0.002**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**0.002**	**<0.005**	**<0.0001**
2	Jun 2018	Not sampled							
	Nov 2018	0.003	<0.0001	<0.001	0.002	<0.001	0.002	<0.005	<0.0001
	Feb 2019	0.004	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Apr 2019	0.003	<0.0001	<0.001	0.001	<0.001	0.003	<0.005	<0.0001
	May 2019	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Median	0.003	<0.0001	<0.001	0.0008	<0.001	0.001	<0.005	<0.0001
2R	Jun 2018	0.002	<0.0001	<0.001	<0.001	<0.001	0.002	<0.005	<0.0001
	Nov 2018	0.003	<0.0001	<0.001	<0.001	<0.001	0.002	<0.005	<0.0001
	Feb 2019	0.004	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Apr 2019	0.003	<0.0001	<0.001	0.001	<0.001	0.002	<0.005	<0.0001
	Median	**0.003**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**0.002**	**<0.005**	**<0.0001**

Low reliability guideline (ANZECC 2018). Values outside of all guidelines are shaded orange

4.3.2 Lower Macintyre Brook (Queensland Border Rivers Basin; sites 3 to 8)

Water quality at sites in the Lower Macintyre Brook was characterised by high EC and elevated concentrations of suspended sediment and nutrients, with low dissolved oxygen (**Table 20** and **Table 21)**. Such results are typical of dry season conditions, when streams form a series of isolated pools that are subject to evaporation. Dissolved metal concentrations were low, with no exceedances of the *ANZECC Guideline* (2018) and with the concentration of most metals below the laboratory level of detection (**Table 22**).

The concentration of PAHs was below the level of detection at all sites. Sites 4, 5 and 8 were dry at the time of field surveys (**Table 3**).

4.3.3 Canning Creek (Queensland Border Rivers Basin; sites 9 to 20)

Water quality at sites in the Canning Creek sub catchment was generally poor, characterised by alkaline pH and elevated concentrations of nutrients (**Table 23** and **Table 24**). EC results exceeded relevant guidelines at Site 16 but were otherwise good. Dissolved metal concentrations were generally low, with exceedances of the *ANZECC Guideline* (2018) for copper at Site 16 in November 2018, February 2019 and April 2019 (**Table 25**). Hardness concentrations at Site 16 of 100 mg/L may provide some protection to biota from the toxic effects of some metals, which reduce with increased hardness (see Table 3.4.4 of the ANZECC Guidelines 2000).

The concentration of PAHs was below the level of detection at all sites. Sites 9, 10, 12, 13, 15, 17 and 19 were dry at the time of field surveys (**Table 3**).

4.3.4 Southern Condamine (Condamine River Basin; sites 21 to 26)

Water quality at sites in the Southern Condamine (Sites 23 and 24) was characterised by alkaline pH, high EC and elevated concentrations of suspended sediment and nutrients (**Table 26** and **Table 27)**. Chlorophyll *a* results also exceeded relevant guidelines. Such results are typical of dry season conditions, when streams form a series of isolated pools that are subject to evaporation.

Dissolved metal concentrations were generally low, with only two exceedances of the *ANZECC Guideline* (2018) for copper and lead at Site 24 (**Table 28**). Hardness concentrations at Site 24 may provide some protection to biota from the toxic effects of some metals, which reduce with increased hardness (see Table 3.4.4 of the ANZECC Guidelines 2000).

The concentration of PAHs was below the level of detection at all sites. Sites 21, 22, 25 and 26 were found not to be suitable for assessment (**Table 2**).

Table 20 Water quality results for Sites 3, 6 and 7 in the Lower Macintyre Brook – physico-chemical

Guideline		pH units	Temp °C	DO %Sat	EC µS/cm	Salinity g/kg	Turbidity NTU	TSS	Calcium	Magnesium	Hardness as $CaCO_3$
Limit of Reporting		0.01	0.1	0.1	1	0.01	1	5	1	1	1
ANZECC		6.5 to 7.5		90 to 110	30 to 350		2 to 25		-	-	-
Basin Plan Low Flow High Flow		 7.4 to 8.0 7.2 to 8.0		 60 to 110 60 to 110	 370 250		 11 25	 10 25			
Site	Trip										
3	Jun 2018	5.58	10.7	46.1	383	0.2	9.7	<5	11	10	69
	Nov 2018	7.33	23.8	89.1	406	0.19	6.5	<5	14	10	76
	Feb 2019	6.65	25.1	50.1	357	0.19	6.9	8	15	10	79
	Apr 2019	7.77	19.6	63.4	423	0.20	14.7	12	20	12	99
	Median	**6.99**	**21.7**	**56.8**	**395**	**0.20**	**8.3**	**10**	**14.5**	**10**	**77.5**
6	Jun 2018	7.97	10.2	52.7	334	0.17	17.2	20@	9	8	55
	Nov 2018	7.08	21.0	51.4	427	0.2	20.8	14	15	10	79
	Feb 2019	7.20	25.1	49.7	389	0.20	15.1	12	16	10	81
	Apr 2019	7.45	18.4	53.1	433	0.21	13.7	10	20	12	99
	Median	**7.33**	**19.7**	**52.1**	**408**	**0.2**	**16.2**	**13**	**15.5**	**10**	**80**
7	Jun 2018	7.80	10.3	48.7	337	0.17	18.0	18	9	9	60
	Nov 2018	7.46	25.2	76.3	434	0.2	15.0	9	15	10	79
	Feb 2019	7.29	26.6	55.3	409	0.21	12.2	12	17	11	88
	Apr 2019	7.64	19.2	51.2	430	0.21	8.2	6	21	12	102
	May 2019	7.55	16.8	79.3	449	0.21	7.3	6	19	11	93
	Median	**7.55**	**19.2**	**55.3**	**430**	**0.21**	**12.2**	**9**	**17**	**11**	**88**

Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise. @ Result was outside the relative percent difference criterion of 35% (see **Section 4.3.7**)

Table 21 Water quality results for Sites 3, 6 and 7 in the Lower Macintyre Brook – nutrients

Guideline (mg/L)		Ammonia	Nitrite	Nitrate	NOx	Organic N	TKN	Total N	Total P	Reactive P	Chlorophyll *a* (µg/L)
Limit of Reporting		0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.01	0.01	1
ANZECC		0.013			0.015				0.03	0.015	-
Basin Plan Low Flow High Flow		0.008 ID			0.018 ID			0.71 0.91	0.055 0.07	0.011 ID	ID ID
Site	Trip										
3	Jun 2018	0.04	<0.01	<0.01	<0.01	0.8	0.8	0.8	0.04	<0.01	<2
	Nov 2018	<0.01	<0.01	<0.01	<0.01	0.6	0.6	0.6	0.04	<0.01	7
	Feb 2019	0.04	<0.01	<0.01	<0.01	1	1	1	0.06	<0.01	12
	Apr 2019	0.02	<0.01	<0.01	<0.01	1.6	1.6	1.6	0.08	<0.01	65
	Median	**0.03**	**<0.01**	**<0.01**	**<0.01**	**0.9**	**0.9**	**0.9**	**0.05**	**<0.01**	**9.5**
6	Jun 2018	0.03	<0.01	0.05	0.05	0.8	0.8	0.8	0.04	<0.01	<2.0
	Nov 2018	<0.01	<0.01	<0.01	<0.01	0.7	0.7	0.7	0.05	<0.01	4
	Feb 2019	0.05	<0.01	<0.01	<0.01	1.2	1.2	1.2	0.06	<0.01	5
	Apr 2019	0.03	<0.01	<0.01	<0.01	1.1	1.1	1.1	0.04	<0.01	10
	Median	**0.03**	**<0.01**	**<0.01**	**<0.01**	**0.95**	**0.95**	**0.95**	**0.05**	**<0.01**	**4.5**
7	Jun 2018	0.04	<0.01	0.15	0.15	0.9	0.9	1	0.04	<0.01	<2
	Nov 2018	<0.01	<0.01	0.02	0.02	0.7	0.7	0.7	0.06	<0.01	5
	Feb 2019	0.05	<0.01	0.03	0.03	1	1	1	0.04	<0.01	6
	Apr 2019	0.03	<0.01	0.09	0.09	1.1	1.1	1.2	0.04	<0.01	14
	May 2019	0.05	<0.01	0.24	0.24	1	1	1.2	0.02	<0.01	7
	Median	**0.045**	**<0.01**	**0.09**	**0.09**	**1**	**1**	**1**	**0.04**	**<0.01**	**6.5**

Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise.

Table 22 Water quality results for Sites 3, 6 and 7 in the Lower Macintyre Brook – dissolved metals

Guideline (mg/L)		Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Limit of Reporting		0.001	0.0001	0.001	0.001	0.001	0.001	0.005	0.0001
ANZECC		0.024	0.0002	0.0033#	0.0014	0.0034	0.011	0.008	0.00006
Basin Plan									
Site	Trip								
3	Jun 2018	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Nov 2018	0.002	<0.0001	<0.001	0.001	<0.001	<0.001	<0.005	<0.0001
	Feb 2019	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Apr 2019	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Median	**0.002**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.005**	**<0.0001**
6	Jun 2018	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Nov 2018	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Feb 2019	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Apr 2019	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Median	**0.0015**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.005**	**<0.0001**
7	Jun 2018	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Nov 2018	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Feb 2019	0.002	<0.0001	<0.001	0.001	<0.001	<0.001	<0.005	<0.0001
	Apr 2019	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	May 2019	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Median	**0.002**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.005**	**<0.0001**

Low reliability guideline (ANZECC 2018). Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise.

Table 23 Water quality results for Sites 11, 14, 16 and 18 in Canning Creek and Site 20R in Nicol Creek – physico-chemical

Guideline		pH units	Temp °C	DO %Sat	EC µS/cm	Salinity (g/kg)	Turbidity (NTU)	TSS	Calcium	Magnesium	Hardness as $CaCO_3$
Limit of Reporting		0.01	0.1	0.1	1	0.01	0.1	5	1	1	1
ANZECC		6.5 to 7.5		90 to 110	30 to 350		2 to 25		-	-	-
Basin Plan Low Flow High Flow		 7.2 to 7.8 6.9 to 7.9		 60 to 110 60 to 110	 200 165		 35 50	 25 60			
Site	Trip										
11	Jun 2018	8.18	10.4	67.6	213	0.15	17	15	11	7	56
	Nov 2018	8.21	23.7	103.1	286	0.13	21	14	13	6	57
	Feb 2019	7.00	25.7	65.0	236	0.12	25	23	12	6	55
	Apr 2019	7.27	16.6	66.0	297	0.14	64	104	16	8	73
	Median	**7.725**	**20.2**	**66.8**	**261**	**0.14**	**23**	**19**	**12.5**	**6.5**	**56.5**
14	Jun 2018	7.70	14.7	64.30	160	0.10	44	20	4	7	39
	Nov 2018	8.09	22.5	86.60	248	0.11	37	<5	5	9	50
	Feb 2019	8.19	28.0	101.40	307	0.16	74	39	6	12	64
	Apr 2019	7.46	19.2	61.70	353	0.17	104	44	7	16	83
	Median	**7.90**	**20.9**	**75.45**	**278**	**0.14**	**59**	**39**	**5.5**	**10.5**	**57**
16	Jun 2018	7.66	12.6	56.30	184	0.11	147	32	14	4	51
	Nov 2018	7.82	18.8	82.30	382	0.17	161	56	27	8	100
	Feb 2019	8.39	29.4	120.00	636	0.33	259	170	25	12	112
	Apr 2019	7.62	19.5	32.00	1255	0.62	>1000	2170	42	18	179
	Median	**7.74**	**19.2**	**69.30**	**509**	**0.25**	**161**	**113**	**26**	**10**	**106**
18	Jun 2018	Not Sampled									
	Nov 2018	Not Sampled									
	Feb 2019	7.22	28.4	57.9	311	0.16	60.6	18	28	7	99
	Apr 2019	7.52	19.4	53.7	320	0.15	23.8	8	34	8	118
	May 2019	7.84	16.0	39.7	332	0.15	36.3	14	29	7	101
	Median	**7.52**	**19.4**	**53.7**	**320**	**0.15**	**36.3**	**14**	**29**	**7**	**101**
20R	Jun 2018	Not Sampled									
	Nov 2018	Not Sampled									
	Feb 2019	Not Sampled									
	Apr 2019	7.31	19.9	32.8	154	0.08	8.63	10	19	6	72
	Median	**7.31**	**19.9**	**32.8**	**154**	**0.08**	**8.63**	**10**	**19**	**6**	**72**

Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise.

Table 24 Water quality results for Sites 11, 14, 16 and 18 in Canning Creek and Site 20R in Nicol Creek – nutrients

Guideline (mg/L)		Ammonia	Nitrite	Nitrate	NOx	Organic N	TKN	Total N	Total P	Reactive P	Chlorophyll *a* (µg/L)
Limit of Reporting		0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.01	0.01	1
ANZECC		0.013			0.015				0.03	0.015	-
Basin Plan Low Flow High Flow		 0.001 ID			 0.006 ID			 0.52 0.60	 0.03 0.04	 0.008 ID	 ID ID
Site	Trip										
11	Jun 2018	0.02	<0.01	0.02	0.02	0.9	0.9	0.9	0.06	<0.01	<2
	Nov 2018	<0.01	<0.01	<0.01	<0.01	1.2	1.2	1.2	0.11	<0.01	40
	Feb 2019	0.04	<0.01	<0.01	<0.01	2.2	2.2	2.2	0.15	<0.01	23
	Apr 2019	0.02	<0.01	<0.01	<0.01	5.7	5.7	5.7	0.33	<0.01	460
	Median	**0.03**	**<0.01**	**<0.01**	**<0.01**	**1.7**	**1.7**	**1.7**	**0.13**	**<0.01**	**31.5**
14	Jun 2018	0.25	<0.01	<0.01	<0.01	1.0	1.2	1.2	0.03	<0.01	<1
	Nov 2018	<0.01	<0.01	<0.01	<0.01	0.7	0.7	0.7	0.03	<0.01	3
	Feb 2019	0.05	<0.01	<0.01	<0.01	1.6	1.6	1.6	0.07	<0.01	6
	Apr 2019	0.03	<0.01	<0.01	<0.01	2.3	2.3	2.3	0.10	<0.01	16
	Median	**0.04**	**<0.01**	**<0.01**	**<0.01**	**1.3**	**1.4**	**1.4**	**0.05**	**<0.01**	**4.5**
16	Jun 2018	0.02	<0.01	<0.01	<0.01	1.0	1.0	1.0	0.11	<0.01	<4
	Nov 2018	0.06	<0.01	0.01	0.01	1.3	1.4	1.4	0.17	<0.01	8
	Feb 2019	0.06	<0.01	0.02	0.02	4.1	4.2	4.2	0.31	<0.01	54
	Apr 2019	1.50	0.05	0.02	0.07	29.6	31.1	31.2	3.93	<0.01	545
	Median	**0.06**	**<0.01**	**0.015**	**0.015**	**2.7**	**2.8**	**2.8**	**0.24**	**<0.01**	**31**
18	Jun 2018	Not Sampled									
	Nov 2018	Not Sampled									
	Feb 2019	0.03	<0.01	<0.01	<0.01	1.2	1.2	1.2	0.10	<0.01	7
	Apr 2019	0.02	<0.01	<0.01	<0.01	0.8	0.8	0.8	0.04	<0.01	4
	May 2019	0.02	<0.01	<0.01	<0.01	0.8	0.8	0.8	0.04	<0.01	5
	Median	**0.02**	**<0.01**	**<0.01**	**<0.01**	**0.8**	**0.8**	**0.8**	**0.04**	**<0.01**	**5**
20R	Jun 2018	Not Sampled									
	Nov 2018	Not Sampled									
	Feb 2019	Not Sampled									
	Apr 2019	0.02	<0.01	<0.01	<0.010	1.6	1.6	1.6	0.32	0.10	21
	Median	**0.02**	**<0.01**	**<0.01**	**<0.010**	**1.6**	**1.6**	**1.6**	**0.32**	**0.10**	**21**

Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise

Table 25 Water quality results for Sites 11, 14, 16 and 18 in Canning Creek and Site 20R in Nicol Creek – dissolved metals

Guideline (mg/L)		Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Limit of Reporting		0.001	0.0001	0.001	0.001	0.001	0.001	0.005	0.0001
ANZECC		0.024	0.0002	0.0033#	0.0014	0.0034	0.011	0.008	0.00006
Basin Plan									
Site	Trip								
11	Jun 2018	0.001	<0.0001	<0.001	<0.001	<0.001	0.001	<0.005	<0.0001
	Nov 2018	0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Feb 2019	0.003	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Apr 2019	0.001	<0.0001	<0.001	<0.001	<0.001	0.002	<0.005	<0.0001
	Median	**0.002**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.005**	**<0.0001**
14	Jun 2018	<0.001	<0.0001	<0.001	<0.001	<0.001	0.001	<0.005	<0.0001
	Nov 2018	0.001	<0.0001	<0.001	<0.001	<0.001	0.001	<0.005	<0.0001
	Feb 2019	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Apr 2019	0.001	<0.0001	<0.001	<0.001	<0.001	0.002	<0.005	<0.0001
	Median	**0.001**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**		**<0.005**	**<0.0001**
16	Jun 2018	<0.001	<0.0001	<0.001	<0.001	<0.001	0.001	<0.005	<0.0001
	Nov 2018	0.001	<0.0001	<0.001	0.002	<0.001	0.002	<0.005	<0.0001
	Feb 2019	0.003	<0.0001	<0.001	0.002	<0.001	0.002	<0.005	<0.0001
	Apr 2019	0.004	<0.0001	<0.001	0.002	<0.001	0.009	<0.005	<0.0001
	Median		**<0.0001**	**<0.001**	**0.002**	**<0.001**	**0.002**	**<0.005**	**<0.0001**
18	Jun 2018	Not Sampled							
	Nov 2018	Not Sampled							
	Feb 2019	0.002	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.0001
	Apr 2019	0.001	<0.0001	<0.001	0.001	<0.001	0.002	<0.005	<0.0001
	May 2019	<0.001	<0.0001	<0.001	0.001	<0.001	0.002	<0.005	<0.0001
	Median	**0.001**	**<0.0001**	**<0.001**	**0.001**	**<0.001**	**0.002**	**<0.005**	**<0.0001**
20R	Jun 2018	Not Sampled							
	Nov 2018	Not Sampled							
	Feb 2019	Not Sampled							
	Apr 2019	0.003	<0.0001	<0.001	<0.001	<0.001	0.004	0.008	<0.0001
	Median	**0.003**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**0.004**	**0.008**	**<0.0001**

Low reliability guideline (ANZECC 2018). Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise.

Table 26 Water quality results for Site 23 and 24 in the Southern Condamine – physico-chemical

Guideline		pH units	Temp °C	DO %Sat	EC µS/cm	Salinity (g/kg)	Turbidity (NTU)	TSS	Calcium	Magnesium	Hardness as $CaCO_3$
Limit of Reporting		0.01	0.1	0.1	1	0.01	0.1	5	1	1	1
ANZECC		6.5 to 7.5		90 to 110	30 to 350		2 to 25		-	-	-
Basin Plan Low Flow High Flow		 7.2 to 7.9 7.0 to 7.6		 60 to 110 60 to 110	 170 160		 9 25	 8 17			
Site	Trip										
23	Jun 2018	Not Sampled									
	Nov 2018	Not Sampled									
	Feb 2019	7.18	32.0	84.70	267	0.14	8.0	8	23	8	90
	Apr 2019	7.38	19.3	68.60	290	0.14	31.1	18	30	10	116
	Median	**7.28**	**25.65**	**76.65**	**278**	**0.14**	**19.6**	**13**	**26.5**	**9**	**103**
24	Jun 2018	7.77	7.9	45.90	345	0.16	239	98	14	11	80
	Nov 2018	8.18	30.9	89.50	580	0.27	251	194	27	18	142
	Feb 2019	7.42	27.2	47.80	281	0.14	135	60	13	8	65
	Apr 2019	Not Sampled									
	Median	**7.77**	**27.2**	**47.80**	**345**	**0.16**	**239**	**98**	**14**	**11**	**80**

Values outside of guidelines are shaded orange. All units mg/L unless stated otherwise.

Table 27 Water quality results for Site 23 and 24 in the Southern Condamine – nutrients

Guideline (mg/L)		Ammonia	Nitrite	Nitrate	NOx	Organic N	TKN	Total N	Total P	Reactive P	Chlorophyll *a* (µg/L)
Limit of Reporting		0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.01	0.01	1
ANZECC		0.013			0.015				0.03	0.015	-
Basin Plan Low Flow High Flow		0.006 ID			0.003 ID			0.595 0.830	0.045 0.060	0.015 0.020	5 ID
Site	Trip										
23	Jun 2018	Not Sampled									
	Nov 2018	Not Sampled									
	Feb 2019	0.03	<0.01	<0.01	<0.01	1.4	1.4	1.4	0.10	0.02	2
	Apr 2019	0.02	<0.01	<0.01	<0.01	0.9	0.9	0.9	0.06	<0.01	7
	Median	0.025	**<0.01**	**<0.01**	**<0.01**	**1.15**	**1.15**	**1.15**	**0.08**	**<0.01**	**4.5**
24	Jun 2018	0.04	<0.01	<0.01	<0.01	0.5	0.5	0.5	0.07	<0.01	<4
	Nov 2018	0.08	<0.01	0.01	0.01	4.1	4.2	4.2	0.51	0.03	28
	Feb 2019	0.04	<0.01	<0.01	<0.01	1.8	1.8	1.8	0.35	0.07	9
	Apr 2019	Not Sampled									
	Median	**0.04**	**<0.01**	**0.01**	**<0.01**	**1.8**	**1.8**	**1.8**	**0.35**	**0.03**	**9**

Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise.

Table 28 Water quality results for Site 23 and 24 in the Southern Condamine – dissolved metals

Guideline (mg/L)		Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Limit of Reporting		0.001	0.0001	0.001	0.001	0.001	0.001	0.005	0.0001
ANZECC		0.024	0.0002	0.0033#	0.0014	0.0034	0.011	0.008	0.00006
Basin Plan									
Site	Trip								
23	Jun 2018	Not Sampled							
	Nov 2018	Not Sampled							
	Feb 2019	0.003	<0.0001	<0.001	<0.001	<0.001	0.001	<0.005	<0.0001
	Apr 2019	0.002	<0.0001	<0.001	<0.001	<0.001	0.003	<0.005	<0.0001
	Median	**0.0025**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**0.002**	**<0.005**	**<0.0001**
24	Jun 2018	<0.001	<0.0001	<0.001	0.001	<0.001	0.005	<0.005	<0.0001
	Nov 2018	0.002	<0.0001	<0.001	0.004	<0.001	0.006	<0.005	<0.0001
	Feb 2019	0.003	<0.0001	<0.001	0.001	0.006	<0.001	<0.005	<0.0001
	Apr 2019	Not Sampled							
	Median	**0.0020**	**<0.0001**	**<0.001**	**0.001**	**<0.001**	**0.005**	**<0.005**	**<0.0001**

Low reliability guideline (ANZECC 2018). Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise.

4.3.5 Central Condamine (Condamine River Basin; sites 27 to 33)

Water quality at sites in the Central Condamine was characterised by alkaline pH and elevated concentrations of suspended sediment and nutrients (**Table 29** and **Table 30**). The high dissolved oxygen results indicate that algal growth occurs at some sites, producing high percent saturation of oxygen during the day from photosynthesis, and more than likely, consuming oxygen at night. The high chlorophyll *a* concentrations at most sites are consistent with this interpretation.

Results are typical of dry season conditions, when streams form a series of isolated pools that are subject to evaporation. Dissolved copper concentrations were consistently high, with dissolved Nickel concentrations also above the *ANZECC Guidelines* (2018) at some sites (**Table 31**). High hardness concentrations (>59 mg/L) may provide some protection to biota from the toxic effects of some metals, which reduce with increased hardness (see Table 3.4.4 of the ANZECC Guidelines 2000).

The concentration of PAHs was below the level of detection at all sites. Site 31 was dry at the time of field surveys (**Table 3**).

4.3.6 Oakey Creek (Condamine River Basin; sites 34 to 43)

Water quality at sites in the Oakey Creek sub catchment was characterised by alkaline pH and high EC (**Table 32**). Nutrient and chlorophyll *a* concentrations were also elevated across most sites (**Table 33**). Such results are typical of dry season conditions, when streams form a series of isolated pools that are subject to evaporation.

Dissolved copper concentrations were slightly elevated, with no other exceedances of the *ANZECC Guidelines* (2018; **Table 34**). Very high hardness concentrations (>200 mg/L) may provide some protection to biota from the toxic effects of some metals, which reduce with increased hardness (see Table 3.4.4 of the ANZECC Guidelines 2000).

The concentration of PAHs was below the level of detection at all sites. Sites 35, 36 and 43 were dry at the time of field surveys (**Table 3**) and Sites 34, 37, 38 and 41 were found not to be suitable for assessment (**Table 2**).

Table 29 Water quality results for Sites 27, 28, 30, 32 and 33 in the Central Condamine – physico-chemical

Guideline		pH units	Temp °C	DO %Sat	EC µS/cm	Salinity (g/kg)	Turbidity (NTU)	TSS	Calcium	Magnesium	Hardness as $CaCO_3$
Limit of Reporting		0.01	0.1	0.1	1	0.01	0.1	5	1	1	1
ANZECC		6.5 to 7.5		90 to 110	30 to 350		2 to 25		-	-	-
Basin Plan Low Flow High Flow		 7.4 to 8.3 7.0 to 7.6		 60 to 110 60 to 110	 890 290		 25 220	 25 130			
Site	Trip										
27	Jun 2018	8.50	10.0	85.0	352	0.28	51.8	28	40	24	199
	Nov 2018	Not sampled									
	Feb 2019	8.34	30.3	134.1	503	0.26	87.5	74	37	25	195
	Apr 2019	7.72	17.2	50.6	233	0.11	671	214	21	12	102
	Median	**8.34**	**17.2**	**85.0**	**352**	**0.26**	**87.5**	**74**	**37**	**24**	**195**
28	Jun 2018	Not sampled									
	Nov 2018	Not sampled									
	Feb 2019	9.13	35.2	233.6	519	0.27	75.6	73	26	22	156
	Apr 2019	7.93	23.1	21.1	315	0.15	477	175	30	18	149
	Median	**8.53**	**29.15**	**127.35**	**417**	**0.21**	**276.3**	**124**	**28**	**20**	**152.5**
29	Jun 2018	Not sampled									
	Nov 2018	Not sampled									
	Feb 2019	Not sampled									
	Apr 2019	8.04	22.0	35.0	307	0.14	77.8	48	33	23	177
	Median	**8.04**	**22.0**	**35.0**	**307**	**0.14**	**77.8**	**48**	**33**	**23**	**177**
30	Jun 2018	-	14.3	65.5	356	0.22	30.0	11	29	18	146
	Nov 2018	8.83	28.8	104.6	507	0.24	98.1	63	22	19	133
	Feb 2019	8.45	25.1	59.6	365	0.19	43.0	35	25	16	128
	Apr 2019	7.71	18.7	70.4	449	0.21	95.6	70	34	26	192
	Median	**8.45**	**21.9**	**67.95**	**407**	**0.215**	**69.3**	**49**	**27**	**18.5**	**139.5**
32	Jun 2018	Not sampled									
	Nov 2018	Not sampled									
	Feb 2019	7.8	23.4	82.2	588	0.30	11.5	95	37	27	204
	Apr 2019	Not sampled									
	Median	**7.8**	**23.4**	**82.2**	**588**	**0.30**	**11.5**	**95**	**37**	**27**	**204**
33	Jun 2018	Not sampled									
	Nov 2018	7.7	25.2	106.8	212	0.10	42.9	15	12	7	59
	Feb 2019	Not sampled									
	Apr 2019	Not sampled									
	Median	**7.7**	**25.2**	**106.8**	**212**	**0.10**	**42.9**	**15**	**12**	**7**	**59**

Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise

Table 30 Water quality results for Sites 27, 28, 30, 32 and 33 in the Central Condamine – nutrients

Guideline (mg/L)		Ammonia	Nitrite	Nitrate	NOx	Organic N	TKN	Total N	Total P	Reactive P	Chlorophyll *a* (µg/L)
Limit of Reporting		0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.01	0.01	1
ANZECC		0.013			0.015				0.03	0.015	-
Basin Plan											
Low Flow		0.004			0.004			0.86	0.17	0.02	9
High Flow		ID			0.480			2.2	0.95	0.50	4
Site	Trip										
27	Jun 2018	0.03	<0.01	<0.01	<0.01	0.90	0.9	0.9	0.11	<0.01	5
	Nov 2018	Not sampled									
	Feb 2019	0.05	<0.01	0.01	0.01	2.20	2.2	2.2	0.23	<0.01	53
	Apr 2019	0.08	<0.01	<0.01	<0.01	1.40	1.5	1.5	0.51	0.04	24
	Median	**0.05**	**<0.01**	**<0.01**	**<0.01**	**1.40**	**1.5**	**1.5**	**0.51**	**0.04**	**24**
28	Jun 2018	Not sampled									
	Nov 2018	Not sampled									
	Feb 2019	0.07	<0.01	<0.01	<0.01	5.10	5.2	5.2	0.43	0.02	56
	Apr 2019	0.04	<0.01	<0.01	<0.01	1.50	1.5	1.5	0.31	0.01	26
	Median	**0.055**	**<0.01**	**<0.01**	**<0.01**	**3.30**	**3.35**	**3.35**	**0.37**	**0.015**	**41**
29	Jun 2018	Not sampled									
	Nov 2018	Not sampled									
	Feb 2019	Not sampled									
	Apr 2019	0.03	<0.01	<0.01	<0.01	1.80	1.8	1.8	0.66	0.37	18
	Median	**0.03**	**<0.01**	**<0.01**	**<0.01**	**1.80**	**1.8**	**1.8**	**0.66**	**0.37**	**18**
30	Jun 2018	0.02	<0.01	<0.01	<0.01	0.50	0.5	0.5	0.07	<0.01	<2
	Nov 2018	0.10	0.01	0.03	0.04	4.50	4.6	4.6	0.39	0.05	57
	Feb 2019	0.06	<0.01	<0.01	<0.01	5.10	5.2	5.2	0.43	0.02	50
	Apr 2019	0.03	<0.01	<0.01	<0.01	3.30	3.3	3.3	0.38	<0.01	72
	Median	**0.045**	**<0.01**	**<0.01**	**<0.01**	**3.9**	**3.95**	**3.95**	**0.385**	**<0.01**	**54**
32	Jun 2018	Not sampled									
	Nov 2018	Not sampled									
	Feb 2019	0.09	<0.01	<0.01	<0.01	3.70	3.8	3.8	0.43	0.03	90
	Apr 2019	Not sampled									
	Median	**0.09**	**<0.01**	**<0.01**	**<0.01**	**3.70**	**3.8**	**3.8**	**0.43**	**0.03**	**90**
33	Jun 2018	Not sampled									
	Nov 2018	0.03	<0.01	<0.01	<0.01	1.00	1.0	1.0	0.23	0.05	3
	Feb 2019	Not sampled									
	Apr 2019	Not sampled									
	Median	**0.03**	**<0.01**	**<0.01**	**<0.01**	**1.00**	**1.0**	**1.0**	**0.23**	**0.05**	**3**

Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise

Table 31 Water quality results for Sites 27, 28, 30, 32 and 33 in the Central Condamine –dissolved metals

Guideline (mg/L)		Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Limit of Reporting		0.001	0.0001	0.001	0.001	0.001	0.001	0.005	0.0001
ANZECC		0.024	0.0002	0.0033#	0.0014	0.0034	0.011	0.008	0.00006
Basin Plan									
Site	Trip								
27	Jun 2018	<0.001	<0.0001	<0.001	0.002	<0.001	0.006	<0.005	<0.0001
	Nov 2018	Not sampled							
	Feb 2019	0.002	<0.0001	<0.001	<0.001	<0.001	0.007	<0.005	<0.0001
	Apr 2019	0.001	<0.0001	<0.001	0.002	<0.001	0.008	<0.005	<0.0001
	Median	**0.001**	**<0.0001**	**<0.001**	**0.002**	**<0.001**	**0.007**	**<0.005**	**<0.0001**
28	Jun 2018	Not sampled							
	Nov 2018	Not sampled							
	Feb 2019	0.005	<0.0001	<0.001	0.002	<0.001	0.012	<0.005	<0.0001
	Apr 2019	0.001	<0.0001	<0.001	0.005	<0.001	0.011	<0.005	<0.0001
	Median	**0.003**	**<0.0001**	**<0.001**	**0.0035**	**<0.001**	**0.0115**	**<0.005**	**<0.0001**
29	Jun 2018	Not sampled							
	Nov 2018	Not sampled							
	Feb 2019	Not sampled							
	Apr 2019	0.003	<0.0001	<0.001	0.005	<0.001	0.015	<0.005	<0.0001
	Median	**0.003**	**<0.0001**	**<0.001**	**0.005**	**<0.001**	**0.015**	**<0.005**	**<0.0001**
30	Jun 2018	<0.001	<0.0001	<0.001	0.001	<0.001	0.003	<0.005	<0.0001
	Nov 2018	0.002	<0.0001	<0.001	0.003	<0.001	0.004	<0.005	<0.0001
	Feb 2019	0.001	<0.0001	<0.001	<0.001	<0.001	0.003	<0.005	<0.0001
	Apr 2019	<0.001	<0.0001	<0.001	0.001	<0.001	0.006	<0.005	<0.0001
	Median	**<0.001**	**<0.0001**	**<0.001**	**0.001**	**<0.001**	**0.0035**	**<0.005**	**<0.0001**
32	Jun 2018	Not sampled							
	Nov 2018	Not sampled							
	Feb 2019	0.003	<0.0001	<0.001	<0.001	<0.001	0.011	<0.005	<0.0001
	Apr 2019	Not sampled							
	Median	**0.003**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**0.011**	**<0.005**	**<0.0001**
33	Jun 2018	Not sampled							
	Nov 2018	<0.001	<0.0001	<0.001	0.004	<0.001	0.008	<0.005	<0.0001
	Feb 2019	Not sampled							
	Apr 2019	Not sampled							
	Median	**<0.001**	**<0.0001**	**<0.001**	**0.004**	**<0.001**	**0.008**	**<0.005**	**<0.0001**

Low reliability guideline (ANZECC 2018). Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise

Table 32 Water quality results for Sites 39, 40 and 42 in the Oakey Creek – physico-chemical

Guideline		pH units	Temp °C	DO %Sat	EC µS/cm	Salinity (g/kg)	Turbidity (NTU)	TSS	Calcium	Magnesium	Hardness as $CaCO_3$
Limit of Reporting		0.01	0.1	0.1	1	0.01	0.1	5	1	1	1
ANZECC		6.5 to 7.5		90 to 110	30 to 350		2 to 25		-	-	-
Basin Plan Low flow High flow		 7.7 to 8.3 7.4 to 8.1		 60 to110 60 to110	 510 375		 13 55	 14 65			
Site	Trip										
39	Jun 2018	8.12	14.0	75.5	2318	1.25	11.3	8	73	137	746
	Nov 2018	8.36	28.2	121.6	1731	0.86	20.5	14	65	94	549
	Feb 2019	8.54	29.4	148.2	2632	1.48	35.2	30	42	169	801
	Apr 2019	8.24	20.3	106.2	1843	0.92	21.9	20	87	122	720
	Median	**8.30**	**24.3**	**113.9**	**2080**	**1.09**	**21.2**	**17**	**69**	**130**	**733**
40	Jun 2018	8.42	10.4	74.6	1320	0.69	8.1	10	51	82	465
	Nov 2018	8.25	24.8	92.0	692	0.33	12.5	9	32	38	236
	Feb 2019	Not Sampled									
	Apr 2019	8.13	20.4	88.6	680	0.33	40.6	26	37	48	290
	Median	**8.25**	**20.4**	**88.6**	**692**	**0.33**	**12.5**	**10**	**37**	**48**	**290**
42	Jun 2018	8.52	9.80	72.8	1287	0.69	4.6	6	55	81	471
	Nov 2018	8.30	32.5	116.7	1157	0.56	6.1	10	49	67	398
	Feb 2019	8.44	30.8	146.6	1339	0.73	10.3	8	43	91	482
	Apr 2019	8.15	22.9	85.0	850	0.41	14.6	12	48	60	367
	May 2019	8.25	16.2	105.4	1339	0.64	5.5	<5	62	86	509
	Median	**8.3**	**22.9**	**105.4**	**1287**	**0.64**	**6.1**	**9**	**49**	**81**	**471**

Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise

Table 33 Water quality results for Sites 39, 40 and 42 in the Oakey Creek – nutrients

Guideline (mg/L)		Ammonia	Nitrite	Nitrate	NOx	Organic N	TKN	Total N	Total P	Reactive P	Chlorophyll *a* (µg/L)
Limit of Reporting		0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.01	0.01	1
ANZECC		0.013			0.015				0.03	0.015	-
Basin Plan Low flow High flow		0.010 ID			0.005 ID			1.000 1.280	0.110 0.340	0.045 0.09	5 ID
Site	Trip										
39	Jun 2018	0.04	0.01	0.51	0.52	0.3	0.3	0.8	0.02	<0.01	<1
	Nov 2018	0.05	<0.01	<0.01	<0.01	0.4	0.5	0.5	0.11	<0.01	13
	Feb 2019	0.06	<0.01	<0.01	<0.01	0.9	1.0	1.0	0.08	<0.01	12
	Apr 2019	0.04	<0.01	0.07	0.07	0.6	0.6	0.7	0.06	<0.01	31
	Median	**0.045**	**<0.01**	**<0.01**	**<0.01**	**0.5**	**0.55**	**0.75**	**0.07**	**<0.01**	**12.5**
40	Jun 2018	0.02	<0.01	<0.01	<0.01	0.3	0.3	0.3	0.02	<0.01	<1
	Nov 2018	0.06	0.02	0.72	0.74	0.3	0.4	1.1	0.20	0.02	7
	Feb 2019	Not Sampled									
	Apr 2019	0.02	0.02	0.90	0.92	0.3	0.3	1.2	0.06	0.02	4
	Median	**0.02**	**0.02**	**0.72**	**0.74**	**0.3**	**0.3**	**1.1**	**0.06**	**0.02**	**4**
42	Jun 2018	0.02	<0.01	1.25	1.25	0.2	0.2	1.4	0.01	<0.01	<1
	Nov 2018	0.05	<0.01	0.82	0.82	0.2	0.2	1.0	0.17	0.01	<1
	Feb 2019	0.06	0.02	0.69	0.71	0.3	0.4	1.1	0.02	<0.01	3
	Apr 2019	0.05	0.02	1.25	1.27	0.2	0.2	1.5	0.04	0.02	2
	May 2019	0.03	0.02	1.38	1.4	0.2	0.2	1.6	<0.01	<0.01	1
	Median	**0.05**	**0.02**	**1.25**	**1.25**	**0.2**	**0.2**	**1.4**	**0.03**	**<0.01**	**1**

Values outside of all guidelines are shaded orange. All units mg/L unless stated otherwise

Table 34 Water quality results for Sites 39, 40 and 42 in the Oakey Creek – dissolved metals

Guideline (mg/L)		Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Limit of Reporting		0.001	0.0001	0.001	0.001	0.001	0.001	0.005	0.0001
ANZECC		0.024	0.0002	0.0033#	0.0014	0.0034	0.011	0.008	0.00006
Basin Plan									
Site	Trip								
39	Jun 2018	<0.001	<0.0001	<0.001	<0.001	<0.001	0.004	<0.005	<0.0001
	Nov 2018	<0.001	<0.0001	<0.001	0.002	<0.001	0.007	<0.005	<0.0001
	Feb 2019	<0.001	<0.0001	<0.001	0.001	<0.001	0.006	<0.005	<0.0001
	Apr 2019	<0.001	<0.0001	<0.001	0.002	<0.001	0.010	<0.005	<0.0001
	Median	**<0.001**	**<0.0001**	**<0.001**	**0.002**	**<0.001**	**0.005**	**<0.005**	**<0.0001**
40	Jun 2018	<0.001	<0.0001	<0.001	<0.001	<0.001	0.002	<0.005	<0.0001
	Nov 2018	<0.001	<0.0001	<0.001	0.003	<0.001	0.004	<0.005	<0.0001
	Feb 2019	Not Sampled							
	Apr 2019	<0.001	<0.0001	<0.001	0.002	<0.001	0.003	<0.005	<0.0001
	Median	**<0.001**	**<0.0001**	**<0.001**	**0.002**	**<0.001**	**0.002**	**<0.005**	**<0.0001**
42	Jun 2018	<0.001	<0.0001	<0.001	<0.001	<0.001	0.002	<0.005	<0.0001
	Nov 2018	<0.001	<0.0001	<0.001	0.002	<0.001	0.002	<0.005	<0.0001
	Feb 2019	<0.001	<0.0001	<0.001	<0.001	<0.001	0.002	<0.005	<0.0001
	Apr 2019	<0.001	<0.0001	<0.001	0.001	<0.001	0.003	<0.005	<0.0001
	May 2019	<0.001	<0.0001	<0.001	<0.001	<0.001	0.002	<0.005	<0.0001
	Median	**<0.001**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**0.002**	**<0.005**	**<0.0001**

[#] Low reliability guideline (ANZECC 2018). Values outside of guidelines are shaded orange. All results mg/L unless stated otherwise.

4.3.7 Quality assurance results

Relative percent differences for duplicate samples in June 2018 (Site 6), November 2018 (Site 3), February 2019 (Site 6), April 2019 (Site 6) and May 2019 (Site 7) were below the acceptance criterion of 35 per cent for all parameters except Total Suspended Solids (TSS) in June 2018, which was 58 per cent (raw TSS values of 11 and 20 mg/L).

When sampling pools of water that are not well mixed, there is potential for one sample to have quantities of detritus or sediment that differs slightly from the duplicate sample. With other assessed duplicate parameters showing a high degree of uniformity, the lack of mixing appears to be the principal driver of error. Also, the results of these samples are close to the laboratory limit of reporting for TSS of 5 mg/L. The relative percent difference variable is sensitive to small differences between values at low concentrations, close to the limit of reporting.

Results for field blank samples were at or below the laboratory level of detection for all samples on all field trips, except ammonia in November 2018 (0.03 mg/L) and April (0.02 mg/L), when the results were slightly above the laboratory limit of detection of 0.01 mg/L. These results indicate that the process of collecting the field blank may have resulted in some very minor contamination of the distilled water. However, several other samples in the November 2018 batch had concentrations of ammonia below the laboratory limit of detection, so any contamination was localised in this batch of samples.

Overall, the quality assurance results indicate a high level of reliability in the data collected.

4.4 Results of aquatic ecology surveys

4.4.1 Aquatic flora

Fourteen species of aquatic plants were detected from the aquatic survey in June and November 2018 (**Table 35**). No EVNT aquatic flora species were detected.

Table 35 Aquatic flora detected within the Project aquatic survey sites June and November 2018

Scientific name	Common name	Survey period	Site (and approximate % cover in reach)												
			2	4	5	8	9	12	13	15	16	17	19	32	43
Arundinella nepalensis	Reed grass	June 2018	-	1			4		1	1		2			
		November 2018		1			4		1	1					
Carex appressa	Tall sedge	June 2018	-		14					3					
		November 2018			14		1		1	3					
Cyperus exaltatus	Tall flat sedge	June 2018	-						1	1			2	1	
		November 2018	1						1				1	1	
Cyperus gracilis	Slender flat-sedge	June 2018	-			1									
		November 2018	1			1									
Cyperus pygmaeus	Dwarf flat-sedge	June 2018	-								5			1	
		November 2018									5			1	
Eleocharis acuta	Spikerush	June 2018	-						1				2		
		November 2018							1				2		
Eleocharis plana	Ribbed spikerush	June 2018	-											5	
		November 2018			1	20								5	
Juncus usitatus	Common rush	June 2018	-		1		3	5	5	5	5	3	2	60	
		November 2018	3		1	1	3	3	5	5	5	3	2	60	
Leptochloa digitata	Umbrella cane grass	June 2018	-								5		20		
		November 2018									5		20		
Ludwigia peploides subsp. montevidensis	Water primrose	June 2018	-									30			
		November 2018													

Scientific name	Common name	Survey period	Site (and approximate % cover in reach)												
			2	4	5	8	9	12	13	15	16	17	19	32	43
Marsilea drummondii	Common nardoo	June 2018	-												
		November 2018	1										1		
Persicaria attenuata	Hairy knotweed	June 2018	-											5	
		November 2018	1											5	
Persicaria decipiens	Slender knotweed	June 2018	-											1	
		November 2018	3											1	
Persicaria orientalis	Lady's Thumb	June 2018													
		November 2018	1									1			
Phragmites australis	Common reed	June 2018	-								15				
		November 2018	2								20				
Scirpus sp.	Club rush	June 2018	-												
		November 2018											1		

- Access was not available to Site 2 during the June 2018 survey

The majority of aquatic flora species encountered during the June and November 2018 field surveys were common emergent species such as aquatic (or semi-aquatic) grasses, sedges and rushes.

The lack of both diversity and abundance of aquatic plants at some sites is likely to be indicative of dry physical conditions. More diverse aquatic communities may occur through recruitment during sustained flows or water pooling over the wetter months of the year.

4.4.2 Physical habitat

The overall physical habitat assessment scores were Fair to Good for each aquatic site surveyed in June and November 2018, with no difference between the two surveys. Channel flow status rated poor at most sites due to the dry conditions encountered at the times of assessment. Epifaunal substrate/available cover also rated poor at most sites, owing to the dominance of silt/clay substrates and general lack of substrate complexity. This is generally a reflection of the natural clay-rich bed substrates, as opposed to siltation. Bed and bank stability rated high at most sites, owing largely to good vegetative bank protection and reasonably intact riparian zones across the impact assessment area (**Table 36**). Site descriptions for Aquatic Ecology sites are provided in **Appendix A**.

Table 36 AusRivAS physical habitat assessment scores for the Project aquatic survey sites, June and November 2018

Habitat parameter		Site (and score)												
		2	4	5	8	9	12	13	15	16	17	19	32	43
Epifaunal substrate/available cover		G14	P5	P5	P4	P4	P3	F9	P5	G15	F7	F9	F7	P4
Pool substrate characterisation		G12	F7	F10	P3	F6	F7	F9	F6	F9	P3	G13	F7	P4
Pool variability		G14	P0	P0	P0	P0	P0	G13	F6	G13	G11	F6	F8	P0
Sediment deposition		G12	E16	E18	E16	P4	G13	E16	E16	G15	E16	F8	E16	E18
Channel flow status		E18	P0	P0	P0	P0	P0	P0	P0	E18	P0	P0	P0	P0
Channel alteration		G13	E16	G15	G15	G13	G13	E18	E18	E18	E16	G13	G11	F9
Channel sinuosity		F10	F7	P5	P5	F6	F6	G11	F7	G12	G13	F9	G13	F7
Bank stability	Left bank	G7	E9	E10	E9	G8	E9	G6	E9	F4	P2	F4	G7	F5
	Right bank	G7	E9	E10	E9	G8	E9	G7	E9	F4	P2	F4	G6	F5
Vegetation protection	Left bank	G7	G8	G7	G6	G6	G6	G6	G6	F4	F5	G6	F5	F5
	Right bank	G7	G8	G7	G6	G6	G6	G6	G6	F4	F5	G6	F5	F5
Riparian zone score	Left bank	G6	G8	E9	G8	G8	G6	E9	G7	F4	F5	G7	G7	P2

Habitat parameter		Site (and score)												
		2	4	5	8	9	12	13	15	16	17	19	32	43
	Right bank	G6	G8	E9	G6	G6	G6	E9	G7	F4	F5	G7	G8	P2
Total (low gradient) habitat score		**G 129**	**G 101**	**G 105**	**F 87**	**F 74**	**F 84**	**G 119**	**G 102**	**G 124**	**F 90**	**F 92**	**F 100**	**F 66**

Notes:

Ratings as per AusRivAS Physical Assessment Protocol (Parsons *et al*. 2002).

Categories for each habitat parameter: E = Excellent (green shading); G = Good (yellow shading); F = Fair (orange shading); P = Poor (pink shading).

Categories for total (low gradient stream) habitat score: E = 154-200; G = 101-153; F = 48-100; P = 0-47.

4.4.3 Macroinvertebrates and stream health

Taxonomic composition

A total of 26 taxa were identified from 523 aquatic macroinvertebrates collected from two sites in November 2018. Taxa richness was slightly more diverse in the samples collected from Bringalily Creek (Site 16; 19 taxa) than in the samples collected from the Macintyre River (Site 2; 18 taxa). Taxa richness was greater in the edge habitat at each site than in the bed habitat, likely owing to the greater habitat complexity and food sources.

A total of 54 taxa were identified from 1,785 aquatic macroinvertebrates collected from five sites in May 2019. Taxa richness was most diverse in the Macintyre River (Site 2; 34 taxa), with slightly lower diversity at sites 18 (30 taxa), 42 (29 taxa), 6R (28 taxa) and 7 (27 taxa). This is likely a reflection of the lower (yet sustained) flow producing greater habitat complexity at site 2, including varying depths, velocities and substrate sizes.

The most taxa-rich orders were Hemiptera (aquatic bugs), Coleoptera (beetles) and Diptera (true flies) in both the November 2018 and May 2019 sampling rounds. Other orders included Acarina (mites), Ephemeroptera (mayflies), Trichoptera (caddis flies), Zygoptera (damselflies), Epiprocta (dragonflies), Gastropoda (aquatic snails) and Veneroida (basket clams), Decapoda (in this case prawns, shrimp and yabbies), Collembola (spring tails), Lepidoptera (aquatic caterpillars), Ostracoda (seed shrimp), Copepoda (copepods), Cladocera (water fleas), Isopoda (isopods), Rhynchobdellida (jawless leeches) and Oligochaeta (segmented worms).

PET taxa

Five PET taxa were detected in samples collected from across the impact assessment area in November 2018, and seven PET taxa were detected in May 2019. Sites 2 (Macintyre River), 6R (Macintyre Brook) and 7 (Macintyre Brook) recorded the greatest number of PET taxa, with six PET taxa recorded from each site in May 2019. PET taxa consisted of three Ephemeroptera (mayfly) taxa: Baetidae, Caenidae and Leptophlebiidae; and four Trichoptera (caddis fly) taxa: Calamoceratidae (sleeping bag caddis), Ecnomidae (caseless caddis), Hydropsychidae (net spinning caddis) and Leptoceridae (stick caddis). No Plecoptera (stoneflies) were detected, nor were they expected to occur within the sites sampled, due to the absence of riffles and suitable substrates.

SIGNAL2 scores

SIGNAL2 scores were greater for the edge habitat samples than for the bed habitat samples at each of the two sites sampled in November 2018 and ranged from 2.88 in the bed habitat of Site 16 (Bringalily Creek) to 3.92 in the edge habitat of Site 2 (Macintyre River). The SIGNAL2 value of 3.36 for the edge habitat sample collected from Site 16 in November 2018 falls within the 20:80 percentile range of 3.13 to 3.75 for slightly to moderately disturbed waters of the Dumaresq catchment within the Queensland Border Rivers basin (Negus *et al*. 2013, cited in DES 2019a).

SIGNAL2 scores were greater for the bed habitat samples than for the edge habitat samples at each of the five sites sampled in May 2019. This is likely a reflection of the retracting water level associated with lower flow, and greater habitat complexity at Site 2, including varying depths, velocities and substrate sizes. SIGNAL2 scores in May 2019 ranged from 3.25 in the edge habitat of Site 6R to 4.33 in the bed habitat of Site 18. The SIGNAL2 values for the edge habitat samples collected from sites 6R, 7 and 18 fall within or favourably above the 20:80 percentile range of 3.13 to 3.75 for slightly to moderately disturbed waters of the Dumaresq catchment within the Queensland Border Rivers basin (Negus *et al.* 2013, cited in DES 2019a).

No SIGNAL2 guidelines are yet available for the broader Macintyre River catchment, or the Condamine River catchment. However, the SIGNAL2 scores for Site 2 fall within or just outside the 20:80 percentile guideline range of 3.33 to 3.85 for bed habitats and 3.31 to 4.20 for edge habitats of slightly to moderately disturbed waters of the Queensland Central Region, as a guide for comparison (DEHP 2013). The SIGNAL2 scores for Site 42 fall within or just outside the 20:80 percentile guideline range of these guidelines.

Tolerant taxa

The percentage of tolerant macroinvertebrate taxa (i.e. those with SIGNAL2 score of three or less) in the edge habitats ranged from 40 to 63 per cent in the samples collected in November 2018 and from 52 to 55 per cent in the samples collected in May 2019. The percentage of tolerant macroinvertebrate taxa in the bed habitats ranged from 40 to 63 per cent in the samples collected in November 2018 and from 22 to 40 per cent in the samples collected in May 2019. The percentage of tolerant taxa in the edge habitat samples collected from Sites 6R, 7, 16 and 18 fall within the 20:80 percentile range of 37.93 to 65.00 per cent for slightly to moderately disturbed waters of the Dumaresq catchment within the Queensland Border Rivers basin (Negus *et al*. 2013, cited in DES 2019a).

No tolerant taxa guidelines are yet available for the broader Macintyre River catchment, or the Condamine River catchment. However, the tolerant taxa scores for Site 2 fall within or just outside the 20:80 percentile guideline range of 25 to 50 per cent for the bed habitat and 44 to 56 per cent for the edge habitat of slightly to moderately disturbed waters of the Queensland Central Region (as a guide for comparison; DEHP 2013). The tolerant taxa scores for Site 42 fall within the 20:80 percentile guideline range of these guidelines.

AusRivAS OE50

The AusRivAS OE50 assessment method describes the biological diversity of macroinvertebrates when compared with reference sites used to create the AusRivAS model. There are five categories of diversity, called bands: X, A, B, C and D. Band A (similar to reference) is assigned when results are similar to reference sites (the expected number of families within the range found at 80% of the reference sites). Band B (significantly impaired) is assigned when there are fewer families than expected, with a potential impact either on water or habitat quality. Band X (more biologically diverse than reference) is assigned when taxonomic richness is higher than reference because of naturally high biodiversity, an impact such as mild nutrient enrichment, or artificially sustained flow in a normally intermittent stream.

Overall, AusRivAS band ratings ranged from Band A (reference condition) to Band B (significantly impaired). Aquatic macroinvertebrate assemblages in the bed and edge habitats of Site 16 (Bringalily

Creek) were in reference condition (Band A; **Table 37**) in November 2018. This was also the case for bed and edge habitats samples collected from Site 18 (also Bringalily Creek) in May 2019, each in reference condition (Band A: **Table 37**). This suggests that most/all of the expected taxa were found and that existing upstream impacts on water quality and/or habitat condition have not resulted in a loss of macroinvertebrate diversity. Both the bed and edge habitat samples collected from Site 2 (Macintyre River) were slightly impaired (Band B).

Table 37 AusRivAS model outputs for sites sampled within the impact assessment area, November 2018

Site	Bed habitat		Edge habitat		Overall Band
	OE50	Band	OE50	Band	
November 2018					
2 (Macintyre River)	0.56	B	0.73	B	B
16 (Bringalily Creek)	0.85	A	0.99	A	A
May 2019					
2 (Macintyre River)	1.22	X	1.02	A	A
6R (Macintyre Brook)	0.61	B	0.92	A	B
7 (Macintyre Brook)	1.22	X	0.83	A	A
18 (Bringalily Creek)	0.91	A	1.10	A	A
42 (Dry Creek)	0.88	A	0.75	B	B

4.4.4 Macro-crustaceans

Three macro-crustacean families: Palaemonidae (freshwater prawns), Atyidae (freshwater shrimp) and Parastacidae (yabbies), were encountered within the impact assessment area. Individuals from the family Palaemonidae were identified as *Macrobrachium australiense*. Individuals from the family Atyidae were identified as *Paratya australiense*. Individuals from the family Parastacidae were identified as *Cherax destructor*.

4.4.5 Fish

There were no fish caught in bait traps during the June 2018 survey, predominantly due to dry conditions and limitations of the sampling method. A total of 202 fish were caught across the two sites in November 2018 with sufficient water for investigation (**Table 38**). These included common native and introduced species. No Murray Cod or Silver Perch were captured. However, both sites had habitat potentially suitable for the Murray Cod. The Agassiz's Glassfish (*Ambassis agassizii*) was captured at Site 2 in the Macintyre River, on the Queensland side of the state border. The western population of this species is listed as an endangered population in NSW (NSW DPI 2013).

A total of 1,865 fish were caught across the five sites in May 2019 with sufficient water for investigation (**Table 38**). These included native species and introduced species. Six Murray Cod were caught at Site 2 on the Macintyre River, with one Murray Cod captured at Site 7 on Macintyre Brook. Other species encountered included the Murray River Rainbowfish, Unspecked Hardyhead, Australian Smelt and Southern Purple Spotted Gudgeon.

Surveys confirmed the presence of several native and pest fish species across the impact assessment area. However, the presence and abundance of fish species at many sites is likely to have been limited by the dry conditions during the approximate 12 month survey period. A greater diversity and abundance of fish across waterways of the impact assessment area is therefore assumed for the purposes of impact assessment. The Murray Cod was confirmed to be present in the Macintyre River and Macintyre Brook, and is assumed to be present in other large waterways of the impact assessment area, including the Condamine River and larger tributaries. Many of the fish species found or assumed to be present in waterways of the impact assessment area undertake migrations, including Bony Bream, Murray River Rainbowfish, Australian Smelt and Murray Cod (Lintermans 2007).

Table 38 Summary of fish caught during November 2018 field surveys

Location	Date	Scientific name	Common name	No. captured	Size range (mm)^
Macintyre River (Site 2)	29 November 2018	*Ambassis agassizii*	Agassiz's glassfish#	1	35
		*Carassius auratus**	Common goldfish*	7	45 to 50
		*Gambusia holbrooki**	Eastern gambusia*	4	25 to 35
		Hypseleotris sp.	Carp Gudgeon	57	20 to 40
		Leiopotherapon unicolor	Spangled perch	2	30 to 45
		Melanotaenia fluviatilis	Murray river rainbowfish	2	35 to 45
		Nematalosa erebi	Bony bream	1	40
	15 -16 May 2019	*Craterocephalus fulvus*	Unspecked hardyhead	7	40 to 55
		*Gambusia holbrooki**	Eastern gambusia*	75	25 to 40
		Hypseleotris sp.	Carp Gudgeon	98	25 to 45
		Leiopotherapon unicolor	Spangled perch	17	60 to 80
		Melanotaenia fluviatilis	Murray river rainbowfish	75	35 to 75
		Maccullochella peelii	Murray cod#	6	310 to 450
		Retropinna semoni	Australian smelt	51	40 to 70
Macintyre Brook (Site 6R)	16 – 17 May 2019	*Hypseleotris sp.*	Carp gudgeon	685	25 to 45
		Craterocephalus fulvus	Unspecked hardyhead	19	35 to 55
		Tandanus tandanus	Freshwater catfish	18	90 to 420
		*Gambusia holbrooki**	Eastern gambusia*	147	25 to 40
		Melanotaenia fluviatilis	Murray river rainbowfish	27	35 to 50
		Retropinna semoni	Australian smelt	1	50
Macintyre Brook (Site 7)	16 – 17 May 2019	*Maccullochella peelii*	Murray cod#	1	490
		Hypseleotris sp.	Carp gudgeon	283	25 to 45
		Melanotaenia fluviatilis	Murray river rainbowfish	238	30 to 55
		Craterocephalus fulvus	Unspecked hardyhead	28	35 to 60
		*Carassius auratus**	Common goldfish*	1	150
		*Cyprinus carpio**	Common carp*	1	160
		*Gambusia holbrooki**	Eastern gambusia*	3	30
		Retropinna semoni	Australian smelt	5	40 to 45
Bringalily Creek (Site 16)	28 November 2018	*Carassius auratus**	Common goldfish*	3	80 to 250
		*Cyprinus carpio**	Common carp*	6	300 to 430
		Hypseleotris sp.	Carp Gudgeon	101	20 to 45
		Macquaria ambigua	Golden perch	3	23 to 29
		Melanotaenia fluviatilis	Murray river rainbowfish	15	35 to 55

Location	Date	Scientific name	Common name	No. captured	Size range (mm)^
Bringalily Creek (Site 18)	17 – 18 May 2019	*Leiopotherapon unicolor*	Spangled perch	52	45 to 70
		Hypseleotris sp.	Carp gudgeon	13	30 to 35
Dry Creek (Site 42)	18 May 2019	*Mogurnda adspersa*	Southern purple spotted gudgeon	14	50 to 80

^Estimated length from snout to tail fork, *Pest species euthanised, # Threatened species in QLD or NSW at location of capture.

4.4.6 Freshwater turtles

Habitat suitable for freshwater turtles was observed throughout the impact assessment area. This included major systems such as the Macintyre and Condamine Rivers, as well as smaller creeks and tributaries, many of which were dry at the time of the field surveys. Turtle nesting habitat was noted to be abundant along the Macintyre River and Macintyre Brook, with the Eastern snake-necked turtle recorded at Bringalily Creek. Due to ongoing dry conditions, many turtles are likely to have moved temporarily to constructed farm dams and other more permanent sources of water during the survey period. No habitat suitable for the Bell's turtle or Southern snapping turtle was identified during the field surveys.

4.5 Synthesis of existing aquatic ecology and surface water values

A summary of key aquatic ecology and surface water values is provided in the following sections, relative to the water quality zones identified by DES (2019a, b) for the implementation of local water quality guidelines. The water quality zones generally align with sub-catchments of the impact assessment area.

In general, aquatic ecology values can be summarised as:

- Biodiversity and nature conservation
- Riparian vegetation
- Habitat connectivity
- Bank stability
- Water quality
- Sediment quality
- Water resources

Macintyre Barwon Floodplain (Sites 1 and 2)

Sites within the Macintyre Barwon Floodplain were located on the largest watercourse in the region (the Macintyre River) and had a significant amount of water present in large pools and channels. Stream banks were generally well defined. However, some areas had been subject to tunnel and gully erosion. Disturbance to the aquatic habitats was noted as a result of both adjacent land use from agricultural grazing and construction of a bridge access.

Riparian vegetation cover was high although aquatic flora comprised only a small proportion of the vegetation present (approximately 2 per cent). Aquatic fauna was recorded at Site 2, with eight native species of fish that inhabit pools and streams of the floodplain, including the Murray Cod and Agassiz's Glassfish. Habitat value in general was assessed as good, with limited barriers to fish passage. Nesting habitat for freshwater turtles was also abundant along the Macintyre River.

Water quality was generally good, with elevated turbidity, EC and suspended sediment concentrations. Macroinvertebrate assemblages were consistent with those expected for slightly to moderately disturbed aquatic ecosystems, indicating the presence of good water quality and habitat features in the period prior to assessment. Representative site photos are provided in **Figure 8**.

Figure 8 Macintyre Barwon Floodplain representative sites November 2018 (left: Site 1, right: Site 2)

Lower Macintyre Brook (sites 3 to 8)

Lower Macintyre Brook consists of several ephemeral drainage features, some of which were dry at the time of field surveys. When water was present, small standing pools were common along with larger deeper stream sections. The poorly defined low sloped banks were consistent with a low potential for erosion. Riparian vegetation was intact at most sites.

Adjacent land consisted of native forest as well as cropping (grain fed cattle and irrigation). Therefore, a moderate to high level of disturbance exists, particularly in areas where irrigation and agricultural runoff occurs. A Eucalypt woodland vegetation community was observed along the drainage, though some clearing has occurred on the floodplains. Aquatic flora persistence and biodiversity was variable, with up to 15 per cent cover in some parts and as low as 1 per cent cover in others.

Six species of native fish were identified at Sites 6R and 7 during field surveys in May 2019, including the Murray Cod. The Lower Macintyre Brook also has suitable habitat for the Platypus, which was observed in the June 2018 survey. Macroinvertebrate scores were variable between sites and generally indicative of good water quality and habitat features. Banks also provide suitable nesting habitat for freshwater turtles. Water flow obstructions were present, including at Site 4, where a dog proof fence intersected the waterway. Overall habitat value was rated from fair to good, with some parts of the brook providing effective fish passage, even at times of low flow. Water quality at sites in the Lower Macintyre Brook was characterised by high EC and elevated TSS and nutrients, with low dissolved oxygen. Representative site photos are provided in **Figure 9**.

Figure 9 Lower Macintyre Brook representative sites, November 2018 (top left: Site 3, top right: Site 4, middle left: Site 5, middle right: Site 6, bottom left: Site 7, bottom right: Site 8)

Canning Creek (sites 9 to 20)

The Canning Creek water quality zone comprises a combination of ephemeral (some of which were dry at the time of assessment) and semi-permanent waterways (e.g. Sites 11, 14 and 16). Stream banks were variable across the impact assessment area, with some well-defined stream banks of varying slope as well as others that were flatter and less distinct waterway pathways.

Adjacent land use included native forest, road reserve and cattle grazing. Areas which have been fenced off to grazing (e.g. Site 9) have experienced less vegetation disturbance than other areas which are subject to stock access. Erosion was observed to range from moderate to severe, with the invasion of exotic pastoral weed Lippia detected, which is known to outcompete native riparian flora and negatively affect bank stability (reported at Sites 9 and 17). Further disturbance has also occurred through the installation of box culverts and bridge access.

Vegetation communities consisted of scattered and clumped Eucalypt woodlands, while aquatic flora cover ranged from 5 per cent (Site 9) to more than 30 per cent (Sites 16 and 17). Aquatic fauna were confirmed at semi-permanent waterways of Sites 16 and 18 where five native species of fish were recorded. These sites also provided potential habitat for EVNT species Murray Cod and SLC Platypus. In general, habit value ranged from fair to good with effective fish passage existing at the majority of sites along Canning Creek.

Water quality within the Canning Creek water quality zone was generally poor, characterised by alkaline pH and elevated concentrations of nutrients. However, macroinvertebrate assemblages in Bringalily Creek were generally consistent with those expected for sites in reference condition (Band A). Representative site photos are provided in **Figure 10**.

Figure 10 Canning Creek representative sites, November 2018 (top left: Site 10, top right: Site 12, middle left: Site 16, middle right: Site 18, bottom left: Site 19, bottom right: Site 11)

Southern Condamine (sites 21 to 26)

Southern Condamine comprised multiple ephemeral drainage features, most of which were dry at the times of assessment, with the exception of Site 24, which generally had water present. The majority of streams exhibited poorly defined, low sloped banks which were assessed as moderately stable. Adjacent land was utilised for agricultural practices such as cattle grazing, which had resulted in some bank erosion.

The riparian zone was particularly wide in some sections with a mix of native and exotic vegetation cover. Large trees such as eucalypts were often scattered, and the abundance of aquatic flora was variable. Areas which contained deeper channels and larger water bodies have the potential to support some aquatic flora and fauna species. This may include the Murray Cod during extended wet periods, when there are larger volumes of water in the Condamine River system. However, aquatic environments are considered unlikely to provide suitable habitat for any EVNT or SLC species during average to dry periods, due to their ephemeral nature. Water quality was characterised by alkaline pH, high EC and elevated concentrations of suspended sediment and nutrients. Representative site photos are provided in **Figure 11**.

Figure 11 Southern Condamine representative sites, November 2018 (top left: Site 24, top right: Site 24, bottom left: Site 23, bottom right: Site 24)

Central Condamine (sites 27 to 33)

Central Condamine consisted of several ephemeral drainage features, some of which were commonly dry at the time of field surveys (Sites 29, 31 and 32). Some small pools of water were sustained throughout the dry periods (Site 30), while others varied with season (Site 27 and 33). There was very little water in the channel, with water generally present in small pools with infrequent deeper stands. Generally, poorly defined low sloped banks existed, which were assessed as moderately stable. However, small areas of severe erosion were noted, particularly adjacent to agricultural cropping activities. Further disturbance as a result of the existing road bridge, culvert and evidence of littler/pollution were recorded at Site 32.

Riparian zones consisted of Eucalypt woodlands, which were scattered and were sparse along some sections of the Condamine River. Native vegetation was dominant (with exotics also readily found), and aquatic flora was particularly abundant and diverse. Habitat values for aquatic fauna was found to be variable, depending on the nature of water presence.

Overall habitat value was limited, and the area is highly unlikely to provide suitable habitat for any EVNT or SLC aquatic flora or fauna species, nor were these detected. However, the Condamine River is recognised as known habitat of the Murray Cod, and the species may utilise waters of the river system during prolonged wetter periods. Water quality at sites in the Central Condamine was characterised by alkaline pH, high EC and elevated concentrations of suspended sediment and nutrients. Representative site photos are provided in **Figure 12**.

Figure 12 Central Condamine representative sites, taken November 2018 (top: Site 33, bottom left: Site 29, bottom right: Site 29)

Oakey Creek (sites 34 to 43)

Oakey Creek comprised multiple ephemeral drainage features, many of which were dry at the times of survey. Some small pools were sustained throughout drier periods. During wet periods, large deep stream channels would be common (these were not observed due to dry conditions). Stream bank slopes ranged from low to moderate, with a high potential for erosion during flood events. Prominent eroded banks and deepening of channels were particularly evident as a result of local land uses.

Adjacent areas consisted of agricultural land used for grazing, with riparian vegetation highly disturbed. This generally consisted of scattered non-remnant vegetation with sparse cover and often dominant exotic species. The riparian zone has been severely reduced in some parts of Oakey Creek (ranging from 0 – 6 m in width). Aquatic flora persistence and biodiversity were severely limited in most locations. One native fish species, the Southern Purple Spotted Gudgeon, was captured at Site 42 (Dry Creek). This site had a macroinvertebrate community typical of slightly to moderately disturbed ecosystems.

Although minimal potential fish habitat exists upstream, there is very restricted movement through waterways, as existing road culverts (such as at Site 43) have not allowed for fish passage. Overall habitat value was assessed as fair, although the area was highly unlikely to provide suitable habitat for any EVNT or SLC aquatic flora or fauna species, nor were these detected. Water quality at Oakey Creek was characterised by alkaline pH, high EC and high dissolved copper concentrations. Representative site photos are provided in **Figure 13**.

Figure 13 Oakey Creek representative survey sites, taken November 2018 (top: looking west from Site 43, middle left: Site 43, middle right: Site 43, bottom left: Site 42, bottom right: Site 42)

5 Impact assessment

5.1 Potential impacts of the Project

Potential impacts of the Project on aquatic ecology values are outlined in **Table 39**, with discussion provided in the following sections.

Clearing of riparian vegetation

Construction of rail infrastructure and associated access tracks, equipment laydown areas and crossings in proximity to waterways will be required during construction phases of the Project. This will result in the removal of habitat for some aquatic species including woody debris, and may result in minor changes in physical attributes of waterways (e.g. reduced shading and increased light penetration). The degree of riparian vegetation clearing and thus, the scale of impact, will vary across the alignment, depending on the size and scale of waterways and the extent of existing disturbance (e.g. existing rail infrastructure).

Clearing of vegetation for construction has the potential to alter temperature and light regimes of aquatic habitats. Increased light penetration into creeks which originally had dense canopy cover may potentially affect the flora composition of aquatic habitats, resulting in a reduction in the abundance and distribution of light-sensitive aquatic plants. Increased light can also be expected to promote the growth of algae and invasive aquatic plants, which may outcompete other plant species and reduce the complexity of aquatic habitats and species diversity. Increased light can also be expected to result in an increase in daytime water temperatures, affecting biological processes such as respiration rates of aquatic organisms, and displacing native species that are not tolerant of high temperatures.

Disturbance of aquatic habitat

The installation of artificial structures such as culverts and bridge pylons within waterways will result in some impacts on aquatic flora and fauna habitat values. Such works may involve the disturbance and removal of stream bed sediments, and changes in habitat structure from a soft bottom to a hard bottom. Some types of infrastructure may increase habitat availability for native and exotic fauna species that are able to utilise a broad range of habitats types, which are lacking in structural complexity. For example, naturally-occurring woody debris habitat generated by riparian vegetation may be replaced with bridge pylons or culverts, resulting in a change in the abundance and diversity of fish species in that location and adjacent areas.

Culverts have the potential to interrupt or become a barrier to aquatic fauna movement, which may affect species life stages and the ability to persist in the local area. Similarly, the installation of bridge support structures may impact on aquatic fauna habitat at a local scale, particularly that of benthos-dwelling species. Temperature and light regimes may also be altered by bridge structures at a local scale through shading of the central part of large waterways, which are not generally shaded by riparian vegetation.

Sediment runoff into waterways

Works adjacent to waterways will result in the exposure of soils which may be mobilised by rainfall and runoff into adjacent aquatic habitats, and also affect areas downstream. Stockpiling of soils close to waterways is also a potential source of sediment inputs into aquatic habitats. Increased runoff to waterways is likely to result in a decline in water quality, through an increase in turbidity and TSS concentrations, and potentially, an increase in the concentration of sediment-bound contaminants such as metals.

Suspended sediments have the potential to impact on fish, freshwater turtles and some invertebrates by disrupting the function of gills (fish and some invertebrates), reducing underwater visibility for predatory species and displacing species that are not tolerant of variable and turbid water quality conditions. This may result in localised fish kills or the displacement of aquatic species to adjacent areas. Metals and other contaminants bound to sediments that wash into waterways may have toxic effects on aquatic organisms or reduce the quality of drinking water for stock. Such effects are likely to be relatively localised (over a scale of hundreds of metres), and will reduce with distance downstream from the source.

Altered hydrology

The installation of artificial structures such as culverts has the potential to alter natural stream flows and volumes in some locations (see EIS Chapter 12: Surface Water and Hydrology). Hydrologic and hydraulic modelling predicted minimal impacts from Project infrastructure on flood flows, floodplain coverage and flow velocities under a range of flow scenarios, including extreme events. Predicted changes in flow velocities were limited in scale to immediately upstream and downstream of culverts. At these locations, such changes may cause minor changes to the location, abundance and structure of aquatic habitats, such as pools, channels, riffles and dry creek beds. This can be expected to result in minor changes to the composition and diversity of aquatic organisms in affected locations.

Changes to the timing and quantity of water flow downstream during major rainfall events are expected to be minor. These changes, have some potential to affect fauna migration and breeding activities such as spawning in fish, which are often linked to water levels and flow rates. Connectivity for aquatic fauna across the flood plains of the impact assessment area is not expected to be affected, due to the design of railway infrastructure. For example, within the Condamine River flood plain, six bridge structures will be constructed, with the largest extending a length of 1,941 m. An extensive network of culverts has also been incorporated into the reference design, with a majority of culverts within the Condamine River flood plain having a width or diameter of >2 m. These design features will minimise changes to hydrology, and are adequate to facilitate continued connectivity among habitats of the flood plain by aquatic fauna, including fish and freshwater turtles. Further details on the predicted changes to hydrology are provided in the Hydrology and Flooding Technical Report (Appendix Q1 and Q2 of the draft EIS).

Changes to groundwater resources, affecting groundwater dependent ecosystems

Project activities have the potential to impact on groundwater resources through effects such as groundwater level reduction, alteration of aquifer flow patterns, the settlement of compressible substrates and reductions in groundwater quality. GDEs are susceptible to indirect impacts from changes to groundwater resources. For example, a reduction in groundwater level may cause spring wetlands to reduce in size or dry up, resulting in a contraction of wetland extent, loss of aquatic habitat and reduction in species diversity. A decline in groundwater quality may also affect aquatic organisms living underground (e.g. stygofauna) or present within surface waters that are sourced from impacted aquifers.

An evaluation of the potential impacts of the Project on groundwater resources (see EIS Chapter 13: Groundwater) concluded that the majority of potential impacts are temporary in nature and related to the construction phase of the Project. While a small number of locations were identified where construction activities have the potential to intersect shallow groundwater resources, engineering controls were assessed to be sufficient to mitigate the extent of impacts. Controls to reduce the risk of contamination of groundwater quality from Project activities (e.g. spills) are also in place and are similar to those related to surface water quality. Further details on the predicted changes to groundwater resources are provided in the Groundwater Technical Report (Appendix R of the draft EIS).

Invasion of aquatic habitats by exotic pest species

Construction of new rail infrastructure has the potential to increase the abundance of weeds and pests and introduce new weed and pest species. The disturbance of existing weeds along the riparian corridor may result in the spread of propagules downstream, or the transport of propagules to other areas either on machinery or through natural dispersal once disturbed. Weed seeds and some pests may also be present on machinery brought in from other areas and be introduced to the local environment. Some farm dams likely to contain exotic species will need to be dewatered to facilitate construction of the Project. This may result in the spread of pest (e.g. exotic fish species) and weed species to adjacent waterways, if not managed appropriately, resulting in a reduction in aquatic habitat quality and species diversity. There are some species of weed that are present in one local government area of the impact assessment area, but are not known to be present in adjoining local government areas (GRC 2019; TRC 2020). The movement of machinery and vehicles across the impact assessment area during the pre-construction and construction phase of the Project has the potential to spread weeds into new localities.

Disturbance of fauna from noise, vibration and lighting

A range of construction activities are likely to result in an increase in noise and vibrations in the vicinity of waterways, reducing habitat quality and increasing disturbance to sensitive fauna. Noise may be created by earthworks, use of heavy machinery or piling in or adjacent to aquatic habitats. Species that are easily disturbed, such as Platypus, may move to adjacent areas to avoid being disturbed, if suitable habitat exists. Such noise and vibration may persist into the operation phase, at a reduced magnitude, and occur at frequent periods each time that a train traverses the alignment. Night works will involve the installation of temporary lighting for safety and operational purposes which may also result in disturbance to sensitive aquatic fauna. Such effects are likely to result in a reduction in aquatic habitat quality and species diversity at the locations affected, and adjacent areas.

Introduction of contaminants into waterways

Construction activities have the potential to result in the introduction of contaminants into waterways, resulting in declines in water quality (e.g. from fuel spills). Similarly, the use of herbicides during future track maintenance has the potential to impact on vegetation living in and adjacent to waterways. An increase in access to aquatic habitat by people during construction (i.e. construction workforce) has the potential to result in litter being deposited within or adjacent to waterways. Such contaminants can be expected to reduce water quality and the quality of aquatic habitats in areas affected, and adjacent areas downstream.

Impacts on EVNT species

The Project is unlikely to have a significant impact on any EVNT species. While the Murray Cod has been confirmed to occur within parts of the impact assessment area, and is assumed to be present in the larger rivers with suitable habitat, potential impacts of the Project on the species are of a low magnitude and localised in scale. Clearing of riparian vegetation and disturbance of aquatic habitats will be minimised to discrete locations where crossings occur. The design of crossings will generally include bridges in areas suitable for Murray Cod (e.g. large rivers such as the Macintyre River). An assessment of impacts on the Murray Cod in relation to significant impact criteria in the MNES Significant Impact Guidelines 1.1 (DoE 2013) is provided in **Appendix E**.

The Project is also unlikely to have a significant impact on the Silver Perch, Bell's turtle or the Southern snapping turtle, as these species are unlikely to be present in the impact assessment area. Measures in place to reduce impacts on the Murray Cod will also benefit the Silver Perch, in the event that a small number of individuals utilise habitat within the impact assessment area from time to time. The western population of Agassiz's Glassfish is listed as endangered under NSW legislation and was confirmed to be present in the Macintyre River. The Project is unlikely to influence threatening processes for this species, which primarily relate to predation from introduced fish species, habitat degradation and rapid fluctuations in water level from regulated flows (NSW DPI 2013).

Table 39 Summary of potential impacts to aquatic ecology values

Aquatic Ecology Value	Delivery Phase	Description of potential impacts
Biodiversity and nature conservation	Pre-construction and construction	<u>Clearing of riparian vegetation</u> Removal of riparian and aquatic habitats including hollow-bearing trees, logs and burrows which will reduce the persistence of native species that utilise these habitats <u>Disturbance of aquatic habitat</u> Loss of submerged aquatic vegetation and woody debris, resulting in a reduction in aquatic habitat complexity and aquatic plant diversity River substrate disturbance (i.e. due to bridge or culvert construction) which may affect bottom dwelling aquatic flora and fauna and their associated habitats Loss of sensitive ecological processes through geomorphological alteration, including a change in photosynthesis and respiration rates from increases in sunlight and water temperature Mortality or displacement of EVNT species <u>Invasion of aquatic habitats by exotic pest species</u> Transmission and invasion of aquatic and terrestrial weeds (e.g. through vehicle and machinery movement) altering riparian and aquatic vegetation community composition <u>Disturbance of fauna from noise, vibration and lighting</u> Disturbance of aquatic fauna from noise, vibration and lighting <u>Changes to groundwater resources, affecting groundwater dependent ecosystems</u> Reduction in groundwater level, resulting in the loss of wetland habitat and an alteration of species composition within GDEs
	Operation	<u>Disturbance of aquatic habitat</u> Mortality or displacement of EVNT species <u>Invasion of aquatic habitats by exotic pest species</u> Transmission of aquatic and terrestrial weeds (through railway) may alter riparian vegetation community composition <u>Disturbance of fauna from noise, vibration and lighting</u>

Aquatic Ecology Value	Delivery Phase	Description of potential impacts
		Disturbance of aquatic fauna from noise, vibration and lighting
Riparian vegetation	Pre-construction and construction	Clearing of riparian vegetation Changes in community structure and composition due to clearing Reduction in shading and increase in light penetration into aquatic habitats, resulting in higher stream temperatures and conditions suitable for the proliferation of algae Invasion of aquatic habitats by exotic pest species Vegetation clearing allowing the colonisation of exotic species
	Operation	Invasion of aquatic habitats by exotic pest species Transmission of aquatic and terrestrial weeds (through railway) may alter riparian vegetation
Habitat connectivity	Pre-construction and construction	Altered hydrology Introduction of physical barriers to aquatic fauna movement through the construction of culverts, bridges, fencing and other infrastructure that affects the existing hydrological conditions Construction of temporary bunding to achieve a dry work area at creek crossings.
	Operation	Altered hydrology Introduction of physical barriers to aquatic fauna movement through the construction of culverts, bridges, fencing and other infrastructure that affects the existing hydrological conditions
Bank stability	Pre-construction and construction	Clearing of riparian vegetation Construction works involving disturbance to the riparian corridor may result in erosion and scouring of streambanks, which are an important component of aquatic habitats. This may result in unstable stream banks unable to support vegetation or tolerate extreme rainfall or flooding events. Disturbance of aquatic habitat Smothering of benthic aquatic habitat due to erosion, sediment transport and sediment deposition. Physical disturbance of stream beds and banks during construction of creek crossings

Aquatic Ecology Value	Delivery Phase	Description of potential impacts
		Invasion of aquatic habitats by exotic pest species Establishment of weeds such as Lippia (recorded in region) in new areas which out compete native species and affect the integrity of stream banks
	Operation	Invasion of aquatic habitats by exotic pest species Establishment of weeds such as Lippia (recorded in region) in new areas which out compete native species and affect the integrity of stream banks
Water quality	Pre-construction and construction	Sediment runoff into waterways Declines in water quality due to runoff from disturbed areas or discharge of water generated from construction activities (e.g. dewatering of a dry work area). This may include increased concentrations of suspended sediments, nutrients, metals and hydrocarbons, which may reduce the suitability of water to support environmental values (e.g. aquatic ecosystems and stock watering). Introduction of contaminants into waterways Spills of contaminants to waterways and in adjacent areas during works, resulting in pollution of local waterways and areas downstream and toxic effects on aquatic organisms. Spills of contaminants to groundwater, resulting in pollution of GDEs and toxic effects on aquatic organisms.
	Operation	Introduction of contaminants into waterways Spills of contaminants to waterways from train and associated infrastructure, resulting in pollution of local waterways and areas downstream and toxic effects on aquatic organisms.
Sediment quality	Pre-construction and construction	Introduction of contaminants into waterways Spills of contaminants to waterways and in adjacent areas during works, resulting in pollution of local waterways and areas downstream and toxic effects on aquatic ecosystems. Sediment runoff into waterways Physical disturbance of soils and mobilisation of contaminants (e.g. metals) to waterways from rainfall runoff, decreasing water quality. Increase in salinity from interplay between works, runoff and sodic or dispersive soils.

Aquatic Ecology Value	Delivery Phase	Description of potential impacts
	Operation	Introduction of contaminants into waterways Spills of contaminants to waterways and in adjacent areas during works, resulting in pollution of local waterways and areas downstream and toxic effects on aquatic ecosystems.
Water resources	Pre-construction and construction	Altered hydrology Changes in watercourse pathway and flow characteristics, including the alteration of habitat composition (ponding, channels and dry creek beds) and flow regime. Changes in water availability: riparian community structure and species composition. Temporary changes in hydrology through bunding to create a dry work area.
	Operation	Altered hydrology Changes in watercourse pathway and flow characteristics, including the alteration of habitat composition (ponding, channels and dry creek beds) and flow regime. Changes in water availability: riparian community structure and species composition. Altered flow regimes which result in changes to aquatic ecology and surface water.

5.2 Mitigation measures

5.2.1 Mitigation through the reference design phase

Development of the reference design has progressed in parallel with the impact assessment process. As a consequence, design solutions for avoiding, minimising or mitigating impacts have been incorporated into the reference design as appropriate and where possible.

Mitigation measures and controls that are relevant to aquatic ecology and have been factored into the reference design, or otherwise implemented by the Project, are summarised in **Table 40**.

Table 40 Initial mitigations of relevance to aquatic ecology

Aquatic ecology value	Initial mitigation measures
Biodiversity and nature conservation Riparian vegetation	• The Project has been positioned to maximise the use of existing rail corridors and to be co-located with existing road infrastructure, where possible. Co-location with existing linear infrastructure minimises the need to develop natural and rural landscapes that have not previously been subject to disturbance for a similar purpose • Greenfield components of the Project have been aligned to minimise: - the extent of impact to remnant vegetation and - the extent of impact to areas of known habitat potential - the number of watercourses and waterways traversed by the Project • The Project footprint has been restricted to what is anticipated to be required to construct, operate and maintain the works in a safe and efficient manner. Restricting the footprint minimises the extent of disturbance required to vegetation and habitats • Greenfield components of the Project have been aligned to minimise the extent of impact to remnant vegetation, and the number of watercourses and waterways traversed by the Project. Clearing of remnant vegetation will be restricted to the minimum required to enable the safe construction, operation and maintenance of the rail corridor, including minimising the disturbance of sensitive areas such as: - Habitat for critically endangered, endangered and vulnerable flora and fauna species - Critically endangered and endangered Threatened Ecological Communities - Riparian vegetation - Steep slopes - Along river banks • The Project has been developed to minimise impacts to watercourses, waterways, riparian vegetation and in-stream flora and habitats by adopting a crossing structure hierarchy where bridges are preferred to culverts, where practical • Bridge structures are provided in the reference design over the following watercourses and waterways, to minimise disturbance of aquatic habitats:

Aquatic ecology value	Initial mitigation measures
	Macintyre River, Macintyre Brook, Pariagara Creek, Cattle Creek, Native Dog Creek, Bringalily Creek, Nicol Creek, Back Creek, Grasstree Creek, Condamine River, Condamine River North Branch, Westbrook Creek and Dry Creek. Further details on the location and length of bridge structures is provided in the Hydrology and Flooding Technical Report (Appendix Q1 and Q2 of the draft EIS) and reference design drawings (Volume III of the draft EIS)
Bank stability Water quality	• The Project footprint has been established to accommodate temporary (i.e. sediment control basins) and permanent (i.e. scour protection, vegetated swales) erosion and sediment control devices during construction and operation of the Project • Bridges have been designed to minimise impacts to the bed, banks and environmental flows of waterways in accordance with requirements of the *Fisheries Act 1994* • Scour and erosion protection measures have been incorporated into the design in areas determined to be at risk, such as around culvert headwalls, drainage discharge pathways and bridge abutments
Habitat connectivity	• Waterway crossing structures (including culverts and bridges) have been designed to maintain aquatic fauna (e.g. for Silver Perch and Murray Cod) passage and minimise the risk of blockages in reference to the Accepted development requirements for operational work that is constructing or raising waterway barrier works (1 October 2018; DAF 2018) • The Project incorporates bridge and culvert structures to maintain existing flow paths and flood flow distributions, such as across the Condamine River floodplain where six bridges have been incorporated into the design with a combined length of 6 km
Water resources	• Bridge and culvert structures have been located and sized to avoid increases in peak water levels, velocities and duration of inundation • No watercourses, as defined and mapped under the *Water Act 2000*, are required to be diverted by the Project. A watercourse determination may be required for works affecting watercourses that are not mapped under the *Water Act 2000*. ARTC is an approved entity for the purpose of the Department of Natural Resources, Mines and Energy Riverine Protection Permit exemption requirements, and works can be undertaken providing that they meet the guidelines of the exemption.

5.2.2 Proposed mitigation measures

In order to manage and mitigate Project risks, additional mitigation measures have been proposed for implementation in future phases of Project delivery. These proposed mitigation measures have been identified to address Project-specific issues and opportunities including legislative requirements and accepted government plans, policy and practices.

Mitigation measures been proposed for implementation in future phases of Project delivery have been grouped and presented, as follows:

- **Table 41** identifies overarching mitigation and management measures for all ecological values
- **Table 42** provides mitigation measures specific to MNES and MSES aquatic ecological receptors that occur within the Project footprint.

The mitigation measures presented in **Table 41 and Table 42** have been considered in the assessment of residual risk, as documented in **Section 5.3**.

Table 41 Aquatic ecology and surface water quality mitigation measures

Delivery phase	Aquatic ecology value and potential impacts	Mitigation and management measures
Detail design	Value Biodiversity and nature conservation Potential impacts Clearing of riparian vegetation Disturbance of aquatic habitat Invasion of aquatic habitats by exotic pest species	▪ The Project will be refined during detail design to minimise the footprint to the extent required for the construction works and safe operation and maintenance of the Project. Confirmation of the construction approach will be achieved through the engagement of a construction contractor. ▪ A Biodiversity Management Sub-plan will be developed as part of the CEMP. This plan should include appropriate criteria, directives and procedures in relation to: – Requirements for pre-clearing surveys, including aquatic and riparian habitats – Staging works so that they avoid breeding periods of the Murray Cod (September and October) as much as possible within areas of habitat (large waterways) – Staged and sequential clearing protocols – Animal handling protocols (e.g. for freshwater turtle species), including relocation and emergency care – Relocation of plants and habitats, including instream woody debris (where applicable) – Requirements for inspections and corrective actions during construction and rehabilitation activities – Biodiversity/fauna and flora management actions to be undertaken by suitably qualified persons – Requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction. – Corrective actions should the outcomes not achieve to the objectives adopted ▪ Construction areas including compounds, stockpiles, fuel storage areas, laydown areas and staff parking will be located and established outside the tree protection zone as defined in AS4970-2009 Protection of trees on development sites. ▪ Develop a Soil Management Sub-plan which includes the following procedures and protocols relevant to potential impacts on land resources: – Soil/land conservation objectives for the Project – Management of problem soils, such as: ▪ Acid sulfate soils, which may occur in proximity to wetland features and water storages, and have a low potential to occur within the impact assessment area.

		■ Erosive or dispersive soils, such as sodosols that are expected to be encountered between the Macintyre River and Yelarbon as well as along the fertile lands north of Inglewood to the west of Kooroongarra ■ Cracking clays (vertosols) that are expected to be encountered between Kooroongarra and Millmerran and from Yandilla to Gowrie ■ Saline soils, particularly in high salinity hazard areas such as between Kurumbul and Yelarbon. – Specification of the type and location of erosion and sediment controls (see below) – Stockpiling and management/segregation of topsoil where it contains native plants seedbank or weed material – Vehicle, machinery and imported fill hygiene protocols and documentation, in accordance with the requirements of the *Biosecurity Act 2014* – Requirements for training, inspections, corrective actions, notification and classification of environmental incidents, record keeping, monitoring and performance objectives for handover on completion of construction. ■ A Rehabilitation and Landscaping Management Sub-plan will be developed for the Project, as a component of the CEMP. This Sub-plan will establish the following: – Location-specific objectives for rehabilitation, reinstatement and/or stabilisation. Objectives will differ for within the rail corridor and outside of the rail corridor. Rehabilitation requirements for watercourses and waterways will be in accordance with the intent of: ■ Riverine protection permit exemption requirements (WSS/2013/726) ■ Accepted development requirements for operational work that is constructing or raising waterway barrier works (DAF 2018), including requirements for the duration of works and the dimensions and design of culverts and other instream structures. – Timeframes for rehabilitation and/or reinstatement/stabilisation works to be achieved – Details of the actions and responsibilities to progressively rehabilitate, regenerate, and/or revegetate areas, consistent with the agreed objectives – Consideration for maintenance or performance issues of rehabilitation e.g. vegetation that does not grow and obscure signals or impact the longevity of rail infrastructure – Procedures, timeframes, measurable performance objectives and responsibilities for monitoring the success of rehabilitation and/or reinstatement/stabilization areas – Corrective actions should the outcomes not achieve to the objectives adopted

Delivery phase	Aquatic ecology value and potential impacts	Mitigation and management measures
		– Where temporary construction facilities/borrow pits are required, land shall be returned to stable condition that complies with the conditions of applicable landowner agreements and regulatory approvals, e.g. Development Approval and/or Environmental Authority (EP Act) – Constructed landscape treatments shall be classified by type and documented to enable ongoing data management for life of the Project (i.e. beyond design). ▪ A Biosecurity Management Sub-plan will be developed as a component of the CEMP. This Sub-plan will include: – Requirements for pre-clearing and operational surveys to determine the risk of weeds (e.g. Lippia) or pest animals (e.g. *Gambusia holbrooki*, Cane Toad) being present – Maps of the existing extent, confirmed through surveys, and severity of weed infestation and weed management requirements – Site hygiene and waste management procedures to deter pest animals – Weed surveillance and treatment during construction and rehabilitation activities – Requirements in relation to pesticide and herbicide use, including any limitations on use. Restrictions may apply in proximity to waterways, known areas of MNES or MSES habitat or land uses sensitive to spray-drift from the application of pesticides and herbicides – Vehicle, machinery and imported fill hygiene protocols and documentation – Erosion and sediment control risks associated with broad scale weed removal or treatment. – Corrective actions should the measures not achieve the adopted objectives.
	<u>Value</u> Water resources <u>Potential impacts</u> Altered hydrology	▪ Design modifications during detail design will be subject to re-runs of the existing flood models to demonstrate continued compliance with the design objectives of the Project, including for extent and time of inundation, afflux and flow velocities.
	<u>Value</u> Habitat connectivity Bank stability <u>Potential impacts</u> Disturbance of aquatic habitat	▪ Where the Project is unable to comply with the Accepted development requirements for operational work that is constructing or raising waterway barrier works (DAF 2018), a development approval for operational work that is constructing or raising waterway barrier works will be required ▪ ARTC is an approved entity for the purpose of the Department of Natural Resources, Mines and Energy Riverine Protection Permit exemption requirements (DNRME 2019). Where the Project is

Delivery phase	Aquatic ecology value and potential impacts	Mitigation and management measures
	Altered hydrology Sediment runoff into waterways	unable to comply with the exemption requirements, a riverine protection permit will be required for works within a watercourse. ▪ The detail design will be developed so that no watercourses, as defined and mapped under the *Water Act 2000*, are required to be diverted for the Project. ▪ The detail design will be developed to ensure that the potential for diversion of waterways as defined under the *Fisheries Act 1994* and mapped according to the spatial data layer, Queensland waterways for waterway barrier works, is minimised ▪ Design modifications during the detail design will be subject to re-runs of the existing flood models to demonstrate continued compliance with the design objectives of the Project, including for extent and time of inundation, afflux and flow velocities. ▪ A Soil Management Sub-plan, inclusive of erosion and sediment controls, and Surface Water Management Sub-plan will be developed as components of the CEMP.
	<u>Value</u> Water quality <u>Potential impacts</u> Sediment runoff into waterways Introduction of contaminants into waterways Invasion of aquatic habitats by exotic pest species	▪ A Surface Water Management Sub-plan will be developed as a component of the CEMP. The Sub-plan will provide a surface water monitoring framework for the Project that establishes: – Additional monitoring and sampling required to establish baseline water quality conditions, as a continuation of data collected during existing environment within the draft EIS. Baseline water quality conditions will preferentially utilise water quality monitoring sites used within the draft EIS, with consideration of construction activities, seasonality and waterway sensitivity. These will be monitored, at a minimum monthly, for a period of 12-24 months prior to construction to determine baseline conditions as a reference for monitoring of impact (as per *Queensland Water Quality Guidelines* 2009). – Waterway-specific water quality criteria, based on baseline data, ANZECC/ARMCANZ, QWQG and relevant WQOs – Frequency and location of surface water sampling during construction of the Project, with consideration for: ▪ Construction activities with potential to impact water quality ▪ Seasonality ▪ Sensitivity of receiving waterway – Further details of the surface water monitoring framework are provided in the Surface Water Quality Technical Report (Appendix P of the draft EIS)

Delivery phase	**Aquatic ecology value and potential impacts**	**Mitigation and management measures**
		– A risk management framework for evaluation of the risks to surface water quality and ecosystems in the receiving environment, including definition of instances (including accidental discharge of contaminants and sediments) that trigger contingency and ameliorative measures – *In situ* water quality parameters and laboratory analysis required for samples collected at each sampling location – QA/QC requirements for surface water sampling and analysis – Location specific impact thresholds – Responses to impact threshold exceedances (to be determined after the establishment of baseline water quality conditions) – Data management and reporting requirements ▪ Dewatering of surface water storages, including private dams, will be required to comply with the *Biosecurity Act 2014* to take reasonable measure to avoid the spread of pest species (with capacity to affect water quality). A strategy for managing dewatering in order to meet water quality objectives will be required. ▪ Dewatering/extraction of water from artificial impoundments will be undertaken after consultation with relevant stakeholders (e.g. impoundment owners) with relevant approvals (water plans under *Water Regulation 2016*) and agreements obtained.
Pre-construction	<u>Value</u> Biodiversity and nature conservation Riparian vegetation <u>Potential impacts</u> Clearing of riparian vegetation Disturbance of aquatic habitat Invasion of aquatic habitats by exotic pest species	▪ The Biodiversity Management Sub-plan, as a component of the CEMP, will be implemented (refer above). ▪ Protected plant surveys, in accordance with the requirements of the NC Act, will be undertaken as required in support of pre-construction enabling works. Such works may include additional geotechnical investigations to confirm the viability of borrow pit locations, re-fencing works or the establishment of accommodation camps. ▪ Prior to any pre-construction clearing works being undertaken, the clearing extents/site boundary/limit of works will be clearly defined with flagging or marking tape. 'No go' areas will also be marked. ▪ A qualified Fauna Spotter Catcher will undertake pre-clearance surveys of vegetation. ▪ The Fauna Spotter Catcher will supervise the subsequent clearing of vegetation. ▪ The significant adverse residual impact to habitat for MNES and MSES will be confirmed for the Project at the conclusion of the detail design process and once the Project footprint is confirmed. ▪ Re-calculated impacts will be used to confirm the Project's offset obligations under Commonwealth and State requirements

Delivery phase	Aquatic ecology value and potential impacts	Mitigation and management measures
		■ A Draft Environmental Offsets Delivery Strategy - Queensland has been prepared for the Project (refer Appendix N: Draft offset strategy of the draft EIS). The Draft Environmental Offsets Delivery Strategy - Queensland will be revised and finalised to reflect significant residual impacts calculated at the conclusion of the detail design phase. The finalised Environmental Offsets Delivery Strategy will provide for the staged delivery of offsets where appropriate, ahead of relevant clearing works being undertaken. The Environmental Offsets Delivery Strategy will be finalised in consultation with relevant Commonwealth and State regulatory agencies, including the Department of Agriculture, Water and the Environment (Commonwealth) and DES (Queensland). ■ The Rehabilitation and Landscape Management Sub-plan, as a component of the CEMP, will be implemented (refer above) ■ Undertake pre-construction survey and mapping of weeds within the Project footprint, in accordance with the Biosecurity Management Sub-plan (refer above)

Delivery phase	Aquatic ecology value and potential impacts	Mitigation and management measures
Construction	Value Biodiversity and nature conservation Riparian vegetation Potential impacts Clearing of riparian vegetation Disturbance of aquatic habitat	▪ Prior to any construction clearing works being undertaken, the clearing extents/site boundary/limit of works will be clearly defined with flagging or marking tape. 'No go' areas will also be marked. ▪ A qualified Fauna Spotter Catcher will undertake pre-clearance surveys of vegetation. ▪ The Fauna Spotter Catcher will supervise the subsequent clearing of vegetation. ▪ Clearing extents will be limited to that required to undertake and operate the works, avoiding impacts to native vegetation and habitats as far as practicable. ▪ The Rehabilitation and Landscape Management Sub-plan, as a component of the CEMP, will be implemented (refer above). Rehabilitation and landscaping will occur sequentially as work fronts are completed. ▪ The salvage and relocation of fish will be managed in accordance with DAF Guidelines for Fish Salvage. ▪ An appropriately qualified person will be consulted to make an assessment on the method of recovery, transport and release of fish and other aquatic fauna, as required. As a minimum, the following will be implemented: – Relocation will be undertaken by a suitably qualified person – Dewatering pumps will have an intake screen – Records of all fish recovered and the location of their release will be maintained. ▪ In the event of a spill incident during construction, any impacted aquatic environments will be assessed for the presence of fauna. If necessary, salvage and recovery efforts will be undertaken.
	Value Biodiversity and nature conservation Riparian vegetation Potential impacts Introduction of contaminants to waterways Altered hydrology	▪ Plant maintenance activities and refuelling must be carried out a minimum of 50 m from riparian vegetation and waterways, where practical, with appropriate interception measures in place to avoid impacts to waterways, aquatic habitats, and groundwater. ▪ Works within or adjacent to watercourses will be conducted in accordance with: – Riverine protection permit exemption requirements (WSS/2013/726) or conditions of a riverine protection permit issued for the Project – Accepted development requirements for operational work that is constructing or raising waterway barrier works (DAF 2018) or conditions of development approval for operational work that is constructing or raising waterway barrier works.
	Value	▪ Construction tasks will be scheduled to avoid, where possible, bulk earthwork activities within the 1% AEP during periods of elevated flood risk. Where works cannot be scheduled outside of this

Delivery phase	Aquatic ecology value and potential impacts	Mitigation and management measures
	Water quality Sediment quality <u>Potential impacts</u> Sediment runoff into waterways Introduction of contaminants into waterways	time period, activity-specific flood readiness and response planning will be required. This planning will be developed in consultation with the relevant local government and QFES during the construction phase, to reduce the potential for sediment discharge into waterways. ▪ Laydown areas and other construction facilities that are located within the 1% AEP will be temporary. Their planning and function in supporting construction will reflect the local flood risk. For example, hazardous goods will not be bulk stored in these locations. ▪ Mobile plant will not be stored in the 1% AEP when not scheduled for, or in use for construction purposes. ▪ Surface water monitoring will be undertaken in accordance with the monitoring procedure established in the Surface Water Management Sub-plan, as a component of the CEMP. ▪ In the event that water quality objectives cannot be achieved for waters to be released, alternate treatment/disposal options are to be implemented to achieve the water criteria relevant for the waterway in question (refer to **Section 2.3**). ▪ The Soil Management Sub-plan, including erosion and sediment control plans, will be implemented as a component of the CEMP (refer above). ▪ ARTC's Enviroline will be advertised for the Project to enable members of the public to notify ARTC of issues, including concerns regarding erosion and sediment control.
	<u>Value</u> Biodiversity and nature conservation Riparian vegetation <u>Potential impacts</u> Invasion of aquatic habitats by aquatic species	▪ The Biosecurity Management Sub-plan, as a component of the CEMP, will be implemented (refer above). ▪ The effectiveness of weed hygiene measures will be monitored as a component of the environmental monitoring procedure for the Project. ▪ Any vegetated material containing, or with the potential to contain, weed seed material will not be used for on-site mulching or erosion protection. ▪ ARTC's Enviroline will be advertised for the Project to enable members of the public to notify ARTC of issues, including concerns regarding weeds and pests.
Operation	<u>Value</u> Biodiversity and nature conservation Riparian vegetation: <u>Potential impacts</u>	▪ Maintenance activities and refuelling must be carried out a minimum of 20 m from riparian vegetation and waterways, with appropriate interception measures in place to avoid impacts to waterways, aquatic habitats, and groundwater. ▪ Works within or adjacent to watercourses and waterways will be conducted in accordance with the intent of:

Delivery phase	Aquatic ecology value and potential impacts	Mitigation and management measures
	Introduction of contaminants into waterways Disturbance of aquatic habitat Altered hydrology Invasion of aquatic habitats by exotic pest species	– Riverine protection permit exemption requirements (WSS/2013/726) or conditions of a riverine protection permit issued for the Project – Accepted development requirements for operational work that is constructing or raising waterway barrier works (DAF 2018) or conditions of development approval for operational work that is constructing or raising waterway barrier works. ▪ Weed management protocols for the operational rail corridor and other ARTC facilities will be in accordance with the requirements of the *Biosecurity Act 2014* and incorporated into the Operation Environmental Management Plan. These protocols will include: – Site hygiene and waste management procedures to deter pest animals – Weed surveillance and treatment during operation and maintenance activities – Requirements in relation to pesticide and herbicide use, including any limitations on use. Restrictions may apply in proximity to waterways, known areas of MNES or MSES habitat or land uses sensitive to spray-drift from the application of pesticides and herbicides – Vehicle, machinery and imported fill hygiene protocols and documentation – Erosion and sediment control risks associated with broad scale weed removal or treatment. – Corrective actions should the outcomes not achieve the adopted objectives ▪ ARTC's Enviroline will be advertised for the Project to enable members of the public to notify ARTC of issues, including concerns regarding weeds and pests.

Table 42 Impact mitigation measures specific to aquatic MNES and MSES that occur in the Project footprint

Sensitive environmental receptor	Project phase	Receptor-specific mitigation and management measures (in addition to those specified in Table 41)
Murray cod	**Construction**	▪ Construction activities scheduled to avoid/minimise instream works and associated riparian habitat in identified habitat, where possible. ▪ Construction works will, where possible, take place outside of the wet season when flows in floodplain systems are more likely ▪ Pre-construction surveys of watercourse crossings that are identified as potential habitat if suitable waterholes are present (i.e. Condamine River floodplain channels and Macintyre River) to identify whether the species occurs. Surveys will follow the Survey guidelines for Australia's threatened fish (DSEWPaC 2011b). ▪ Where a temporary impoundment or diversion is required for construction purposes and the species is found to be present, an appropriately qualified person will be consulted to make an assessment on the method of recovery, transport and release of fish and will follow relevant State (DAF) fish salvage guidelines during construction activities. ▪ Where possible, instream habitat will be reinstated to pre-construction state (e.g. replacement of large woody debris and ensure no or limited change to instream flows and allow fish passage). ▪ Implementation of the Biosecurity Management Sub-plan, Soil Management Sub-plan and the Surface Water Management Sub-plan.
	Operation	▪ Maintenance of erosion and sediment controls within the rail corridor with specific reference to maintaining the pre-construction condition watercourses and drainage features that adjoin the rail corridor. ▪ Maintenance of the effectiveness of cross drainage structure (e.g. culverts) to ensure continued connectivity of watercourses and drainage features that are aligned across the rail corridor.
Platypus	**Construction**	▪ Construction activities scheduled to avoid/minimise instream works and associated riparian habitat in identified habitat, where possible. ▪ Construction works will, where possible, take place outside of the wet season when flows in floodplain systems are more likely ▪ Pre-construction surveys of watercourse crossings that are identified as potential habitat if suitable waterholes are present (i.e. Condamine River floodplain channels and Macintyre River) to identify whether the species occurs. ▪ Where a temporary impoundment or diversion are required for construction purposes and the species is found to be present, an appropriately qualified person will be consulted to make an assessment on the requirement for a species management program should breeding places (i.e. burrows) be present.

Sensitive environmental receptor	Project phase	Receptor-specific mitigation and management measures (in addition to those specified in Table 41)
		▪ Where possible, instream habitat will be reinstated to pre-construction state (e.g. replacement of large woody debris and ensure no or limited change to instream flows and passage). ▪ Implementation of the Biosecurity Management Sub-plan, Soil Management Sub-plan and the Surface Water Management Sub-plan.
	Operation	▪ Maintenance of erosion and sediment controls within the rail corridor with specific reference to maintaining the pre-construction condition watercourses and drainage features that adjoin the rail corridor. ▪ Maintenance of the effectiveness of cross drainage structure (e.g. culverts) to ensure continued connectivity of watercourses and drainage features that are aligned across the rail corridor.

5.3 Impact assessment

Potential impacts to aquatic ecology values associated with the Project in the pre-construction, construction and operation phases are outlined in **Table 43**. These impacts have been subjected to a significance assessment as per the methodology detailed in **Section 3.8**, based on the sensitivity of aquatic ecology values to the potential impact, and the likely magnitude of the impact. Each of the potential impacts to aquatic ecology values in **Table 39** has been carried forward into the significance assessment presented in **Table 43**.

Results of the significance assessment are also summarised in **Table 44** for the pre-construction and construction phases of the Project, from the perspective of the key aquatic ecology values identified in **Table 39**. Significance ratings are derived from the highest residual significance as assessed in **Table 43**, and provide a summary of how environmental significance varies across aquatic ecology values and the various modes of potential impact from Project construction activities. Residual significance associated with the pre-construction and construction phase was higher than the operation phase for all aquatic ecology values, with the exception of habitat connectivity and bank stability.

The initial significance assessment was undertaken on the assumption that the design considerations (or initial mitigation measures) factored into the reference design phase (**Table 40**) have been implemented. Additional mitigation and management measures, including those listed in relevant management plans, were then applied as appropriate to the phase of the Project to reduce the level of potential impacts. These are documented in **Section 5.2.2** (**Table 41 and Table 42**).

The residual risk level of the potential impacts was then reassessed after mitigation and management measures in **Table 41** and **Table 42** were applied. The pre-mitigated risk levels were compared with the residual risk levels in order to assess the effectiveness of the mitigation and management measures.

The assessment has identified that the significance of impacts to aquatic ecology and associated surface water quality values range from Negligible to Moderate (**Table 44**). The following impacts were assessed to be the highest risk (moderate):

- Invasion of aquatic habitats by weed and pest species during the construction phase
- Declines in water and sediment quality from bank erosion, and the runoff of sediments and contaminants into waterways during the construction phase.

These impacts were considered to be the highest risk to aquatic ecology values, due to the relatively disturbed nature of the impact assessment area, and the potential for Project-related activities to result in further deterioration of aquatic ecology values.

The residual significance of other potential impacts on aquatic ecology values (i.e., potential impacts other than those related to biosecurity and the quality of water and sediment) was assessed to be Negligible or Low.

The residual significance of changes to groundwater levels on GDEs was assessed to be Low, due to the temporary nature of potential impacts during the construction phase, and availability of engineering design controls to reduce the extent of impacts. Existing hydrogeological and processes sustaining GDEs and wetlands are unlikely to be affected by the Project.

There will be some impacts on riparian vegetation, and on the interaction between terrestrial and aquatic ecosystems (e.g. through a reduction in shading of waterways by riparian vegetation). However, the localised scale of such impacts resulted in a residual significance rating of Low.

The residual significance of changes in hydrology and flood plain inundation were assessed to be Negligible during construction and Low during operations. This is primarily a result of the large number of bridges and culverts included in the reference design for the project, which will minimise changes to existing hydrological conditions which facilitate migration of aquatic fauna and connectivity across the flood plains of the impact assessment area.

With the implementation of appropriate environmental management and design practices (**Table 40, Table 41 and Table 42**), impacts will be minimised or confined to the localised area. Key mitigation measures to reduce impacts on aquatic ecology values include:

- Designing waterway crossings to avoid disturbance of aquatic habitats, avoid obstructions to fauna passage and minimise alterations to the natural hydrological regime. This will be achieved through use of bridge designs in preference to culverts or through application of the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF 2018)
- Erosion and sediment control measures, such as the storage of soil stockpiles away from waterways and the use of silt fences, will reduce the potential for construction activities to add to existing high concentrations of TSS in local aquatic habitats. The cumulative effect of the Project with existing agricultural practices will be important to take into consideration when designing and implementing management plans
- Spills and the discharge of contaminants to waterways will be avoided, and rapidly cleaned up when they occur. This will maintain existing water quality values, which are characterised by low concentrations of dissolved metals and organic contaminants, which may be toxic to biota.

Table 43 Results of significance assessment for impacts on aquatic ecology

Potential Impact (and associated aquatic ecology value)	Phase	Initial significance[1]			Residual Significance[2]	
		Sensitivity	Magnitude	Significance	Magnitude	Significance
Biodiversity and nature conservation Removal of riparian and aquatic habitats including hollow-bearing trees, logs and burrows which will reduce the persistence of native species that utilise these habitats Loss of submerged aquatic vegetation and woody debris, resulting in a reduction in aquatic habitat complexity and aquatic plant diversity River substrate disturbance (i.e. due to bridge or culvert construction) which may affect bottom dwelling aquatic flora and fauna and their associated habitats Loss of sensitive ecological processes through geomorphological alteration, including a change in photosynthesis and respiration rates from increases in sunlight and water temperature Reduction in groundwater level, resulting in the loss of wetland habitat and an alteration of species composition within GDEs	Pre-construction and construction	Moderate	Moderate	Moderate	Low	Low
	Operation		Negligible	Low	Negligible	Low
Biodiversity and nature conservation Transmission and invasion of aquatic and terrestrial weeds (e.g. through vehicle and machinery movement) altering riparian and aquatic vegetation community composition	Pre-construction and construction	Moderate	High	High	Moderate	Moderate
	Operation		Low	Low	Low	Low
Biodiversity and nature conservation Disturbance of aquatic fauna from noise, vibration and lighting	Pre-construction and construction	Low	Moderate	Low	Low	Negligible
	Operation		Low	Negligible	Negligible	Negligible
Biodiversity and nature conservation Mortality or displacement of EVNT species.	Pre-construction and construction	Moderate	Moderate	Moderate	Low	Low
	Operation		Low	Low	Low	Low
Riparian vegetation Changes in community structure and composition due to clearing	Pre-construction and construction	Moderate	Moderate	Moderate	Low	Low

Potential Impact (and associated aquatic ecology value)	Phase	Initial significance[1]			Residual Significance[2]	
		Sensitivity	Magnitude	Significance	Magnitude	Significance
Vegetation clearing allowing the colonisation of exotic species Reduction in shading and increase in light penetration into aquatic habitats, resulting in higher stream temperatures and conditions suitable for the proliferation of algae Transmission of aquatic and terrestrial weeds (through railway) may alter riparian vegetation	Operation		Negligible	Low	Negligible	Low
Habitat connectivity Introduction of physical barriers to aquatic fauna movement through the construction of culverts, bridges, fencing and other infrastructure that affects the existing hydrological conditions Construction of temporary bunding to achieve a dry work area at creek crossings.	Pre-construction and construction	Low	Moderate	Low	Low	Negligible
	Operation	Moderate	Moderate	Moderate	Low	Low
Bank stability Construction works involving disturbance to the riparian corridor may result in erosion and scouring of streambanks, which are an important component of aquatic habitats. This may result in unstable stream banks unable to support vegetation or tolerate extreme rainfall or flooding events. Smothering of benthic aquatic habitat due to erosion, sediment transport and sediment deposition. Physical disturbance of stream beds and banks during construction of creek crossings Establishment of weeds such as Lippia (recorded in region) in new areas which out compete native species and affect the integrity of stream banks	Pre-construction and construction	Moderate	Moderate	Moderate	Low	Low
	Operation	Low	Moderate	Low	Low	Negligible

Potential Impact (and associated aquatic ecology value)	Phase	Initial significance[1]			Residual Significance[2]	
		Sensitivity	Magnitude	Significance	Magnitude	Significance
Water quality and sediment quality Declines in water quality due to runoff from disturbed areas or discharge of water generated from construction activities (e.g. dewatering of a dry work area). This may include increased concentrations of suspended sediments, nutrients, metals and hydrocarbons, which may reduce the suitability of water to support environmental values (e.g. aquatic ecosystems and stock watering). Spills of contaminants to waterways and in adjacent areas during works, resulting in pollution of local waterways and areas downstream and toxic effects on aquatic organisms.	Pre-construction and construction	Moderate	Moderate	Moderate	Moderate	Moderate
Spills of contaminants to groundwater, resulting in pollution of GDEs and toxic effects on aquatic organisms. Spills of contaminants to waterways from train and associated infrastructure, resulting in pollution of local waterways and areas downstream and toxic effects on aquatic organisms. Physical disturbance of soils and mobilisation of contaminants (e.g. metals) to waterways from rainfall runoff, decreasing water quality. Increase in salinity from interplay between works, runoff and sodic or dispersive soils.	Operation		Negligible	Low	Negligible	Low
Water resources Changes in watercourse pathway and flow characteristics, including the alteration of habitat composition (ponding, channels and dry creek beds) and flow regime. Changes in water availability: riparian community structure and species composition.	Pre-construction and construction	Low	Medium	Low	Low	Negligible
Temporary changes in hydrology through bunding to create a dry work area. Altered flow regimes which result in changes to aquatic ecology and surface water.	Operation	Moderate	Moderate	Moderate	Low	Low

1. Includes implementation of initial mitigation measures specified in **Table 40**
2. Assessment of residual risk once the mitigation measures identified in **Table 41** and **Table 42**

Table 44 Residual significance assessment

Aquatic Ecology Value	Potential Impact	Residual significance (Pre-construction and construction phases)
Biodiversity and nature conservation	Disturbance of aquatic habitat Changes to groundwater resources, affecting groundwater dependent ecosystems	Low
	Invasion of aquatic habitats by exotic pest species	Moderate
	Disturbance of fauna from noise, vibration and lighting	Negligible
	Impacts on EVNT species	Low
Riparian vegetation	Clearing of riparian vegetation	Low
Habitat connectivity	Disturbance of aquatic habitat Altered hydrology	Negligible
Bank stability	Sediment runoff into waterways Altered hydrology	Low
Water quality Sediment quality	Sediment runoff into water courses Introduction of contaminants into waterways	Moderate
Water resources	Altered hydrology	Negligible

5.4 Cumulative impacts on aquatic and surface water values

Twenty three projects were initially identified as having potential to contribute to cumulative impacts in combination with the Border to Gowrie project (**Table 10**). These projects are either currently operational, expected to undergo future expansion or are currently going through an approval process. Of these, five projects were considered to be relevant to the assessment of impacts on aquatic ecology values (**Table 45**).

Projects relevant to the assessment of cumulative impacts are those that will be constructed or expanded in the future, and may cause impacts to existing aquatic ecology values that are additive to impacts from the Project. Examples of aquatic ecology values that may be affected include water quality (increases in turbidity and the concentration of nutrients and metals) and additional disturbance to the habitats of aquatic fauna over a broad geographic area within the Murray Darling Basin. Only five of the initial 23 projects identified meet these criteria, as listed in **Table 45**.

Table 45 Projects considered for the cumulative impact assessment

Projects	Location	Description	Construction dates [1]
New Acland Coal Mine Stage 3	35 km northwest of Toowoomba 18 km north of the Project footprint	Expansion of the existing New Acland open-cut coal mine to up to 7.5 Mtpa.	2019-TBC
Goondiwindi Abattoir	Goondiwindi, QLD 13 km north of the Project footprint	A new beef abattoir located on the outskirts of Goondiwindi with beef processing of up to 72,000 tonnes per year.	TBC Approved with conditions by Goondiwindi Regional Council
Wyemo Piggery	Texas-Yelarbon Road, Glenarbon 8 km south of the Project footprint	A new intensive piggery, with approval for 55,000 pig units	TBC Approved with conditions by Goondiwindi Regional Council
North Star to NSW/QLD Border (Inland Rail)	Rail alignment from North Star, NSW to the NSW/QLD border Adjoins the Project at its southern limit	New 37 km rail corridor to connect North Star (NSW) to the Queensland Rail South West Rail Line just over the NSW/QLD border.	2021 – 2024
Gowrie to Helidon (Inland Rail)	Rail alignment from Gowrie to Helidon, QLD Adjoins the Project at its northern limit	New 26km dual gauge track between Gowrie (north-west of Toowoomba) and Helidon (east of Toowoomba), extending through the Local Government Areas of Toowoomba and Lockyer Valley. The Project includes a 6.38 km tunnel to create an efficient route through the steep terrain of the Toowoomba Range.	2021 – 2025

1 TBC – To be confirmed

The projects listed in **Table 45** were identified for their potential to have cumulative impacts on aquatic ecology values for the following reasons:

- Expansion of the existing New Acland Coal Mine has the potential to impact aquatic ecology and surface water quality values in sections of the Murray Darling Basin located downstream from the Project. The proposed mine expansion is located approximately 25 km to the north of Gowrie, at the eastern extent of the Project.
- The approved Goondiwindi Abattoir which will process 72,000 tonnes of beef per year is located on the Cunningham Highway approximately 30 km west of Yelarbon near the southern extent of the Project. The abattoir project has the potential to influence water quality in sections of the Murray Darling Basin located downstream from the Project.
- The Wyemo Piggery involves the intensive production of pork and is located on Texas-Yelarbon Road, Glenarbon, approximately 8 km south of the Project. The piggery project has the potential to influence water quality in sections of the Murray Darling Basin located upstream of the Project (Dumaresq River).
- The North Star to NSW/QLD Border and Gowrie to Helidon sections of the Inland Rail Program are located immediately adjacent to the Project and are likely to influence waterways immediately adjacent to and downstream of the Project in the Murray Darling Basin. These projects occur over smaller areas than the Border to Gowrie project, with large parts of the Gowrie to Helidon project located in coastal catchments east of the Great Dividing Range, and therefore of limited relevance to the assessment of cumulative impacts.

Following consideration of the probability of impact, duration of impact, magnitude of impact and sensitivity of the receiving environment, the significance of cumulative impacts from other projects was assessed to be low (**Table 46**). The basis of the assessment is summarised as follows:

- The probability of impact was assessed as Low for all five other projects. The New Acland Coal Mine Stage 3, the Goondiwindi Abattoir and the Wyemo Piggery are located more than 8 km from the Project, and will be subject to conditions of an Environmental Authority (EP Act) that regulate the nature of water discharges to the environment, which may affect aquatic ecology values. The North Star to NSW/QLD Border and Gowrie to Helidon sections of the Inland Rail project have a similar level of environmental risk as the Project, and will be subject to a similar range of environmental management procedures to maintain impacts to the localised area. This will minimise the potential for cumulative impacts.
- The duration of impact was assessed to be Medium. While all other projects are likely to be operating for a period of more than 10 years, the construction phase of the Inland Rail projects, when impacts will be greatest, will be limited to a much shorter period of approximately 5 years.
- The magnitude/intensity of impact was assessed to be Low, due to the highly regulated nature of the other projects, which will be subject to a range of environmental management plans. Also, in the case of the mining, piggery and abattoir projects, conditions of an Environmental Authority (EP Act) will also apply and limit the nature of water discharges to the receiving environment. While there is a risk of spills or other types of environmental incidents occurring at the sites of the other projects, the impacts of these are likely to be localised, with minimal potential to act cumulatively with those of the Project.
- The sensitivity of the receiving environment was assessed to be Medium. The Murray-Darling Basin is highly modified from a range of existing land uses, including agriculture, infrastructure and mining. Existing aquatic ecology values are unlikely to be sensitive to the localised impacts from the Project acting cumulatively with the other projects. Some threatened species such as the Murray Cod are known to occur in the impact assessment area and waters downstream.

Table 46 Summary of the results of a cumulative impact significance assessment for other relevant projects

Project	Potential cumulative impact	Factor affecting impact	Relevance factor	Sum of relevance factors	Impact significance	Comments and management measures
New Acland Coal Mine Stage 3 – New Acland Coal Pty Ltd	Degradation of aquatic values	Probability of the impact	Low (1)	6	Low	Will be managed through: ▪ Development and implementation of the sub-plans specified in **Table 41** and **Table 42**
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Low (1)			
		Sensitivity of the receiving environment	Medium (2)			
Goondiwindi Abattoir	Degradation of aquatic values	Probability of the impact	Low (1)	6	Low	Will be managed through: ▪ Development and implementation of the sub-plans specified in **Table 41** and **Table 42**
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Low (1)			
		Sensitivity of the receiving environment	Medium (2)			
Wyemo Piggery	Degradation of aquatic values	Probability of the impact	Low (1)	6	Low	Will be managed through: ▪ Development and implementation of the sub-plans specified in **Table 41** and **Table 42**
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Low (1)			
		Sensitivity of the receiving environment	Medium (2)			
North Star to NSW/QLD Border (Inland Rail)	Degradation of aquatic values	Probability of the impact	Low (1)	6	Low	Will be managed through: ▪ Development and implementation of the sub-plans specified in **Table 41** and **Table 42** ▪ ARTC to ensure the compatibility of mitigation measures and controls across projects in the Inland Rail Program
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Low (1)			
		Sensitivity of the receiving environment	Medium (2)			
Gowrie to Helidon (Inland Rail)	Degradation of aquatic values	Probability of the impact	Low (1)	6	Low	Will be managed through:
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Low (1)			

Project	Potential cumulative impact	Factor affecting impact	Relevance factor	Sum of relevance factors	Impact significance	Comments and management measures
		Sensitivity of the receiving environment	Medium (2)			▪ Development and implementation of the sub-plans specified in **Table 41** and **Table 42** ▪ ARTC to ensure the compatibility of mitigation measures and controls across projects in the Inland Rail Program

6 Conclusions and Recommendations

Aquatic ecology and surface water values of the impact assessment area are variable across the rail alignment. Ephemeral waterways, which have been subject to previous disturbance from agricultural development and public infrastructure such as road crossings, are dominant. However, areas of less disturbed aquatic habitat are present, and on larger waterways, these provide good quality habitat for a variety of aquatic fauna. Water quality is variable across the impact assessment area, with the absence of flow during dry conditions a key driver in small waterways.

The sedge *Fimbristylis vagans* has potential to occur in the impact assessment area and is listed as Endangered under the *Nature Conservation Act 1992* (Qld). Larger waterways of the impact assessment area including of the Macintyre and Condamine catchments also provide habitat for the Murray Cod, which is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), and the Platypus, which is listed as Special Least Concern under the *Nature Conservation Act 1992* (Qld). The Agassiz's Glassfish (listed as an endangered population in NSW) was also confirmed to be present in the Macintyre River. Other listed flora and fauna species have been determined as unlikely to occur in the impact assessment area.

The sensitivity of aquatic ecology and surface water quality values to impacts from the Project range from negligible to moderate in scale. The highest sensitivities (moderate) are associated with:

- Invasion of aquatic habitats by weed and pest species during the construction phase
- Declines in water and sediment quality from bank erosion, and the runoff of sediments and contaminants into waterways during the construction phase.

However, these risks can be effectively managed through a range of design features (e.g. bridges spanning waterways in preference to culverts) and through the development and implementation of detailed environmental management plans during detail design, pre-construction, construction and operation phases of the Project.

In implementing the Project, it is recommended that actions are taken to minimise disturbance to aquatic habitats and riparian vegetation of major waterways within the impact assessment area as much as possible. In particular, the Macintyre River and Macintyre Brook have been confirmed to provide aquatic habitats utilised by threatened species, and disturbance of these values should be minimised through a range of design, engineering and on site controls, as outlined in **Section 5.2**.

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APPENDIX

K

Aquatic Ecology Technical Report

Appendix A Site Descriptions for Aquatic Ecology Sites

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

IR_1534

Appendix A: Site Descriptions for Aquatic Ecology Sites

Site descriptions for Aquatic Ecology Sites are provided on the following pages.

Site descriptions for Surface Water Sites are provided in the Surface Water Quality Technical Report (Appendix P of the Project EIS)

Season: Spring

Site Code: 2 **Location:** Macintyre River **Latitude:** 28° 39’ 52” **Longitude:** 150° 28’ 01” **Date:** 29/11/2018


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Permanent watercourse; Baseflow at the time of assessment; symmetrical floodplain valley shape; two stage shaped channel; defined bed and banks; bank slope vertical; bank shape concave; no distinct floodplain; no obvious channel modifications; Moderate deposition regarding bank stability; upstream and adjacent land use is predominantly native and non-native pasture for cattle grazing; bankfull width approximately 56 m; bankfull height approximately 5 m (from stream bed); substrate composition 40% sand (0.06-2 mm) and 60% silt / clay (<0.06 mm); bank material 5% gravel (2-16 mm), 55% sand (0.06-2 mm) and 40% silt / clay (<0.06 mm); 10% large woody debris; < 10% filamentous algae cover, < 10% periphyton, < 10% moss detected and < 10% detritus cover.

Riparian vegetation

Riparian zone approximately 25 m left bank and 25 m right bank; longitudinal vegetation extent semi-continuous; vegetation community *Eucalyptus tereticornis or E. camaldulensis* woodland fringing drainage lines, vegetation characterised by sparse cover (35% estimated crown cover) of trees >10 m, dominated by Queensland blue gum (*E. tereticornis*) with occasional river she-oak (*Casuarina cunninghamiana*) and white sally wattle (*Acacia floribunda*) ; sparse cover (40%) of trees <10 m, dominated by snow-in-summer (*Melaleuca linariifolia*) with occasional *E. camaldulensis, sally wattle (A. salicina)*; very sparse (10%) shrub layer, dominated by spiny-headed mat-rush (*Lomandra longifolia*) with occasional *Acacia* sp. and common reed (Phragmites Australis) and mid-dense (60%) groundcover, dominated by dayflower (C*ommelina* sp.) and green panic (*Megathyrsus maximus*) regeneration of native woody vegetation present.

Vegetation disturbance: Moderate.

Aquatic flora

Macrophyte cover approximately 2% cover; emergent macrophytes included slender flat sedge (Cyperus gracilis) (1%), common rush (*Juncus usitatus*) (1%); common reed (*Phragmites australis*) (2%), tall flat sedge (*Cyperus exaltatus*) (1%) and slender knotweed (Persicaria decipiens) (1%).

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Good passage expected during times of flow. Located in Purple zone (Major risk of impact on fish movement)

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

The Murray cod (*Maccullochella peelii*) Vulnerable EPBC Act was confirmed to be present at this site, with six individual caught in the May 2019 field trip . Additionally, the Critically Endangered (EPBC Act) silver perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act and NC Act) Bell's turtle (*Wollumbinia belli*) and Special Least Concern (NC Act) platypus are recorded from the Border Rivers catchment (DES 2018b). The study reach provides habitat for the Murray cod and potential habitat for the platypus but is unlikely to provide habitat for the silver perch or Bell's turtle. Agassiz's Glassfish (listed as Endangered in NSW) was also found in the June 2018 field trip (on the Queensland side of the river).

Physico-chemical water quality

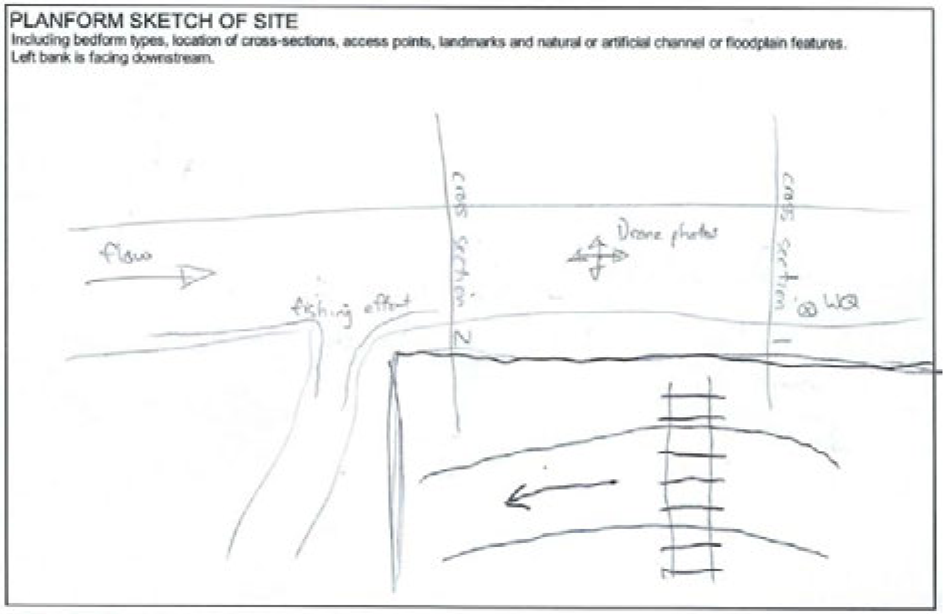
Collection time: 16:15; water temp.: 28.7°C; specific conductivity: 211.0 µS/cm (fresh); turbidity: 22.9; dissolved oxygen: 101.6%, 7.86 mg/L; pH: 6.77; Redox: 104.6 mV.

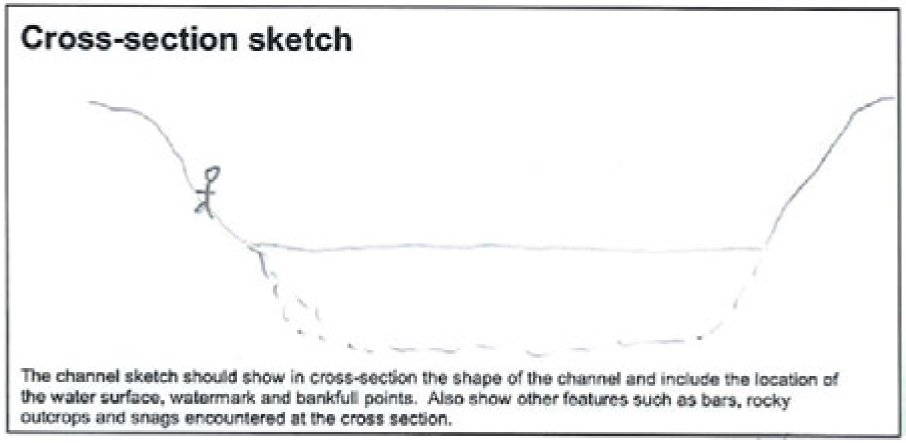
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Good (14); Pool substrate characterisation: Good (12); Pool variability: Good (14); Sediment deposition: Good (12); Channel flow status: Excellent (18); Channel alteration: Good (13); Channel sinuosity: Fair (10); Bank Stability: Good (left bank 7; right bank 7); Vegetative protection: Good (left bank 7; right bank 7); Riparian zone score: Good (left bank 6, right bank 6).

Overall habitat score: Good (129 out of 200).





Season: Autumn

Site Code: 4 **Location:** Unnamed tributary of Macintyre Brook **Latitude:** 28° 26' 21" **Longitude:** 150° 57' 28" **Date:** 16/06/2018

Upstream

Left Bank

Downstream

Right Bank

General Site Description

Site attributes

Ephemeral drainage feature; dry at the time of assessment; study reach positioned within undeveloped road reserve; broad valley setting; flat U shaped channel; poorly defined bed and banks; bank slope low; bank shape concave; no distinct floodplain; no obvious channel modifications; bed stable; upstream and adjacent land use is predominantly native forest; little local catchment erosion; bankfull width approximately 30 m; bankfull height approximately 1 m (from stream bed); substrate composition 95% sand (0.06-2 mm) and 5% silt / clay (<0.06 mm); bank material 40% gravel (2-16 mm), 50% sand (0.06-2 mm) and 10% silt / clay (<0.06 mm); 10% large woody debris; no filamentous algae, periphyton or moss detected; detritus cover 35-65%.

Riparian vegetation

Riparian zone approximately 20 m left bank and 20 m right bank; longitudinal vegetation extent continuous; vegetation community appears to be RE 11.3.25 ('*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines'), with sparse cover (40% estimated crown cover) of trees >10 m, dominated by Queensland blue gum (*E. tereticornis*) and rough-barked apple (*Angophora floribunda*), with occasional Baradine red gum (*E. chloroclada*); sparse cover (30%) of trees <10 m, dominated by Queensland blue gum and white cypress pine (*Callitris glaucophylla*); very sparse (15%) shrub layer, including *Acacia* sp., velvet tree pear (*Opuntia tomentosa*) and spiny-headed mat-rush (*Lomandra longifolia*); mid-dense (50%) groundcover, dominated by lovegrass (*Eragrostis* sp.), with frequent wiregrass (*Aristida* sp.); regeneration of native woody vegetation present.

Vegetation disturbance: Low to Moderate.

Aquatic flora

Macrophyte cover approximately 1% cover; fringing macrophytes included reed grass (*Arundinella nepalensis*) (1%); study reach dominated by terrestrial flora.

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Very restricted passage expected during low flow, base flow and high flow, including dog-proof fence (chicken wire) on upstream side of road reserve. Located in Red zone (High risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Vulnerable (EPBC Act and NC Act) Bell's turtle (*Wollumbinia belli*) and Special Least Concern (NC Act) Platypus are recorded from the Queensland Border Rivers catchment (DES 2018b). The study reach is highly unlikely to provide suitable habitat for these species.

Physico-chemical water quality

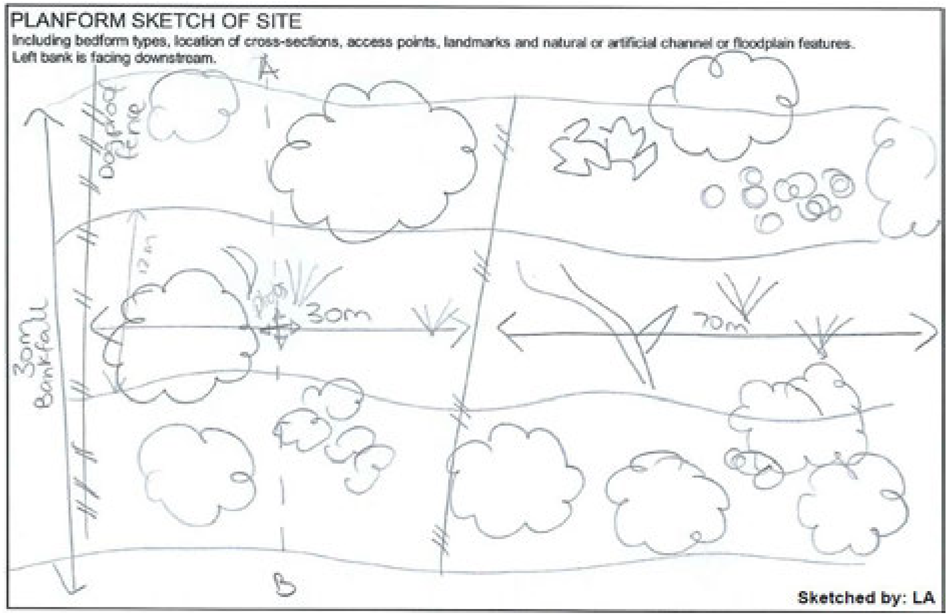
Dry at the time of the site visit.

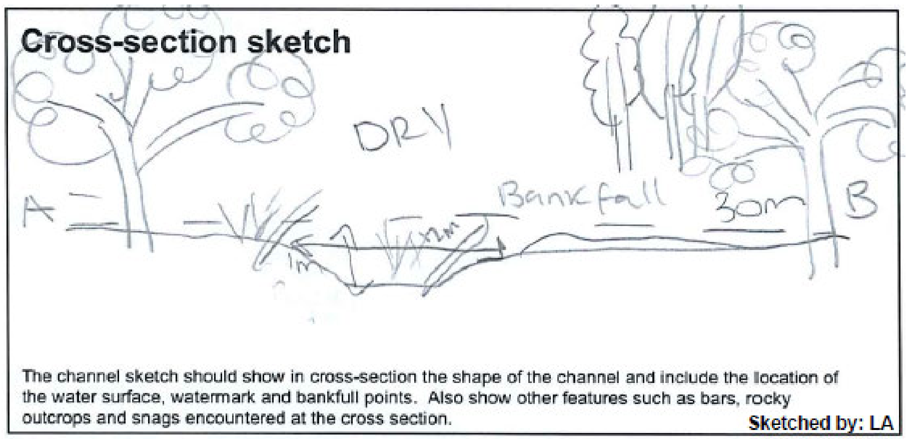
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Poor (5); Pool substrate characterisation: Fair (7); Pool variability: Poor (0); Sediment deposition: Excellent (16); Channel flow status: Poor (0); Channel alteration: Excellent (16); Channel sinuosity: Fair (7); Bank Stability: Excellent (left bank 9; right bank 9); Vegetative protection: Good (left bank 8; right bank 8); Riparian zone score: Good (left bank 8, right bank 8).

Overall habitat score: Good (101 out of 200).





Season: Autumn

Site Code: 5 **Location:** Unnamed tributary of Macintyre Brook **Latitude:** 28° 25' 58" **Longitude:** 150° 58' 54" **Date:** 16/06/2018


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Ephemeral drainage feature; dry at the time of assessment; symmetrical floodplain valley setting; widened channel; poorly defined bed and banks; bank slope flat (<10°); bank shape concave; no floodplain features present; no obvious channel modifications; potential for runoff from nearby pivot irrigation; bed stable; upstream land use predominantly native forest; adjacent land use beyond left bank is irrigated cropping, with grazing on the right bank; little local catchment erosion; bankfull width approximately 65 m; bankfull height approximately 0.5 m (from stream bed); substrate composition 100% silt / clay (<0.06 mm); bank material 100% silt / clay (<0.06 mm); 5% large woody debris; no filamentous algae, periphyton or moss detected; detritus cover 65-90%.

Riparian vegetation

Riparian zone approximately 25 m left bank and 25 m right bank; longitudinal vegetation extent continuous; vegetation community appears to be RE 11.3.25 ('*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines'), with mid-dense cover (70% estimated crown cover) of trees >10 m, dominated by Queensland blue gum (*E. tereticornis*), with occasional coolibah (*E. coolabah*); very sparse cover (5%) of trees <10 m, dominated by Queensland blue gum; very sparse (1%) shrub layer, including velvet tree pear (*Opuntia tomentosa*); mid-dense (50%) groundcover, dominated by tall sedge (*Carex appressa*), with frequent gilgai grass (*Walwhalleya subxerophila*) and occasional *Sida* spp.; regeneration of native woody vegetation very limited (<1% cover).

Vegetation disturbance: Low to Moderate.

Aquatic flora

Macrophyte cover approximately 15% cover; fringing macrophytes included common rush (*Juncus usitatus*) (1%) and tall sedge (*Carex appressa*) (14%); study reach dominated by terrestrial flora.

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Good fish passage expected during low and base flow; unrestricted passage during high flow. Located in Purple zone (Major risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Vulnerable (EPBC Act and NC Act) Bell's turtle (*Wollumbinia belli*) and Special Least Concern (NC Act) Platypus are recorded from the Queensland Border Rivers catchment (DES 2018b). The study reach is highly unlikely to provide suitable habitat for these species.

Physico-chemical water quality

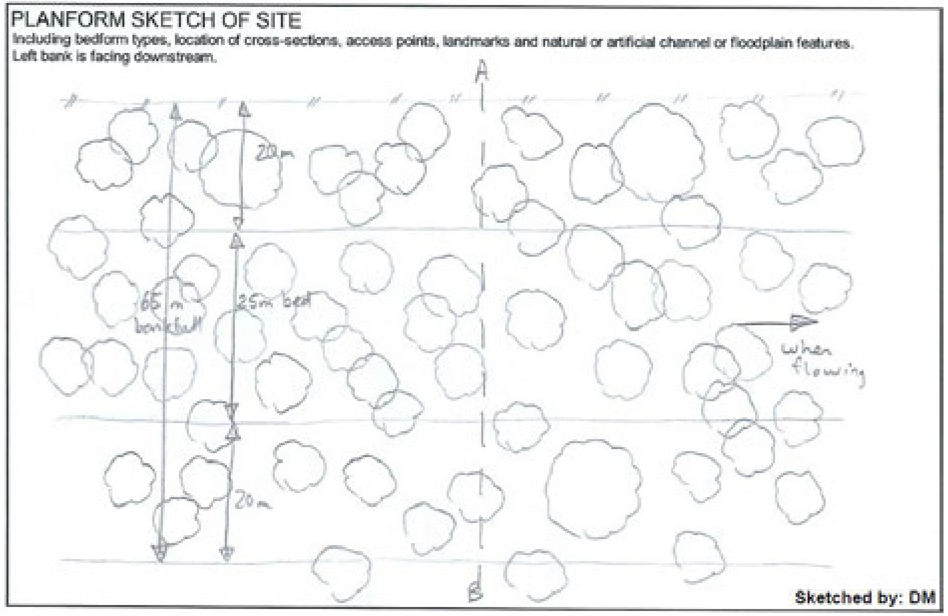
Dry at the time of the site visit.

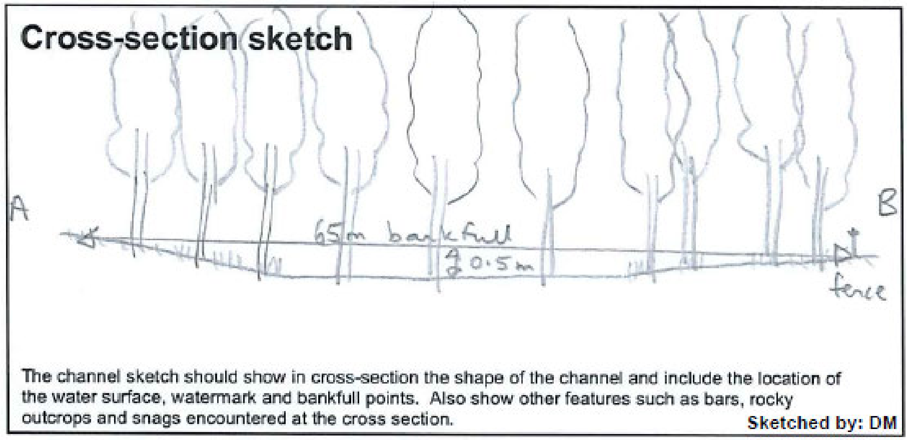
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Poor (5); Pool substrate characterisation: Fair (10); Pool variability: Poor (0); Sediment deposition: Excellent (18); Channel flow status: Poor (0); Channel alteration: Good (15); Channel sinuosity: Poor (5); Bank Stability: Excellent (left bank 10; right bank 10); Vegetative protection: Good (left bank 7; right bank 7); Riparian zone score: Excellent (left bank 9, right bank 9).

Overall habitat score: Good (105 out of 200).





Season: Autumn

Site Code: 8 **Location:** Unnamed tributary of Macintyre Brook **Latitude:** 28° 23’ 39” **Longitude:** 151° 03’ 12” **Date:** 17/06/2018


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Ephemeral drainage feature; dry at the time of assessment; symmetrical floodplain valley setting; widened channel; poorly defined bed and banks; bank slope flat (<10°); bank shape concave; no floodplain features present; no obvious channel modifications; potential for runoff from nearby dryland cropping; bed stable; upstream land use predominantly native forest; adjacent land use is native forest on the left bank, with dryland cropping on the right bank; little local catchment erosion; bankfull width approximately 60 m; bankfull height approximately 0.5 m (from stream bed); substrate composition 100% silt / clay (<0.06 mm); bank material 100% silt / clay (<0.06 mm); 15% large woody debris; no filamentous algae, periphyton or moss detected; detritus cover <10%.

Riparian vegetation

Riparian zone approximately 20 m on the left bank and 20 m on the right bank; longitudinal vegetation extent semi-continuous; vegetation community appears to be RE 11.3.25 (‘*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines’), with sparse cover (20% estimated crown cover) of trees >10 m, dominated by Queensland blue gum (*E. tereticornis*); very sparse cover (10%) of trees <10 m, dominated by Queensland blue gum; sparse (20%) shrub layer, including Queensland blue gum regeneration and wattles (*Acacia* spp.); mid-dense (60%) groundcover, including heavily grazed grasses (unidentifiable), slender flat-sedge (*Cyperus gracilis*) and Mayne’s pest (*Verbena aristigera*)*; regeneration of native woody vegetation abundant (>5% cover) and healthy.

Vegetation disturbance: Moderate to high (heavily grazed; intrusion of exotic species).

Aquatic flora

Macrophyte cover approximately 1% cover; fringing macrophytes included slender flat-sedge (*Cyperus gracilis*) (1%); study reach dominated by terrestrial flora.

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Unrestricted fish passage in times of low, base and high flow. Located in Amber zone (Moderate risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Vulnerable (EPBC Act and NC Act) Bell’s turtle (*Wollumbinia belli*) and Special Least Concern (NC Act) Platypus are recorded from the Queensland Border Rivers catchment (DES 2018b). The study reach is highly unlikely to provide suitable habitat for these species.

Physico-chemical water quality

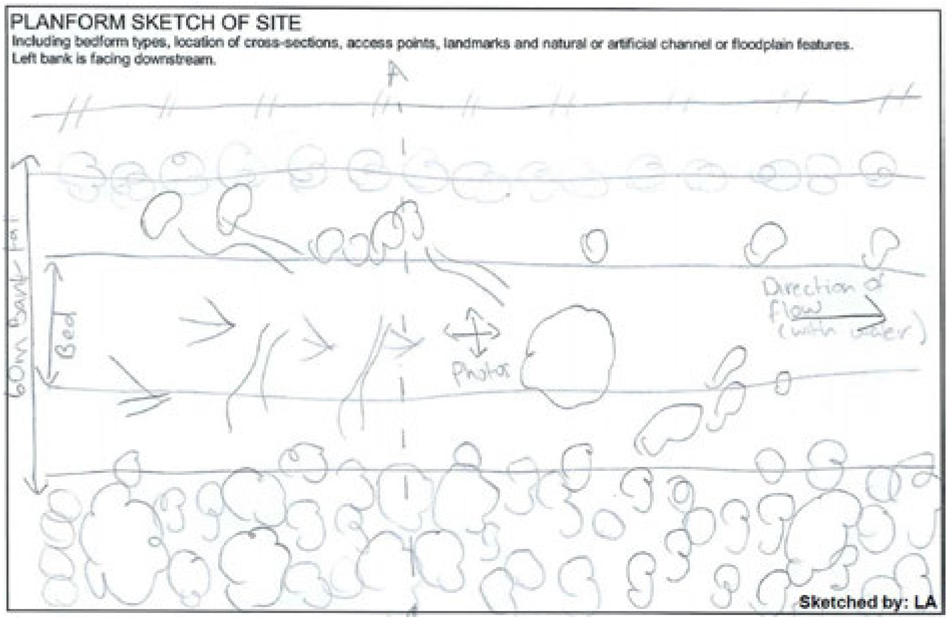
Dry at the time of the site visit.

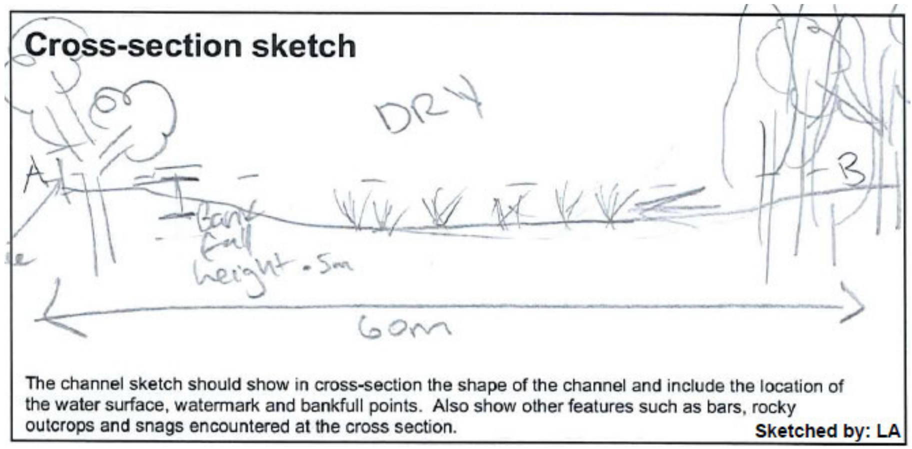
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Poor (4); Pool substrate characterisation: Poor (3); Pool variability: Poor (0); Sediment deposition: Excellent (16); Channel flow status: Poor (0); Channel alteration: Good (15); Channel sinuosity: Poor (5); Bank Stability: Excellent (left bank 9; right bank 9); Vegetative protection: Good (left bank 6; right bank 6); Riparian zone score: Good (left bank 8, right bank 6).

Overall habitat score: Fair (87 out of 200).





Season: Autumn

Site Code: 9 **Location:** Pariagara Creek **Latitude:** 28° 23’ 35” **Longitude:** 151° 04’ 45” **Date:** 15/06/2018


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Ephemeral watercourse; dry at the time of assessment; symmetrical floodplain valley shape; flat U shaped channel; well defined bed and banks; bank slope low (10-30°); bank shape concave; no floodplain features present; no obvious channel modifications; bed moderately unstable – moderate sand deposition; upstream land use predominantly native forest; adjacent land use includes cattle grazing on crop stubble beyond the left bank, with native forest on the right bank; little local catchment erosion; bankfull width approximately 8 m; bankfull height approximately 1.8 m (from stream bed); substrate composition 100% sand (0.06-2 mm); bank material 95% sand (0.06-2 mm), 5% silt / clay (<0.06 mm); 5% large woody debris; no filamentous algae, periphyton or moss detected; detritus cover 10-35%.

Riparian vegetation

Riparian zone approximately 20 m on the left bank and 20 m on the right bank; longitudinal vegetation extent continuous; fenced off from grazing; vegetation community appears to be RE 11.3.25 (‘*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines’), with mid-dense cover (75% estimated crown cover) of trees >10 m, dominated by Queensland blue gum (*E. tereticornis*), with abundant carbeen (*Corymbia tessellaris*), occasional rough-barked apple (*Angophora floribunda*) and white cypress pine (*Callitris glaucophylla*); sparse cover (30%) of trees <10 m, dominated by white cypress pine; very sparse (5%) shrub layer, including snow-in-summer (*Melaleuca linariifolia*) and spiny-headed mat-rush (*Lomandra longifolia*); mid-dense (70%) groundcover, dominated by common couch (*Cynodon dactylon*) and other native grasses; occasional weeds, including mother-of-millions (*Bryophyllum delagoense*); regeneration of native woody vegetation present.

Vegetation disturbance: Low (fenced off from grazing).

Aquatic flora

Macrophyte cover approximately 7%; fringing macrophytes included common rush (*Juncus usitatus*) (3% cover) and reed grass (*Arundinella nepalensis*) (4%); study reach dominated by terrestrial flora.

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Unrestricted fish passage in times of low, base and high flow. Located in Purple zone (Major risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Vulnerable (EPBC Act and NC Act) Bell's turtle (*Wollumbinia belli*) and Special Least Concern (NC Act) Platypus are recorded from the Queensland Border Rivers catchment (DES 2018b). The study reach is highly unlikely to provide suitable habitat for these species.

Physico-chemical water quality

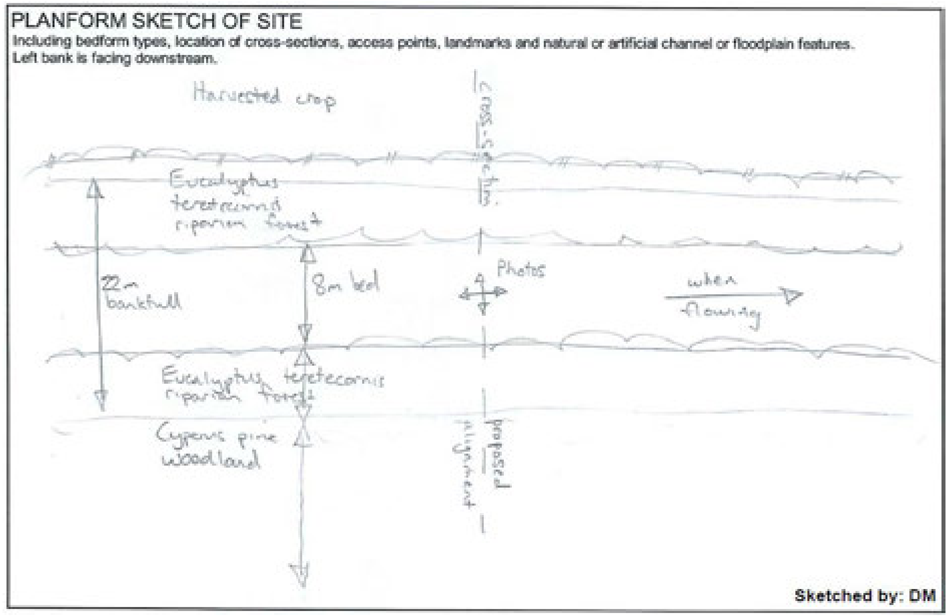
Dry at the time of the site visit.

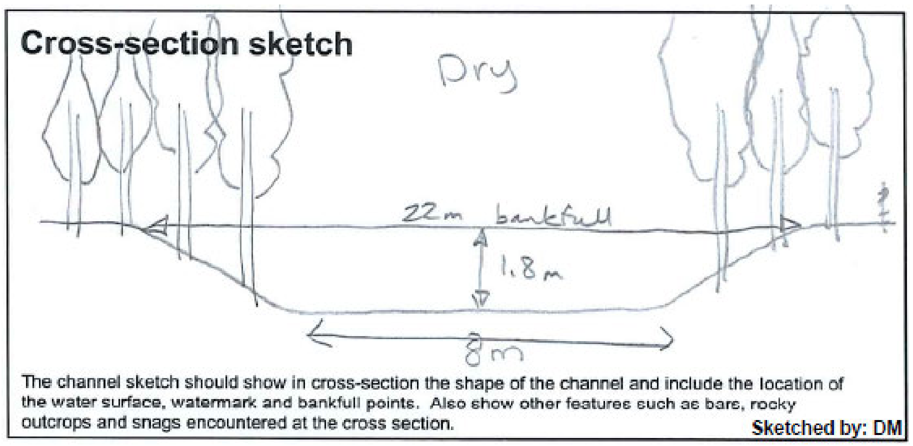
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Poor (4); Pool substrate characterisation: Fair (6); Pool variability: Poor (0); Sediment deposition: Poor (4); Channel flow status: Poor (0); Channel alteration: Good (13); Channel sinuosity: Fair (6); Bank Stability: Good (left bank 8; right bank 8); Vegetative protection: Good (left bank 6; right bank 6); Riparian zone score: Good (left bank 8, right bank 6).

Overall habitat score: Fair (74 out of 200).





Season: Autumn

Site Code: 12 **Location:** Unnamed tributary of Canning Creek **Latitude:** 28° 14' 17" **Longitude:** 151° 09' 21" **Date:** 17/06/2018


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Ephemeral drainage feature; dry at the time of assessment; broad valley setting; flat U shaped channel; poorly defined bed and banks; bank slope flat (<10°); bank shape concave; no floodplain features present; no obvious channel modifications; bed appears to be stable; upstream land use predominantly native forest; study reach within road corridor; adjacent land use dominated by native forest on left and right banks; little local catchment erosion; bankfull width approximately 40 m; bankfull height approximately 1 m (from stream bed); substrate composition 100% sand (0.06-2 mm); bank material 70% sand (0.06-2 mm), 30% silt / clay (<0.06 mm); 2% large woody debris; no filamentous algae, periphyton or moss detected; detritus cover 35-65%.

Riparian vegetation

Riparian zone approximately 10 m on the left bank and 10 m on the right bank; longitudinal vegetation extent semi-continuous; non-remnant vegetation in road corridor comprising study reach; adjoining vegetation community appears to be RE 11.5.4 ('*Eucalyptus chloroclada*, *Callitris glaucophylla*, *C. endlicheri*, *Angophora leiocarpa* woodland on Cainozoic sand plains and/or remnant surfaces'), with sparse cover (25% estimated crown cover) of trees >10 m, including Baradine red gum (*Eucalyptus chloroclada*), white cypress pine (*Callitris glaucophylla*) and rusty gum (*Angophora leiocarpa*); sparse cover (20%) of trees <10 m, dominated by buloke (*Allocasuarina luehmannii*) and dirty gum; sparse (45%) shrub layer, including teatree (*Leptospermum* sp.) and wattles (*Acacia* spp.); mid-dense (65%) groundcover, dominated by lovegrass (*Eragrostis* sp.), with frequent native oatgrass (*Themeda avenacea*); regeneration of native woody vegetation abundant (>5% cover) and healthy.

Vegetation disturbance: Low (expected on rail alignment) to high (in road corridor).

Aquatic flora

Macrophyte cover approximately 5%; fringing macrophytes included common rush (*Juncus usitatus*) (5%); study reach dominated by terrestrial flora.

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Unrestricted fish passage in times of low, base and high flow. Located in Red zone (High risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Vulnerable (EPBC Act and NC Act) Bell's turtle (*Wollumbinia belli*) and Special Least Concern (NC Act) Platypus are recorded from the Queensland Border Rivers catchment (DES 2018b). The study reach is highly unlikely to provide suitable habitat for these species.

Physico-chemical water quality

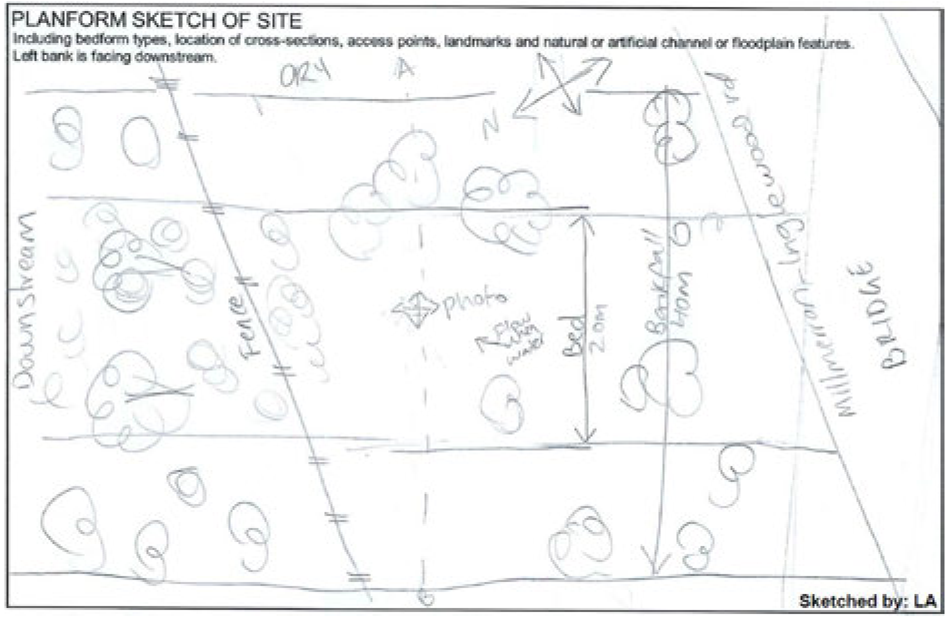
Dry at the time of the site visit.

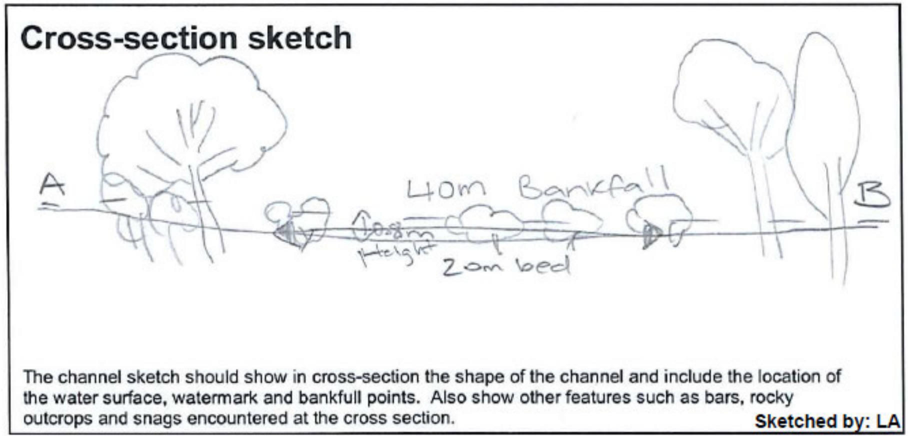
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Poor (3); Pool substrate characterisation: Fair (7); Pool variability: Poor (0); Sediment deposition: Good (13); Channel flow status: Poor (0); Channel alteration: Good (13); Channel sinuosity: Fair (6); Bank Stability: Excellent (left bank 9; right bank 9); Vegetative protection: Good (left bank 6; right bank 6); Riparian zone score: Good (left bank 6, right bank 6).

Overall habitat score: Fair (84 out of 200).





Season: Autumn

Site Code: 13 **Location:** Cattle Creek **Latitude:** 28° 13' 46" **Longitude:** 151° 09' 15" **Date:** 14/06/2018




Upstream | Left Bank | Downstream | Right Bank

General Site Description

Site attributes

Ephemeral watercourse; dry at the time of assessment; symmetrical floodplain valley shape; two stage channel shape; bank slope flat (<10°); bank shape stepped; flood channels present; no obvious channel modifications; bed appears to be stable; upstream land use predominantly native forest; study reach within road corridor; adjacent land use dominated by native forest on left and right banks; little local catchment erosion; bankfull width approximately 60 m; bankfull height approximately 3 m (from stream bed); substrate composition 95% sand (0.06-2 mm) and 5% silt /clay (<0.06 mm); bank material 5% sand (0.06-2 mm) and 95% silt / clay (<0.06 mm); 1% large woody debris; no filamentous algae, periphyton or moss detected; detritus cover 35-65%.

Riparian vegetation

Riparian zone approximately 30 m on the left bank and 60 m on the right bank; longitudinal vegetation extent semi-continuous; non-remnant vegetation in road corridor; adjoining vegetation community appears to be RE 11.3.4 ('*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains'), with sparse cover (40% estimated crown cover) of trees >10 m, dominated by Baradine red gum (*Eucalyptus chloroclada*), Queensland blue gum (*E. tereticornis*) and rough-barked apple (*Angophora floribunda*); sparse cover (30%) of trees <10 m, including white cypress pine (*Callitris glaucophylla*); very sparse (10%) shrub layer; mid-dense (60%) groundcover, dominated by blady grass (*Imperata cylindrica*); regeneration of native woody vegetation abundant (>5% cover) and healthy.

Vegetation disturbance: Low (expected on rail alignment) to high (in road corridor).

Aquatic flora

Macrophyte cover approximately 8%; fringing macrophytes included common rush (*Juncus usitatus*) (5%); spikerush (*Eleocharis acuta*) (1%), reed grass (*Arundinella nepalensis*) (1%) and tall flatsedge (*Cyperus exaltatus*) (1%); study reach dominated by terrestrial flora.

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Unrestricted fish passage in times of low, base and high flow. Located in Purple zone (Major risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Vulnerable (EPBC Act and NC Act) Bell's turtle (*Wollumbinia belli*) and Special Least Concern (NC Act) Platypus are recorded from the Queensland Border Rivers catchment (DES 2018b). The study reach is highly unlikely to provide suitable habitat for these species.

Physico-chemical water quality

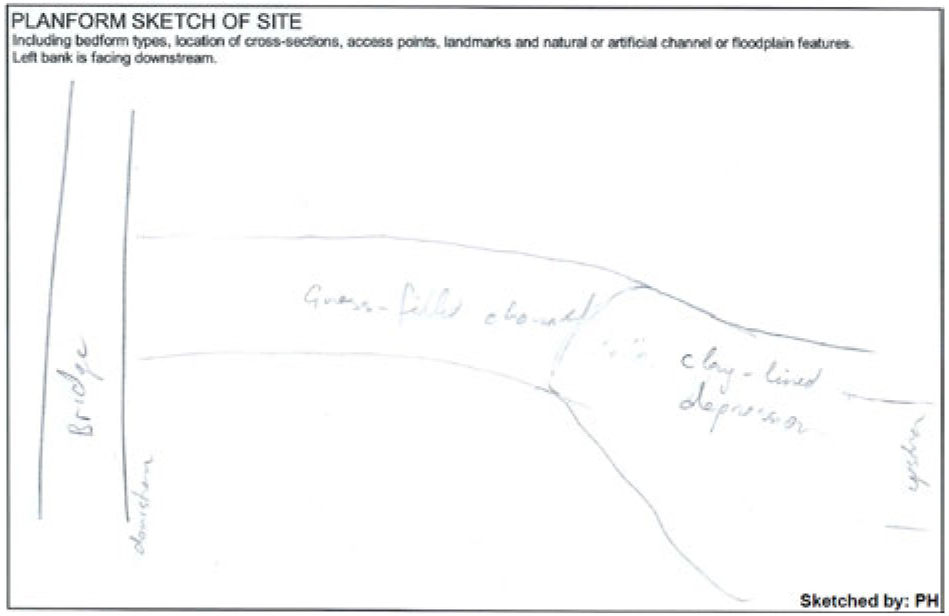
Dry at the time of the site visit.

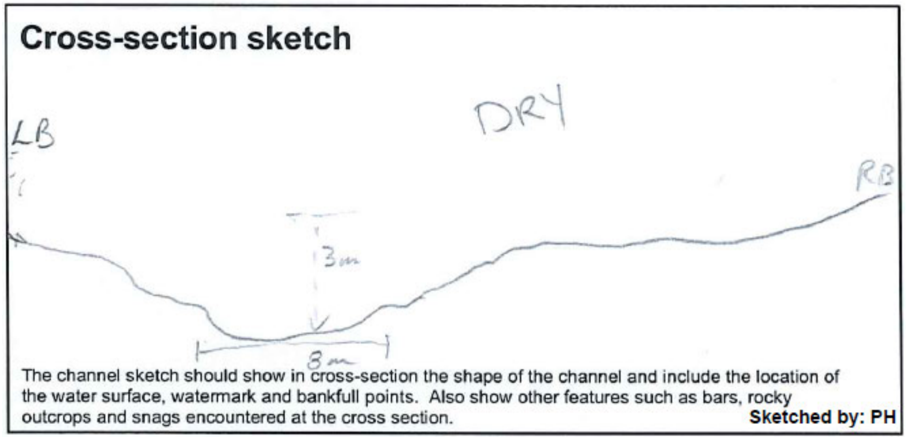
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Fair (9); Pool substrate characterisation: Fair (9); Pool variability (when wet): Good (13); Sediment deposition: Excellent (16); Channel flow status: Poor (0); Channel alteration: Excellent (18); Channel sinuosity: Good (11); Bank Stability: Good (left bank 6; right bank 7); Vegetative protection: Good (left bank 6; right bank 6); Riparian zone score: Excellent (left bank 9, right bank 9).

Overall habitat score: Good (119 out of 200).





Season: Autumn

Site Code: 15 **Location:** Native Dog Creek **Latitude:** 28° 11’ 03” **Longitude:** 151° 10’ 40” **Date:** 17/06/2018


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Ephemeral drainage feature; dry at the time of assessment; bridge and agricultural fence approximately 100 m upstream; broad valley shape; widened channel shape; bank slope flat (<10°); bank shape concave; no floodplain features present; no obvious channel modifications; bed appears to be stable; upstream land use predominantly native forest; adjacent land use dominated by native forest on left and right banks; little local catchment erosion; bankfull width approximately 30 m; bankfull height approximately 0.5 m (from stream bed); substrate composition 95% sand (0.06-2 mm) and 5% silt /clay (<0.06 mm); bank material 5% sand (0.06-2 mm) and 95% silt / clay (<0.06 mm); 5% large woody debris; no filamentous algae, periphyton or moss detected; detritus cover 10-35%.

Riparian vegetation

Riparian zone approximately 12 m on the left bank and 12 m on the right bank; longitudinal vegetation extent semi-continuous; vegetation community appears to be RE 11.3.2 (‘*Eucalyptus populnea* woodland on alluvial plains’), with sparse cover (25% estimated crown cover) of trees >10 m, dominated by poplar box (*Eucalyptus populnea*), with occasional Baradine red gum (*E. chloroclada*); very sparse cover (15%) of trees <10 m, including belah (*Casuarina cristata*), poplar box and white cypress pine (*Callitris glaucophylla*); very sparse (5%) shrub layer, including wilga (*Geijera parviflora*); mid-dense (65%) groundcover, heavily grazed; occasional weeds, including lippia (*Phyla canescens*)*, mother-of-millions (*Bryophyllum delagoense*); common prickly pear (*Opuntia stricta*) and velvet tree pear (*O. tomentosa*); regeneration of native woody vegetation very limited (<1% cover).

Vegetation disturbance: Moderate.

Aquatic flora

Macrophyte cover approximately 10%; fringing macrophytes included common rush (*Juncus usitatus*) (5%); tall sedge (*Carex appressa*) (3%), tall flatsedge (*Cyperus exaltatus*) (1%) and reed grass (*Arundinella nepalensis*) (1%); groundcover mostly dead / dry (likely to be identifiable in spring).

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Unrestricted fish passage in times of low, base and high flow. Located in Red zone (High risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Vulnerable (EPBC Act and NC Act) Bell's turtle (*Wollumbinia belli*) and Special Least Concern (NC Act) Platypus are recorded from the Queensland Border Rivers catchment (DES 2018b). The study reach is highly unlikely to provide suitable habitat for these species.

Physico-chemical water quality

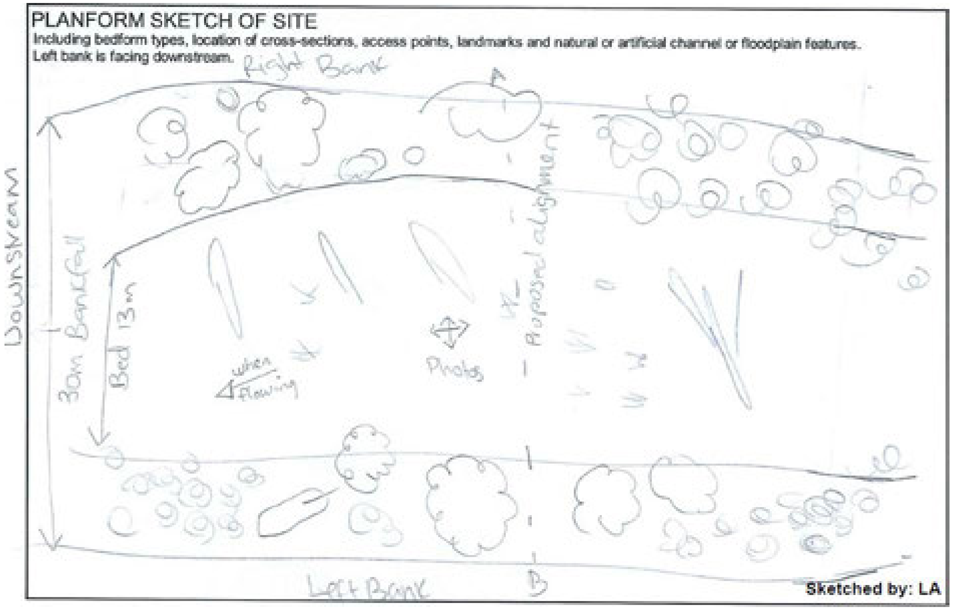
Dry at the time of the site visit.

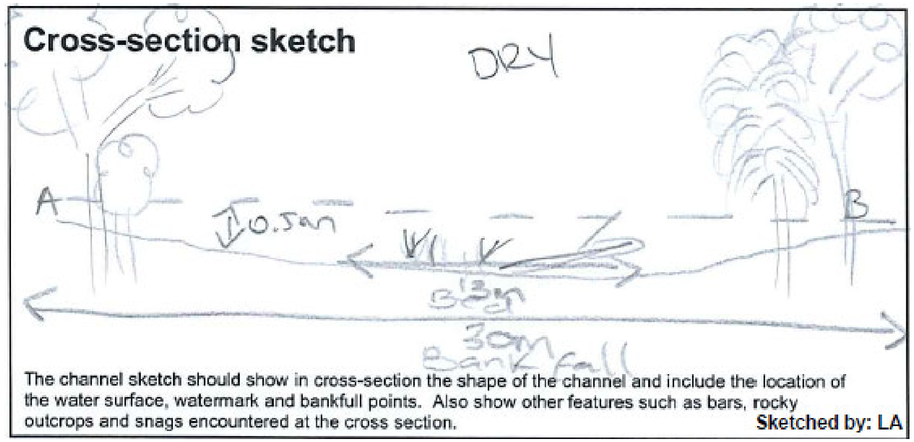
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Poor (5); Pool substrate characterisation: Fair (6); Pool variability (when wet): Fair (6); Sediment deposition: Excellent (16); Channel flow status: Poor (0); Channel alteration: Excellent (18); Channel sinuosity: Fair (7); Bank Stability: Excellent (left bank 9; right bank 9); Vegetative protection: Good (left bank 6; right bank 6); Riparian zone score: Good (left bank 7, right bank 7).

Overall habitat score: Good (102 out of 200).





Season: Autumn

Site Code: 16 **Location:** Bringalily Creek **Latitude:** 28° 09' 21" **Longitude:** 151° 11' 14" **Date:** 13/06/2018


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Semi-permanent watercourse; water level low at the time of assessment; symmetrical floodplain valley shape; box channel shape; bank slope vertical (80-90°); bank shape wide lower bench on left bank, undercut on right bank; floodplain features include flood channels and floodplain scours; no obvious channel modifications; bed moderately unstable – eroding; upstream land use predominantly cattle grazing; adjacent land use predominantly cattle grazing; little local catchment erosion; bankfull width approximately 31 m; bankfull height approximately 3.8 m (from stream bed); substrate composition 100 silt /clay (<0.06 mm); bank material 100% silt / clay (<0.06 mm); 10% large woody debris; no filamentous algae, periphyton or moss detected; detritus cover 10-35%.

Riparian vegetation

Riparian zone approximately 10 m on the left bank and 10 m on the right bank; longitudinal vegetation extent scattered; vegetation community appears to be RE 11.3.25 ('*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines'), with very sparse cover (15% estimated crown cover) of trees >10 m, dominated by Queensland blue gum (*Eucalyptus tereticornis*), with occasional river red gum (*E. camaldulensis*), rough-barked apple (*Angophora floribunda*) and poplar box (*E. populnea*); no trees <10 m detected; no shrubs detected; mid-dense (80%) groundcover; regeneration of native woody vegetation very limited (<1% cover).

Vegetation disturbance: High.

Aquatic flora and fauna

Macrophyte cover approximately 30%; fringing macrophytes included common reed (*Phragmites australis*) (15% estimated cover), common rush (*Juncus usitatus*) (5%), dwarf flat-sedge (*Cyperus pygmaeus*) (5%), and umbrella canegrass (*Leptochloa digitata*) (5%).

Five eastern snake-necked turtle (*Chelodina longicollis*) shells observed; no fish catch (despite seven bait traps deployed for approximately two hours, supplemented by dip-netting with Enviro-net®). Waterbody better suited to back-pack electrofishing and fyke netting.

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Good passage expected during times of flow. Located in Purple zone (Major risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Vulnerable (EPBC Act and NC Act) Bell's turtle (*Wollumbinia belli*) and Special Least Concern (NC Act) Platypus are recorded from the Queensland Border Rivers catchment (DES 2018b). The study reach provides potential habitat for the Murray Cod and Platypus, but is unlikely to provide habitat for the Silver Perch or Bell's turtle.

Physico-chemical water quality

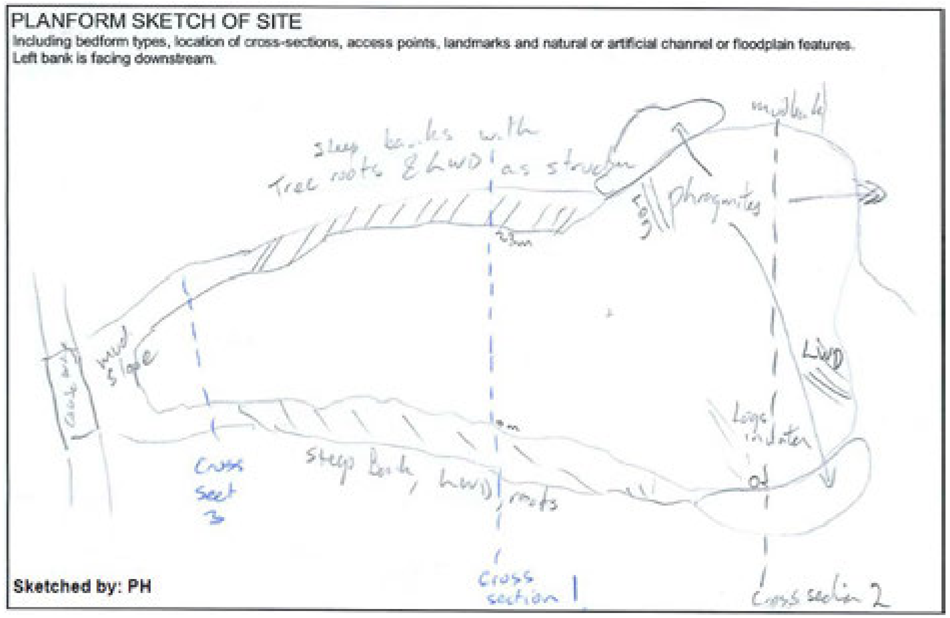
Collection time: 9:30; water temp.: 12.6°C; specific conductivity: 209.3 µS/cm (fresh); turbidity: 138 (poor clarity); dissolved oxygen: 62.1%, 6.64 mg/L (low, but expected for time of day); pH: 7.83 (mildly alkaline); Redox: 191.1 (moderately reducing).

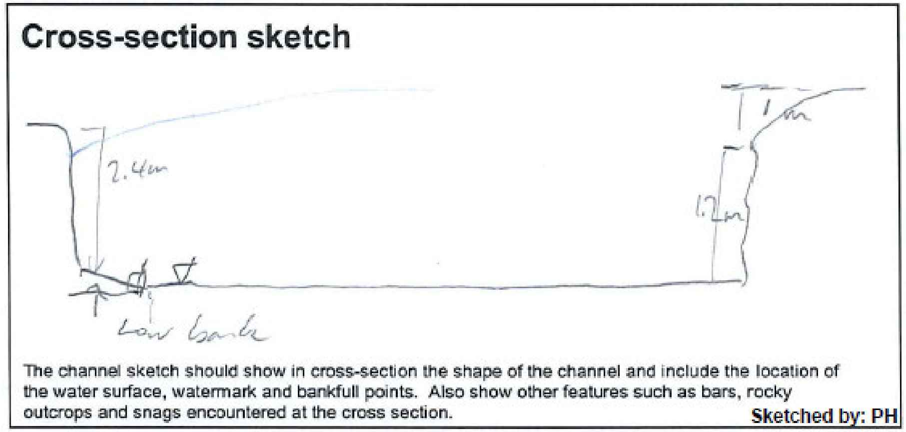
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Good (15); Pool substrate characterisation: Fair (9); Pool variability: Good (13); Sediment deposition: Good (15); Channel flow status: Excellent (18); Channel alteration: Excellent (18); Channel sinuosity: Good (12); Bank Stability: Fair (left bank 4; right bank 4); Vegetative protection: Fair (left bank 4; right bank 4); Riparian zone score: Fair (left bank 4, right bank 4).

Overall habitat score: Good (124 out of 200).





Season: Autumn

Site Code: 17 **Location:** Bringalily Creek **Latitude:** 28° 07' 44" **Longitude:** 151° 11' 20" **Date:** 17/06/2018


Upstream


Left Bank


Downstream


Right Bank

General Site Description

Site attributes

Ephemeral watercourse; dry at the time of assessment; symmetrical floodplain valley shape; two stage channel shape; bank slope moderate (30-60°); bank shape stepped; no floodplain features present; no obvious channel modifications; bed moderately unstable – eroding, affected by cleared vegetation and stock access; upstream land use predominantly cattle grazing; adjacent land use cattle grazing on left and right banks (and within stream reach); some local catchment erosion, including stream bank erosion exacerbated by lippia (*Phyla canescens*) impacts, and cattle; bankfull width approximately 30 m; bankfull height approximately 3 m (from stream bed); substrate composition 100% silt / clay (<0.06 mm); bank material 30% sand (0.06-2 mm) and 70% silt / clay (<0.06 mm); 25% large woody debris; no filamentous algae, periphyton or moss detected; detritus cover <10%.

Riparian vegetation

Riparian zone approximately 10 m on the left bank and 10 m on the right bank; longitudinal vegetation extent comprises occasional clumps; vegetation community appears to be RE 11.3.25 ('*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines'), with very sparse cover (15% estimated crown cover) of trees >10 m, dominated by Queensland blue gum (*Eucalyptus tereticornis*), with occasional rough-barked apple (*Angophora floribunda*); very sparse cover (5%) of trees <10 m, including Queensland blue gum; very sparse (1%) shrub layer, including *Mimosa* sp.; mid-dense (60%) groundcover, heavily grazed, dominated by common couch (Cynodon dactylon), with frequent lippia (*Phyla canescens*)*; no regeneration of native woody vegetation detected.

Vegetation disturbance: Very high (heavily impacted by sustained cattle grazing during drought conditions).

Aquatic flora

Macrophyte cover approximately 35%; fringing macrophytes included water primrose (*Ludwigia peploides* subsp. *montevidensis*) (30% estimated cover), common rush (*Juncus usitatus*) (3%) and reed grass (*Arundinella nepalensis*) (2%).

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Unrestricted fish passage in times of flow. Located in Purple zone (Major risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Vulnerable (EPBC Act and NC Act) Bell's turtle (*Wollumbinia belli*) and Special Least Concern (NC Act) Platypus are recorded from the Queensland Border Rivers catchment (DES 2018b). The study reach is highly unlikely to provide suitable habitat for these species.

Physico-chemical water quality

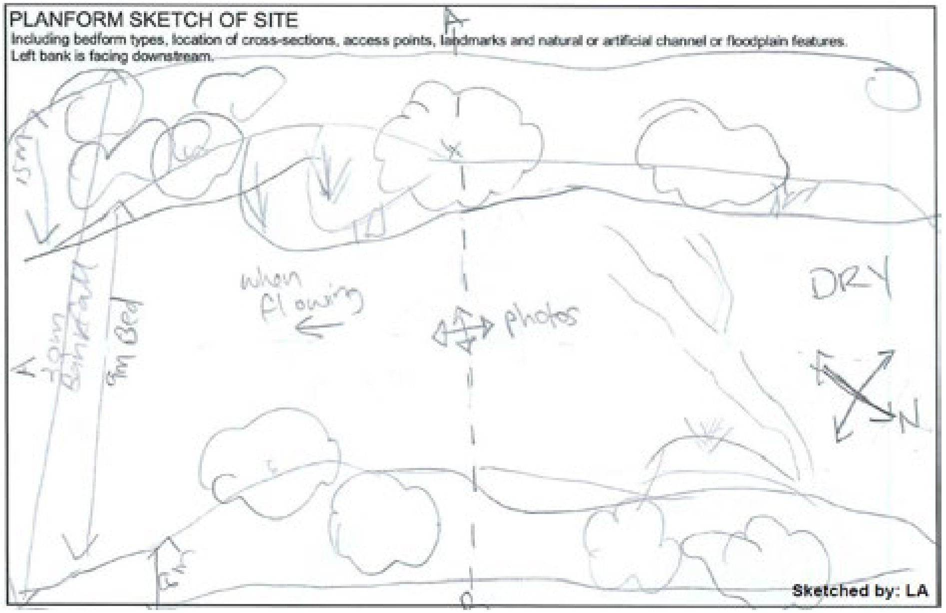
Dry at the time of the site visit.

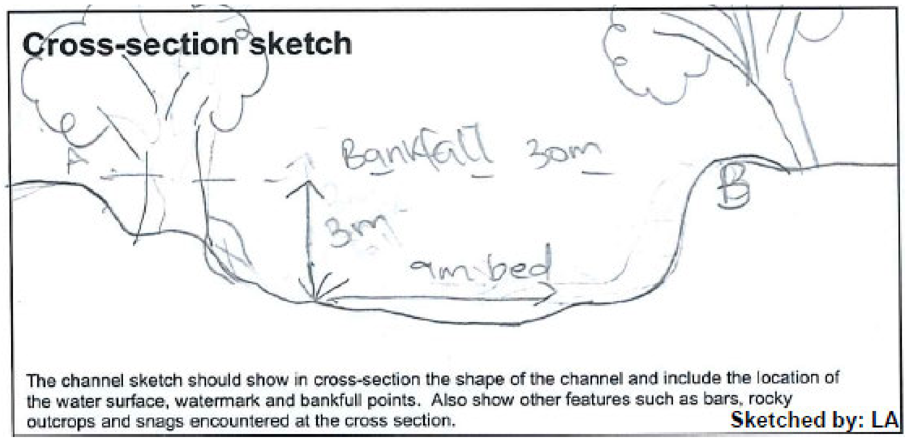
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Fair (7); Pool substrate characterisation: Poor (3); Pool variability (when wet): Good (11); Sediment deposition: Excellent (16); Channel flow status: Poor (0); Channel alteration: Excellent (16); Channel sinuosity: Good (13); Bank Stability: Poor (left bank 2; right bank 2); Vegetative protection: Fair (left bank 5; right bank 5); Riparian zone score: Fair (left bank 5, right bank 5).

Overall habitat score: Fair (90 out of 200).





Season: Autumn

Site Code: 19 **Location:** Nicol Creek **Latitude:** 28° 05' 07" **Longitude:** 151° 11' 46" **Date:** 13/06/2018

Upstream

Left Bank

Downstream

Right Bank

General Site Description

Site attributes

Ephemeral watercourse; dry at the time of assessment; asymmetrical floodplain valley shape; two stage channel shape; bank slope steep (60-80%) on left bank, moderate (30-60%) on right bank; bank shape stepped; floodplain features include remnant channels, flood channels and flood scours; no obvious channel modifications; bed stable, although unstable in heavily grazed paddock immediately downstream; upstream land use predominantly cattle grazing and dryland cropping; study reach within road corridor, comprising native woodland; little local catchment erosion, including stream bank erosion exacerbated by lippia (*Phyla canescens*) impacts; bankfull width approximately 150 m; bankfull height approximately 1.5 m (from stream bed); substrate composition 5% sand (0.06-2 mm) and 95% silt / clay (<0.06 mm); bank material 100% silt / clay (<0.06 mm); no large woody debris, filamentous algae, periphyton or moss detected; detritus cover <10%.

Riparian vegetation

Riparian zone approximately 100 m on the left bank and 50 m on the right bank; longitudinal vegetation extent regularly spaced; vegetation community appears to be RE 11.3.2 ('*Eucalyptus populnea* woodland on alluvial plains'), with a very sparse cover (10% estimated crown cover) of trees >10 m, dominated by poplar box (*Eucalyptus populnea*), with occasional Queensland blue gum (*E. tereticornis*); very sparse cover (10%) of trees <10 m, including poplar box and brigalow (*Acacia harpophylla*); very sparse (5%) shrub layer, including poplar box regrowth; mid-dense (80%) groundcover; regeneration of native woody vegetation present.

Vegetation disturbance: Moderate.

Aquatic flora

Macrophyte cover approximately 25%; fringing macrophytes included umbrella canegrass (*Leptochloa digitata*) (20% estimated cover), common rush (*Juncus usitatus*) (2%), spikerush (*Eleocharis acuta*) (2%) and tall flatsedge (*Cyperus exaltatus*) (1%).

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Moderately restricted passage in times of flow. Located in Red zone (High risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Vulnerable (EPBC Act and NC Act) Bell's turtle (*Wollumbinia belli*) and Special Least Concern (NC Act) Platypus are recorded from the Queensland Border Rivers catchment (DES 2018b). The study reach is highly unlikely to provide suitable habitat for these species.

Physico-chemical water quality

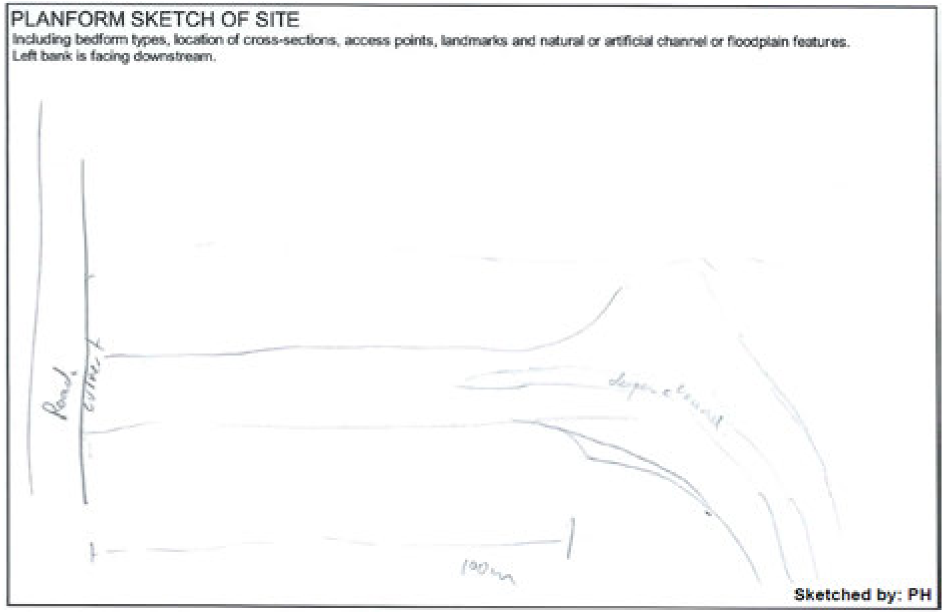
Dry at the time of the site visit.

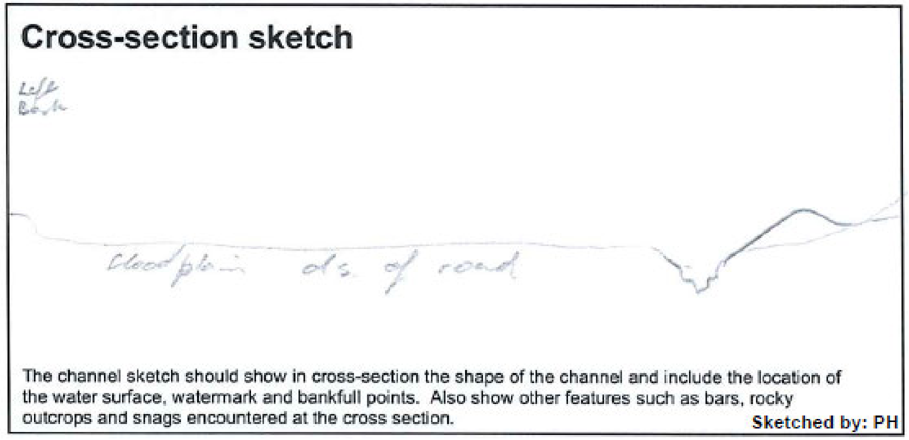
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Fair (9); Pool substrate characterisation: Good (13); Pool variability (when wet): Fair (6); Sediment deposition: Fair (8); Channel flow status: Poor (0); Channel alteration: Good (13); Channel sinuosity: Fair (9); Bank Stability: Fair (left bank 4; right bank 4); Vegetative protection: Good (left bank 6; right bank 6); Riparian zone score: Good (left bank 7, right bank 7).

Overall habitat score: Fair (92 out of 200).





Season: Autumn

Site Code: 32 **Location:** Condamine River (North) **Latitude:** 27° 46’ 51” **Longitude:** 151° 25’ 25” **Date:** 14/06/2018

Upstream

Left Bank

Downstream

Right Bank

General Site Description

Site attributes

Ephemeral watercourse; dry at the time of assessment; symmetrical floodplain valley shape; two stage channel shape; bank slope moderate (30-60%) on left bank, steep (60-80%) on right bank; bank shape stepped; no natural floodplain features present; no obvious channel modifications; bed stable; upstream and adjacent land use dominated by irrigated cropping on Vertosol floodplains; little local catchment erosion; bankfull width approximately 65 m; bankfull height approximately 3 m (from stream bed); substrate composition 5% boulder (>256 mm) and 95% silt / clay (<0.06 mm); bank material 5% boulder (>256 mm) and 95% silt / clay (<0.06 mm); no large woody debris, filamentous algae, periphyton or moss detected; detritus cover 10-35%.

Riparian vegetation

Riparian zone approximately 10 m on the left bank and 10 m on the right bank; longitudinal vegetation extent regularly spaced; narrow riparian corridor of RE 11.3.25 (‘*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines’), with a sparse cover (20% estimated crown cover) of trees >10 m, dominated by Queensland blue gum (*Eucalyptus tereticornis*); sparse cover (20%) of trees <10 m, dominated by beefwood (*Grevillea striata*); very sparse (10%) shrub layer; mid-dense (70%) groundcover; regeneration of native woody vegetation present.

Vegetation disturbance: High.

Aquatic flora

Macrophyte cover approximately 73%; fringing macrophytes included common rush (*Juncus usitatus*) (estimated cover 60%), ribbed spikerush (*Eleocharis plana*) (5%), hairy knotweed (*Persicaria attenuata*) (5%), slender knotweed (*P. decipiens*) (1%), tall flatsedge (*Cyperus exaltatus*) (1%) and dwarf flat-sedge (*Cyperus pygmaeus*) (1%).

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Partly restricted passage in times of flow. Located in Purple zone (Major risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Endangered (NC Act) fringing rush (*Fimbristylis vagans*) and Special Least Concern (NC Act) Platypus are recorded from the Condamine-Balonne Basin (DES 2018b). The study reach is unlikely to provide suitable habitat for these species, nor were any detected at the time of assessment.

Physico-chemical water quality

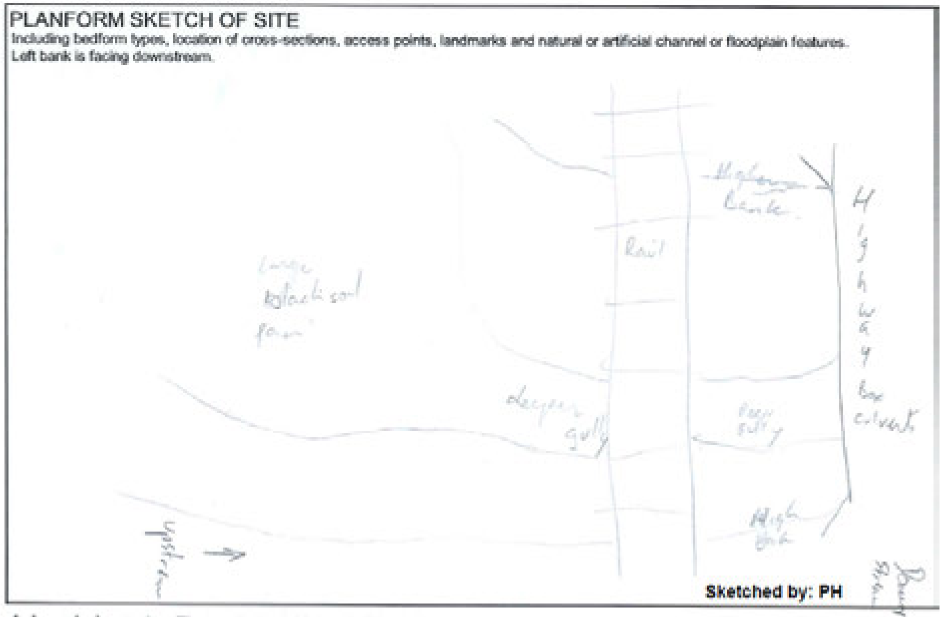
Dry at the time of the site visit.

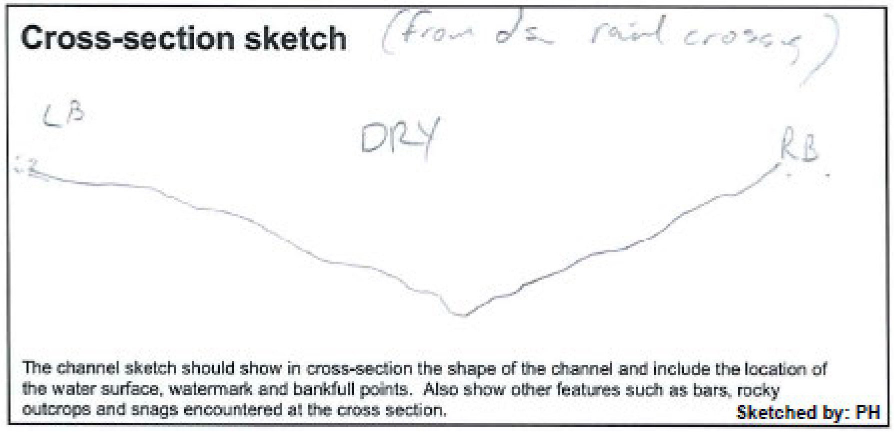
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Fair (7); Pool substrate characterisation: Fair (7); Pool variability (when wet): Fair (8); Sediment deposition: Excellent (16); Channel flow status: Poor (0); Channel alteration: Good (11); Channel sinuosity: Good (13); Bank Stability: Good (left bank 7; right bank 6); Vegetative protection: Fair (left bank 5; right bank 5); Riparian zone score: Good (left bank 7, right bank 8).

Overall habitat score: Fair (100 out of 200).





Season: Autumn

Site Code: 43 **Location:** Unnamed tributary of Gowrie Creek **Latitude:** 27° 29’ 38” **Longitude:** 151° 50’ 59” **Date:** 12/06/2018

Upstream

Left Bank

Downstream

Right Bank

General Site Description

Site attributes

Ephemeral drainage feature; dry at the time of assessment; study reach is downstream of road and rail culvert crossings; symmetrical floodplain valley shape; flat U channel shape; bank slope moderate (30-60%) on left and right banks; bank shape concave; no natural floodplain features present; channel modifications include reinforced banks associated with road and rail crossings; bed stable; banks stable, although unstable (slumping) on adjoining land downstream; upstream and adjacent land use dominated by rainfed cropping; some local catchment erosion; bankfull width approximately 40 m; bankfull height approximately 3.5 m (from stream bed); substrate composition 100% silt / clay (<0.06 mm); bank material 100% silt / clay (<0.06 mm); no large woody debris, filamentous algae, periphyton or moss detected; detritus cover <10%.

Riparian vegetation

Riparian zone approximately 1 m on the left bank and 1 m on the right bank; longitudinal vegetation extent isolated / scattered; non-remnant vegetation, with a very sparse cover (2% estimated crown cover) of trees <10 m, including *Casuarina* sp. and *Corymbia* sp. (not accessible); no shrub layer; dense (95%) groundcover, including *Sorghum* sp., *Chloris* sp., *Setaria* sp. and *Eragrostis* sp.; no regeneration of native woody vegetation.

Vegetation disturbance: Very high.

Aquatic flora

No macrophytes detected.

Physical barriers to local fish passage and DAF waterway zoning and risk of impact

Very restricted passage (road culverts have not allowed for fish passage, although minimal potential fish habitat upstream). Located in Amber zone (Moderate risk of impact on fish movement).

Endangered, Vulnerable, Near Threatened (EVNT) or Special Least Concern (SLC) flora and fauna

No EVNT or SLC aquatic flora or fauna species were detected. The Critically Endangered (EPBC Act) Silver Perch (*Bidyanus bidyanus*), Vulnerable (EPBC Act) Murray Cod (*Maccullochella peelii*), Endangered (NC Act) fringing rush (*Fimbristylis vagans*) and Special Least Concern (NC Act) Platypus are recorded from the Condamine-Balonne Basin (DES 2018b). The study reach is unlikely to provide suitable habitat for these species, nor were any detected at the time of assessment.

Physico-chemical water quality

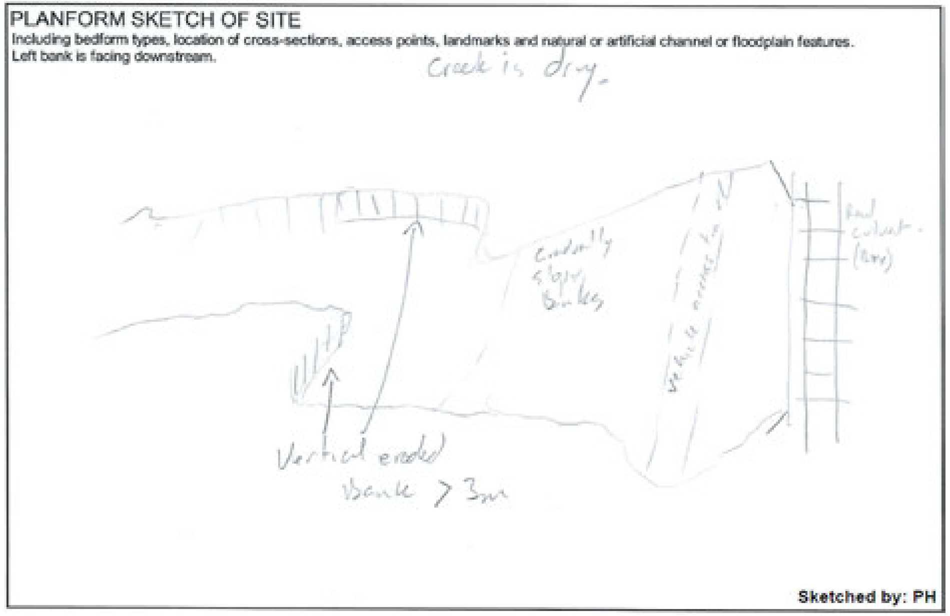
Dry at the time of the site visit.

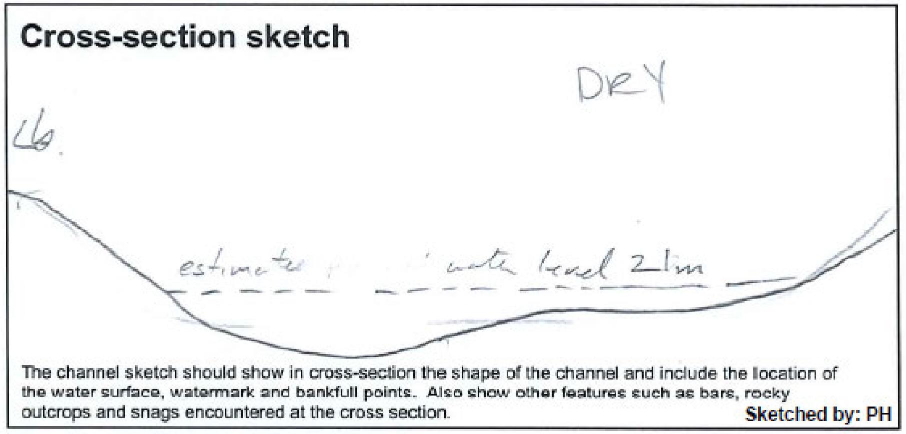
Summary: Normal.

Habitat scoring – Low gradient streams (as per AusRivAS Physical Habitat Assessment Protocol)

Epifaunal substrate / available cover: Poor (4); Pool substrate characterisation: Poor (4); Pool variability (when wet): Poor (0); Sediment deposition: Excellent (18); Channel flow status: Poor (0); Channel alteration: Fair (9); Channel sinuosity: Fair (7); Bank Stability: Fair (left bank 5; right bank 5); Vegetative protection: Fair (left bank 5; right bank 5); Riparian zone score: Poor (left bank 2, right bank 2).

Overall habitat score: Fair (66 out of 200).





APPENDIX

K

Aquatic Ecology Technical Report

Appendix B Likelihood of Occurrence

IR_1534

Appendix B: Likelihood of Occurrence

Species Name	Common Name	Status		Likelihood	Habitat Description & Justification[3]
		NC Act[1]	EPBC Act[2]		
FAUNA					
Fish					
Maccullochella peelii	Murray Cod	-	V	Known	Murray Cod are main-channel specialists and are frequently found in the main channels of rivers and larger tributaries (DoEE 2018). Preferred microhabitat consists of complex structural features in streams such as large rocks, snags (pieces of large submerged woody debris), overhanging stream banks and vegetation, tree stumps, logs, branches and other woody structures. Such structures reduce or influence stream flows and provide Murray Cod with shelter from fast-flowing water. They also serve as predatory ambush points for foraging, particularly during the day (DoEE 2019a). Where areas of deep stream occur throughout the southern portion of the impact assessment area, such as in some reaches of Brigalily Creek, potential habitat for the species occurs. Most areas in the impact assessment area are unsuitable due to the ephemeral nature of the systems. Closest known records (within 10km of the impact assessment area) occur in Dumaresq River and the southern reach of Boonal Anabranch (ALA 2018). The Murray Cod was confirmed to be present in the impact assessment area during field surveys, at the Macintyre River and Macintyre Brook.
Bidyanus bidyanus	Silver Perch	-	CE	Unlikely	Silver Perch are a highly migratory freshwater fish and are endemic to the Murray-Darling system (including all states and sub-basins) (Allen *et al*. 2002). Silver Perch

Species Name	Common Name	Status		Likelihood	Habitat Description & Justification[3]
		NC Act[1]	EPBC Act[2]		
					are consistently reported by anglers and researchers to show a general preference for faster-flowing water, including rapids and races, and more open sections of river and preference for submergent macrophytes, which may be important nursery areas for juveniles (DoEE 2018). Adult Silver Perch are omnivorous, taking a variety of small prey including zooplankton, aquatic insects, molluscs, small crustaceans and worms as well as algae (NSW DPI, 2006). A historical species record occurs in Back Creek, near Millmerran (within 10km of the impact assessment area; ALA 2018), however, due to the absence of fast-flowing water systems in the impact assessment area, the species is unlikely to occur in the impact assessment area.
Turtle					
Elseya albagula	Southern Snapping Turtle	E	CE	Unlikely	The southern snapping turtle is a habitat specialist (TSSC 2014). Within the river system it prefers clear, flowing, well-oxygenated waters. Water quality is an important aspect of the species ability to utilise habitat as due to its physiological adaptation to extract oxygen from water via cloacal respiration (DoEE 2017; TSSC 2014). Suitable habitat and species records are absent from the impact assessment area and surrounding region (ALA 2018). As such, the species is unlikely to occur in the impact assessment area.
Wollumbinia belli	Bell's Turtle	V	V	Unlikely	The species is restricted to upland streams (between 600 and 1100 m altitude) that contain permanent pools deeper than about 2 m, granite boulders and bedrock. Its habitat is often complex, with underwater caverns formed by boulders, logs and overhanging banks. In areas of lower velocity, the typical substratum is coarse granitic sand overlain by fine silt, algal growth, and dense beds of macrophytes

Species Name	Common Name	Status		Likelihood	Habitat Description & Justification[3]
		NC Act[1]	EPBC Act[2]		
					(DoEE 2019b). It is absent from areas away from flowing streams, such as farm ponds and natural wetlands (DoEE 2019b). The species is unlikely to occur in the impact assessment area due to the absence of suitable habitat. No species records occur within 10km of the impact assessment area (ALA 2018).
Monotreme					
Ornithorhynchus anatinus	Platypus	SLC	-	Known	Preferred habitat for the species includes a river or a stream with earth banks and native vegetation that provides shading of the stream and cover near the bank. The presence of logs, twigs, and roots, as well as cobbled or gravel water substrate result in increased macroinvertebrate fauna (a main food source), and the Platypus also tends to be more abundant in areas with pool-riffle sequences (Australia Museum 2018). Platypus was observed in the Macintyre Brook, near Inglewood during the dry season survey. The species is also known to inhabit the Macintyre River (ALA 2018).
FLORA					
Monocots					
Fimbristylis vagans	-	E	-	Potential	*Fimbristylis vagans* is a species of plant in the family Cyperaceae, a sedge family of monocotyledonous flowering plants. The species is a wetland indicator (Wetland*Info* 2019). The species is associated with clay pans, open sedge land and sparse-tussock grasslands on shallow alluvial sand plains but may also occur in other ecosystems (other species of *Fibristylis* are common in pastures of central Queensland).

Species Name	Common Name	Status		Likelihood	Habitat Description & Justification[3]
		NC Act[1]	EPBC Act[2]		
					The species was not detected during field surveys and no species records occur within 10km of the impact assessment area (ALA 2018).

[1]E = Endangered, V = Vulnerable and SLC = Special Least Concern under the NC Act.
[2]CE = Critically Endangered, E = Endangered, V = Vulnerable under the EPBC Act.
[3] Information should be cited as being from the Species Profile – Department of the Environment and Energy unless otherwise cited.

APPENDIX

K

Aquatic Ecology Technical Report

Appendix C Records of Calibration for Water Quality Meter

IR_1534

Appendix C: Records of Calibration for Water Quality Meter

Form:	FRM-001
Title:	Water Quality Meter Calibration Certificate

Instrument make:	YSI Professional Plus
Display serial number:	14M100367
Sonde serial number:	14M100051
Calibrated by:	D. MOORE
Calibrated for (job no.)	DPM18004 (BZG) - TRIP 1 START
Date calibrated:	11/06/2018

Parameter	Calibration standard expiry date	Units	Before calibration		After calibration	
			Expected value	Measured value	Expected value	Measured value
Temperature	Factory cal.	°C	N/A	N/A	N/A	19.4
pH 4	Dec 18	pH units	4.00	3.89	4.00	4.00
pH 7	Dec 18	pH units	7.02	6.84	7.02	7.02
pH 10	Dec 18	pH units	10.06	9.97	10.06	10.06
ORP	May 20	mV	240.2	239.2	240.2	240.2
SPC	Jan 19	µS/cm	1413	1340	1413	1413
Barometric pressure	N/A	mmHg		765.7	765.7	765.7
DO (zero)	N/A	%S	0.0	0.0	0.0	0.0
DO (sat.)	N/A	%S	100.0	94.5	100.0	100.0

The instrument has been inspected for visible signs of wear, damage, cleanliness, and condition, and is verified to be in good working order.

Comments on the instrument:

Instrument in good condition. New batteries installed.

Signed: ______________________

Date: ______________________

Form:	FRM-001
Title:	Water Quality Meter Calibration Certificate

Instrument make:	YSI Professional Plus
Display serial number:	14M100367
Sonde serial number:	14M100051
Calibrated by:	D. MOORE
Calibrated for (job no.)	DPM18004 (B26) – TRIP 1 FINISH
Date calibrated:	18/6/2018

Parameter	**Calibration standard expiry date**	**Units**	**Before calibration**		**After calibration**	
			Expected value	Measured value	Expected value	Measured value
Temperature	Factory cal.	°C	N/A	N/A	N/A	18.0
pH 4	Dec 18	pH units	4.00	4.03	4.00	4.00
pH 7	Dec 18	pH units	7.03	7.00	7.03	7.03
pH 10	Dec 18	pH units	10.08	9.97	10.08	10.08
ORP	May 20	mV	241.2	240.3	241.2	241.2
SPC	Jan 19	µS/cm	1413	1414	1413	1413
Barometric pressure	N/A	mmHg		765.5	765.5	765.5
DO (zero)	N/A	%S	0.0	0.4	0.0	0.0
DO (sat.)	N/A	%S	100.0	104.4	100.0	100.0

The instrument has been inspected for visible signs of wear, damage, cleanliness, and condition, and is verified to be in good working order.

Comments on the instrument:
Instrument maintained calibration. In good condition.

Signed: D Moore

Date: 18/6/2018

Form:	FRM-001
Title:	Water Quality Meter Calibration Certificate

Instrument make:	YSI Professional Plus
Display serial number:	14M100367
Sonde serial number:	14M100051
Calibrated by:	P. HANCOCK
Calibrated for (job no.)	DPM18004 (B2C) - TRIP 2 START
Date calibrated:	26/11/2018

Parameter	**Calibration standard expiry date**	**Units**	**Before calibration**		**After calibration**	
			Expected value	Measured value	Expected value	Measured value
Temperature	Factory cal.	°C	N/A	N/A	N/A	—
pH 4	Apr 20	pH units	4.00	3.99	4.00	4.00
pH 7	Jun 20	pH units	7.01	7.29	7.01	7.01
pH 10	May 20	pH units	10.01	9.96	10.01	10.01
ORP	May 20	mV	230.7	305.6	230.7	230.7
SPC	Apr 20	µS/cm	1413	1324	1413	1413
Barometric pressure	N/A	mmHg	—	717.7	717.7	717.7
DO (zero)	N/A	%S	0.0	-0.4	0.0	0.0
DO (sat.)	N/A	%S	100.0	78.9	100.0	100.0

The instrument has been inspected for visible signs of wear, damage, cleanliness, and condition, and is verified to be in good working order.

Comments on the instrument:

Instrument in good condition. Battery level adequate. Spare batteries inside case.

Signed: [signature]

Date: 26/11/2018

Form:	FRM-001
Title:	Water Quality Meter Calibration Certificate

Instrument make:	YSI Professional Plus
Display serial number:	14M100367
Sonde serial number:	14M100051
Calibrated by:	D. MOORE
Calibrated for (job no.)	DPM18004 (B2a) - TRIP 2 FINISH
Date calibrated:	2/12/2018

Parameter	Calibration standard expiry date	Units	Before calibration		After calibration	
			Expected value	Measured value	Expected value	Measured value
Temperature	Factory cal.	°C	N/A	N/A	N/A	23.8
pH 4	Apr 20	pH units	4.00	4.00	4.00	4.00
pH 7	Jun 20	pH units	7.01	6.91	7.01	7.01
pH 10	May 20	pH units	10.01	10.05	10.01	10.01
ORP	May 20	mV	233.4	231.7	233.4	233.4
SPC	Apr 20	μS/cm	1413	1408	1413	1413
Barometric pressure	N/A	mmHg	716.7	716.7	716.7	716.7
DO (zero)	N/A	%S	0.0	-0.2	0.0	0.0
DO (sat.)	N/A	%S	100.0	104.7	100.0	100.0

The instrument has been inspected for visible signs of wear, damage, cleanliness, and condition, and is verified to be in good working order.

Comments on the instrument:
Instrument has maintained calibration. Instrument in good condition.

Signed: D Moore

Date: 2/12/2018

DPM ENVIROSCIENCES

Form:	FRM-001
Title:	Water Quality Meter Calibration Certificate

Instrument make:	YSI Professional Plus
Display serial number:	14M100367
Sonde serial number:	14M100051
Calibrated by:	D. MOORE
Calibrated for (job no.)	DPM18004 (B2G) - TRIP 3 START
Date calibrated:	10/2/2019

Parameter	**Calibration standard expiry date**	**Units**	**Before calibration**		**After calibration**	
			Expected value	Measured value	Expected value	Measured value
Temperature	Factory cal.	°C	N/A	N/A	N/A	25.3
pH 4	Apr 20	pH units	4.01	3.97	4.01	4.01
pH 7	Jun 20	pH units	7.00	6.92	7.00	7.00
pH 10	May 20	pH units	9.98	9.96	9.98	9.98
ORP	May 20	mV	227.7	227.5	227.7	227.7
SPC	Apr 20	µS/cm	1413	1509	1413	1413
Barometric pressure	N/A	mmHg	745.6	745.6	745.6	745.6
DO (zero)	N/A	%S	0.0	0.0	0.0	0.0
DO (sat.)	N/A	%S	100.0	100.6	100.0	100.0

The instrument has been inspected for visible signs of wear, damage, cleanliness, and condition, and is verified to be in good working order.

Comments on the instrument:
Instrument in good condition. Batteries replaced.

Signed: D Moore

Date: 10/2/2019

Form:	FRM-001
Title:	Water Quality Meter Calibration Certificate

Instrument make:	YSI Professional Plus
Display serial number:	14M100367
Sonde serial number:	14M100051
Calibrated by:	D. MOORE
Calibrated for (job no.)	DPM18004 (B26) - Trip 3 finish
Date calibrated:	15/2/2019

Parameter	Calibration standard expiry date	Units	Before calibration		After calibration	
			Expected value	Measured value	Expected value	Measured value
Temperature	Factory cal.	°C	N/A	N/A	N/A	28.0
pH 4	Apr 20	pH units	4.01	4.06	4.01	4.01
pH 7	Jun 20	pH units	6.99	7.04	6.99	6.99
pH 10	Apr 20	pH units	9.97	9.99	9.97	9.97
ORP	May 20	mV	224.6	222.3	224.6	224.6
SPC	Apr 20	μS/cm	1413	1414	1413	1413
Barometric pressure	N/A	mmHg	754.7	754.7	—	—
DO (zero)	~~N/A~~ Mar 20	%S	0.0	-0.2	0.0	0.0
DO (sat.)	N/A	%S	100.0	101.6	100.0	100.0

The instrument has been inspected for visible signs of wear, damage, cleanliness, and condition, and is verified to be in good working order.

Comments on the instrument:

Instrument has maintained calibration.
In good condition. Cleaned and stored for next use.

Signed: D Moore

Date: 15/2/2019

Form:	FRM-001
Title:	Water Quality Meter Calibration Certificate

Instrument make:	YSI Professional Plus
Display serial number:	14M100367
Sonde serial number:	14M100051
Calibrated by:	D. MOORE
Calibrated for (job no.)	DPM18004
Date calibrated:	28/4/2019 - Commencement of Trip 4

Parameter	Calibration standard expiry date	Units	Before calibration		After calibration	
			Expected value	Measured value	Expected value	Measured value
Temperature	Factory cal.	°C	N/A	N/A	N/A	22.1
pH 4	10/20	pH units	4.00	4.21	4.00	4.00
pH 7	10/20	pH units	7.01	7.17	7.01	7.01
pH 10	10/20	pH units	10.03	10.21	10.03	10.03
ORP	2/21	mV	233.8	225.8	233.8	233.8
SPC	1/21	µS/cm	1413	2268	1413	1413
Barometric pressure	N/A	mmHg		—	758.84	758.84
DO (zero)	N/A	%S	0.0	-0.1	0.0	0.0
DO (sat.)	~~N/A~~ 3/20	%S	100.0	109.0	100.0	100.0

The instrument has been inspected for visible signs of wear, damage, cleanliness, and condition, and is verified to be in good working order.

Comments on the instrument:

Last calibrated and used by Blue Earth Environmental. Advise BEE that their cal. solution for SPC needs replacing. Checked with two SPC cal. solution batches. Instrument in good condition.

Signed: D Moore

Date: 28/4/2019

Form:	FRM-001
Title:	Water Quality Meter Calibration Certificate

Instrument make:	YSI Professional Plus
Display serial number:	14M100367
Sonde serial number:	14M100051
Calibrated by:	D. Moore
Calibrated for (job no.)	DPM18004
Date calibrated:	3/5/2019 - Completion of Trip 4

Parameter	Calibration standard expiry date	Units	Before calibration		After calibration	
			Expected value	Measured value	Expected value	Measured value
Temperature	Factory cal.	°C	N/A	N/A	N/A	22.3
pH 4	10/20	pH units	4.00	4.09	4.00	4.00
pH 7	10/20	pH units	7.01	7.05	7.01	7.01
pH 10	10/20	pH units	10.03	10.01	10.03	10.03
ORP	2/21	mV	2~~53~~ 35.0	239.5	235.0	235.0
SPC	1/21	μS/cm	1413	1402	1413	1413
Barometric pressure	N/A	mmHg		753.6	753.6	753.6
DO (zero)	~~N/A~~ 3/20	%S	0.0	-0.3	0.0	0.0
DO (sat.)	N/A ~~3/20~~	%S	100.0	98.7	100.0	100.0

The instrument has been inspected for visible signs of wear, damage, cleanliness, and condition, and is verified to be in good working order.

Comments on the instrument:

Instrument has maintained calibration. In good condition. Cleaned and stored for next use.

Signed: D Moore

Date: 3/5/2019

DPM ENVIROSCIENCES

Form:	FRM-001
Title:	Water Quality Meter Calibration Certificate

Instrument make:	YSI Professional Plus
Display serial number:	14M100367
Sonde serial number:	14M100051
Calibrated by:	D. MOORE
Calibrated for (job no.)	DPM18004
Date calibrated:	15/5/2019 - Commencement of Trip 5

Parameter	Calibration standard expiry date	Units	Before calibration		After calibration	
			Expected value	Measured value	Expected value	Measured value
Temperature	Factory cal.	°C	N/A	N/A	N/A	22.2
pH 4	10/20	pH units	4.00	4.01	4.00	4.00
pH 7	10/20	pH units	7.01	7.01	7.01	7.01
pH 10	10/20	pH units	10.03	10.02	10.03	10.03
ORP	2/21	mV	235.0	236.1	235.0	235.0
SPC	1/21	µS/cm	1413	1410	1413	1413
Barometric pressure	N/A	mmHg	769.6	769.6	769.6	769.6
DO (zero)	3/20	%S	0.0	-0.1	0.0	0.0
DO (sat.)	N/A	%S	100.0	99.7	100.0	100.0

The instrument has been inspected for visible signs of wear, damage, cleanliness, and condition, and is verified to be in good working order.

Comments on the instrument:

In good condition. Calibrated and ready for use.

Signed: D Moore

Date: 15/5/2019

DPM ENVIROSCIENCES

Form:	FRM-001
Title:	Water Quality Meter Calibration Certificate

Instrument make:	YSI Professional Plus
Display serial number:	14M100367
Sonde serial number:	14M100051
Calibrated by:	
Calibrated for (job no.)	
Date calibrated:	

Parameter	Calibration standard expiry date	Units	Before calibration		After calibration	
			Expected value	Measured value	Expected value	Measured value
Temperature	Factory cal.	°C	N/A	N/A	N/A	
pH 4	10/20	pH units	4.00	4.03	4.00	4.00
pH 7	10/20	pH units	7.00	7.04	7.00	7.00
pH 10	10/20	pH units	10.05	10.09	10.05	10.05
ORP	2/21	mV	1413	1438	1413	1413
SPC	1/21	µS/cm	238.0	237.4	238.0	238.0
Barometric pressure	N/A	mmHg	763.4	763.5	763.4	763.4
DO (zero)	3/20	%S	0.0	-0.8	0.0	0.0
DO (sat.)	N/A	%S	100.0	98.8	100.0	100.0

The instrument has been inspected for visible signs of wear, damage, cleanliness, and condition, and is verified to be in good working order.

Comments on the instrument:

Instrument has maintained calibration. In good condition. Cleaned and stored for next use.

Signed: J Moore

Date: 19/5/2019

APPENDIX

K

Aquatic Ecology Technical Report

Appendix D Laboratory Certificates of Analysis, Chain of Custody and Quality Control

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

IR_1534

Appendix D: Laboratory Certificates of Analysis, Chain of Custody and Quality Control

CHAIN OF CUSTODY

ALS Laboratory: *please tick →*

☐ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8162 5130 E: adelaide@alsglobal.com
☑BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 48 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com
☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
☐WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: Eco Logical Australia
OFFICE: Brisbane
PROJECT: Inland Rail - Border to Gowrie EIS PROJECT NO 10558
ORDER NUMBER: PURCHASE ORDER NO.:
PROJECT MANAGER: Miles Yeates CONTACT PH: 0467 738 954
SAMPLER: David Moore and Peter Hancock SAMPLER MOBILE:
COC Emailed to ALS? (YES / NO) EDD FORMAT (or default):
Email Reports to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au
Email Invoice to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☑ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO.: BN/142/18 V2
COUNTRY OF ORIGIN: Australia

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR LABORATORY USE ONLY (Circle)

Custody Seal Intact?	Yes	No	N/A
Free ice / frozen ice bricks present upon receipt?	Yes	No	N/A
Random Sample Temperature on Receipt:	°C		
Other comment:			

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
[signature]	DAVE R		
DATE/TIME: 15/6/18 3pm	DATE/TIME: 15/6/18 1507	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY LAB ID	SAMPLE DETAILS MATRIX: Solid(S) Water(W) SAMPLE ID	DATE / TIME	MATRIX	CONTAINER INFORMATION TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EA020-EC-P Conductivity and Salinity	EA025H Total Suspended Solids (TSS)	NT-1C Total Hardness as CaCO3	NT-8A Nutrients suite - Ammonia as N, Nitrite, Nitrate, Total N, TKN, NOx, Reactive P and Total P	EK060 Organic Nitrogen	W-2 Dissolved metals - 8 metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn and Hg) - samples are field filtered	EP075B SIM PAHs (16 analytes)	ophyll a (filter paper	Additional Information
1	Site 14	13/6/18 noon	W		4	X	X	X	X	X	X	X		These samples are Batch 1 of a nine day field trip. A second batch of samples will follow in 5-6 days time. All metals samples are field filtered. Frozen Chlorophyll a filter paper samples will be included in Batch 2 (not in this batch).
2	Site 42	12/6/18 noon	W		4	X	X	X	X	X	X	X		
3	Site 40	12/6/18 noon	W		4	X	X	X	X	X	X	X		
4	Site 39	12/6/18 noon	W		4	X	X	X	X	X	X	X		
5	Site 30	14/6/18 noon	W		4	X	X	X	X	X	X	X		
6	Site 27	15/6/18 noon	W		4	X	X	X	X	X	X	X		
7	Site 16	13/6/18 noon	W		4	X	X	X	X	X	X	X		
				TOTAL	28									

Environmental Division
Brisbane
Work Order Reference
EB1814632

Telephone : + 61-7-3243 7222

HT

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1814632**	Page	: 1 of 7
Client	: **ECO LOGICAL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Contact	: Customer Services EB
Address	: PO BOX 1422 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 02 8536 8667	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 15-Jun-2018 15:00
Order number	:	Date Analysis Commenced	: 15-Jun-2018
C-O-C number	: ----	Issue Date	: 21-Jun-2018 16:58
Sampler	: DAVID MOORE and PETER HANCOCK		
Site	: ----		
Quote number	: BN/142/18 V2		
No. of samples received	: 7		
No. of samples analysed	: 7		

ilac-MRA NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Matt Frost	Senior Organic Chemist	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP075(SIM): Matrix spike shows poor recovery. Insufficient sample for re-extraction and re-analysis.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 14	Site 42	Site 40	Site 39	Site 30
			Client sampling date / time	13-Jun-2018 00:00	12-Jun-2018 00:00	12-Jun-2018 00:00	12-Jun-2018 00:00	14-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EB1814632-001	EB1814632-002	EB1814632-003	EB1814632-004	EB1814632-005
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	207	1380	1380	2440	449
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.10	0.69	0.69	1.25	0.22
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	20	6	10	8	11
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	39	471	465	746	146
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	4	55	51	73	29
Magnesium	7439-95-4	1	mg/L	7	81	82	137	18
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.001
Nickel	7440-02-0	0.001	mg/L	0.001	0.002	0.002	0.004	0.003
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.25	0.02	0.02	0.04	0.02
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	1.25	<0.01	0.51	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	1.25	<0.01	0.52	<0.01
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	1.0	0.2	0.3	0.3	0.5
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.2	0.2	0.3	0.3	0.5
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 14	Site 42	Site 40	Site 39	Site 30
			Client sampling date / time	13-Jun-2018 00:00	12-Jun-2018 00:00	12-Jun-2018 00:00	12-Jun-2018 00:00	14-Jun-2018 00:00
Compound	CAS Number	LOR	Unit	EB1814632-001	EB1814632-002	EB1814632-003	EB1814632-004	EB1814632-005
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	1.2	1.4	0.3	0.8	0.5
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.03	0.01	0.02	0.02	0.07
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	26.6	29.0	25.7	26.1	29.8
2-Chlorophenol-D4	93951-73-6	1.0	%	74.9	74.4	69.9	69.2	76.1
2.4.6-Tribromophenol	118-79-6	1.0	%	61.2	52.6	48.6	46.4	52.2
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	79.1	78.2	75.7	79.4	82.1
Anthracene-d10	1719-06-8	1.0	%	105	103	95.9	101	108
4-Terphenyl-d14	1718-51-0	1.0	%	104	105	101	107	120

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 27	Site 16	----	----	----
			Client sampling date / time	15-Jun-2018 00:00	13-Jun-2018 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1814632-006	EB1814632-007	-------	-------	-------
				Result	Result	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	582	225	----	----	----
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.28	0.11	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	28	32	----	----	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	199	51	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	40	14	----	----	----
Magnesium	7439-95-4	1	mg/L	24	4	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	0.002	<0.001	----	----	----
Nickel	7440-02-0	0.001	mg/L	0.006	0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.03	0.02	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	----	----	----
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	0.9	1.0	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.9	1.0	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 27	Site 16	----	----	----
			Client sampling date / time	15-Jun-2018 00:00	13-Jun-2018 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1814632-006	EB1814632-007	-------	-------	-------
				Result	Result	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	0.9	1.0	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.11	0.11	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	28.2	26.8	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	73.3	74.3	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	46.5	53.2	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	84.1	82.7	----	----	----
Anthracene-d10	1719-06-8	1.0	%	103	101	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	115	113	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	72
2-Chlorophenol-D4	93951-73-6	27	130
2.4.6-Tribromophenol	118-79-6	19	181
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	14	146
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	36	154

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EB1814632	Page	: 1 of 10
Client	: ECO LOGICAL AUSTRALIA PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 15-Jun-2018
Site	: ----	Issue Date	: 21-Jun-2018
Sampler	: DAVID MOORE and PETER HANCOCK	No. of samples received	: 7
Order number	:	No. of samples analysed	: 7

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EK055G: Ammonia as N by Discrete Analyser	EB1814627--002	Anonymous	**Ammonia as N**	7664-41-7	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		*Date extracted*	*Due for extraction*	***Days overdue***	*Date analysed*	*Due for analysis*	***Days overdue***
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural							
Site 42, Site 39	Site 40,	----	----	----	15-Jun-2018	14-Jun-2018	1
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural							
Site 42, Site 39	Site 40,	----	----	----	15-Jun-2018	14-Jun-2018	1

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	11	0.00	10.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	*Sample Date*	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		***Date extracted***	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P) Site 42, Site 40, Site 39	12-Jun-2018	----	----	----	19-Jun-2018	10-Jul-2018	✓
Clear Plastic Bottle - Natural (EA010-P) Site 14, Site 16	13-Jun-2018	----	----	----	19-Jun-2018	11-Jul-2018	✓
Clear Plastic Bottle - Natural (EA010-P) Site 30	14-Jun-2018	----	----	----	19-Jun-2018	12-Jul-2018	✓
Clear Plastic Bottle - Natural (EA010-P) Site 27	15-Jun-2018	----	----	----	19-Jun-2018	13-Jul-2018	✓
EA025: Total Suspended Solids dried at 104 ± 2°C							
Clear Plastic Bottle - Natural (EA025H) Site 42, Site 40, Site 39	12-Jun-2018	----	----	----	19-Jun-2018	19-Jun-2018	✓
Clear Plastic Bottle - Natural (EA025H) Site 14, Site 16	13-Jun-2018	----	----	----	19-Jun-2018	20-Jun-2018	✓
Clear Plastic Bottle - Natural (EA025H) Site 30	14-Jun-2018	----	----	----	19-Jun-2018	21-Jun-2018	✓
Clear Plastic Bottle - Natural (EA025H) Site 27	15-Jun-2018	----	----	----	19-Jun-2018	22-Jun-2018	✓
EA065: Total Hardness as CaCO3							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 42, Site 40, Site 39	12-Jun-2018	----	----	----	20-Jun-2018	10-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 14, Site 16	13-Jun-2018	----	----	----	20-Jun-2018	11-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 30	14-Jun-2018	----	----	----	20-Jun-2018	12-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 27	15-Jun-2018	----	----	----	20-Jun-2018	13-Jul-2018	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 42, Site 40, Site 39	12-Jun-2018	----	----	----	20-Jun-2018	10-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 14, Site 16	13-Jun-2018	----	----	----	20-Jun-2018	11-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 30	14-Jun-2018	----	----	----	20-Jun-2018	12-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 27	15-Jun-2018	----	----	----	20-Jun-2018	13-Jul-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) Site 42, Site 40, Site 39	**12-Jun-2018**	----	----	----	**20-Jun-2018**	09-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) Site 14, Site 16	**13-Jun-2018**	----	----	----	**20-Jun-2018**	10-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) Site 30	**14-Jun-2018**	----	----	----	**20-Jun-2018**	11-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) Site 27	**15-Jun-2018**	----	----	----	**20-Jun-2018**	12-Dec-2018	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) Site 42, Site 40, Site 39	**12-Jun-2018**	----	----	----	**20-Jun-2018**	10-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) Site 14, Site 16	**13-Jun-2018**	----	----	----	**20-Jun-2018**	11-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) Site 30	**14-Jun-2018**	----	----	----	**20-Jun-2018**	12-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) Site 27	**15-Jun-2018**	----	----	----	**20-Jun-2018**	13-Jul-2018	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) Site 42, Site 40, Site 39	**12-Jun-2018**	----	----	----	**18-Jun-2018**	10-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) Site 14, Site 16	**13-Jun-2018**	----	----	----	**18-Jun-2018**	11-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) Site 30	**14-Jun-2018**	----	----	----	**18-Jun-2018**	12-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) Site 27	**15-Jun-2018**	----	----	----	**18-Jun-2018**	13-Jul-2018	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) Site 42, Site 40, Site 39	**12-Jun-2018**	----	----	----	**15-Jun-2018**	14-Jun-2018	×
Clear Plastic Bottle - Natural (EK057G) Site 14, Site 16	**13-Jun-2018**	----	----	----	**15-Jun-2018**	15-Jun-2018	✓
Clear Plastic Bottle - Natural (EK057G) Site 30	**14-Jun-2018**	----	----	----	**15-Jun-2018**	16-Jun-2018	✓
Clear Plastic Bottle - Natural (EK057G) Site 27	**15-Jun-2018**	----	----	----	**15-Jun-2018**	17-Jun-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 42, Site 39	Site 40,	12-Jun-2018	----	----	----	18-Jun-2018	10-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 14,	Site 16	13-Jun-2018	----	----	----	18-Jun-2018	11-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 30		14-Jun-2018	----	----	----	18-Jun-2018	12-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 27		15-Jun-2018	----	----	----	18-Jun-2018	13-Jul-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 42, Site 39	Site 40,	12-Jun-2018	19-Jun-2018	10-Jul-2018	✓	19-Jun-2018	10-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 14,	Site 16	13-Jun-2018	19-Jun-2018	11-Jul-2018	✓	19-Jun-2018	11-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 30		14-Jun-2018	19-Jun-2018	12-Jul-2018	✓	19-Jun-2018	12-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 27		15-Jun-2018	19-Jun-2018	13-Jul-2018	✓	19-Jun-2018	13-Jul-2018	✓
EK067G: Total Phosphorus as P by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 42, Site 39	Site 40,	12-Jun-2018	19-Jun-2018	10-Jul-2018	✓	19-Jun-2018	10-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 14,	Site 16	13-Jun-2018	19-Jun-2018	11-Jul-2018	✓	19-Jun-2018	11-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 30		14-Jun-2018	19-Jun-2018	12-Jul-2018	✓	19-Jun-2018	12-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 27		15-Jun-2018	19-Jun-2018	13-Jul-2018	✓	19-Jun-2018	13-Jul-2018	✓
EK071G: Reactive Phosphorus as P by discrete analyser								
Clear Plastic Bottle - Natural (EK071G) Site 42, Site 39	Site 40,	12-Jun-2018	----	----	----	15-Jun-2018	14-Jun-2018	×
Clear Plastic Bottle - Natural (EK071G) Site 14,	Site 16	13-Jun-2018	----	----	----	15-Jun-2018	15-Jun-2018	✓
Clear Plastic Bottle - Natural (EK071G) Site 30		14-Jun-2018	----	----	----	15-Jun-2018	16-Jun-2018	✓
Clear Plastic Bottle - Natural (EK071G) Site 27		15-Jun-2018	----	----	----	15-Jun-2018	17-Jun-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 42, Site 40, Site 39	**12-Jun-2018**	**19-Jun-2018**	19-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 14, Site 16	**13-Jun-2018**	**19-Jun-2018**	20-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 30	**14-Jun-2018**	**19-Jun-2018**	21-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 27	**15-Jun-2018**	**19-Jun-2018**	22-Jun-2018	✓	**20-Jun-2018**	29-Jul-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	3	26	11.54	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	8	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	7	28.57	10.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	11	0.00	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	7	14.29	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	1	7	14.29	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	26	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	2	7	28.57	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	26	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Method Blanks (MB) - Continued							
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	26	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Salinity	EA020-EC-P	WATER	In house: Referenced to APHA 2520B. Calculation from Electrical conductivity. This method is compliant with NEPM (2013) Schedule B(3)
Suspended Solids (High Level)	EA025H	WATER	In house: Referenced to APHA 2540D. A gravimetric procedure employed to determine the amount of `non-filterable` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (2013) Schedule B(3)
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Organic Nitrogen as N (TKN - NH3) (discrete analyser)	EK060G	WATER	In house: Referenced to APHA 4500-Norg/4500-NH3. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

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☑BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com
☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
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☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
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Environmental Division
Brisbane
Work Order Reference
EB1814715

Telephone: + 61-7-3243 7222

6.7°
5.7°

CLIENT: Eco Logical Australia
OFFICE: Brisbane
PROJECT: Inland Rail - Border to Gowrie EIS PROJECT NO 10558
ORDER NUMBER: PURCHASE ORDER NO.:
PROJECT MANAGER: Miles Yeates CONTACT PH: 0467 738 954
SAMPLER: David Moore and Loren Appleby SAMPLER MOBILE:
COC Emailed to ALS? (YES / NO) EDD FORMAT (or default):
Email Reports to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au
Email Invoice to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au

TURNAROUND REQUIREMENTS : ☑ Standard TAT (List due date):
(Standard TAT may be longer for some tests e.g.. Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):
ALS QUOTE NO.: BN/142/18 V2
COUNTRY OF ORIGIN: Australia

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

RELINQUISHED BY:
DATE/TIME: 18

RECEIVED BY: Jess H
DATE/TIME: 18/6/18 1.40

N/A
N/A

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EA020-EC-P Conductivity and Salinity	EA025H Total Suspended Solids (TSS)	NT-1C Total Hardness as CaCO3	NT-8A Nutrients suite - Ammonia as N, Nitrite, Nitrate, Total N, TKN, NOx, Reactive P and Total P	EK060 Organic Nitrogen	W-2 Dissolved metals - 8 metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn and Hg) - samples are field filtered	EP075B SIM PAHs (16 analytes)	EP008 Chlorophyll a (filter paper method)	These samples are Batch 2 of a seven day field trip. Batch 1 samples were delivered on Friday 15/6/18 (EB1814632). All metals samples are field filtered. Frozen Chlorophyll a filter paper samples are included in this work order for both batches. Filter paper is 47mm GFF ~0.7 micron. Filtered volume is noted below and on jar. Filter paper was foil wrapped and kept frozen at -17°C up to delivery.
1	Site 14	13/6/18 noon	W		1								X	Chl a: vol filtered 1,000 mL
2	Site 42	12/6/18 noon	W		1								X	Chl a: vol filtered 1,000 mL
3	Site 40	12/6/18 noon	W		1								X	Chl a: vol filtered 1,000 mL
4	Site 39	12/6/18 noon	W		1								X	Chl a: vol filtered 1,000 mL
5	Site 30	14/6/18 noon	W		1								X	Chl a: vol filtered 600 mL
6	Site 27	15/6/18 noon	W		1								X	Chl a: vol filtered 425 mL
7	Site 16	13/6/18 noon	W		1								X	Chl a: vol filtered 275 mL
8	Site 1R	16/6/18 noon	W		5	X	X	X	X	X	X	X	X	Chl a: vol filtered 500 mL
9	Site 2R	16/6/18 noon	W		5	X	X	X	X	X	X	X	X	Chl a: vol filtered 800 mL
10	Site 3	17/6/18 noon	W		5	X	X	X	X	X	X	X	X	Chl a: vol filtered 600 mL
11	Site 6	16/6/18 noon	W		5	X	X	X	X	X	X	X	X	Chl a: vol filtered 475 mL
12	Site 7	17/6/18 noon	W		5	X	X	X	X	X	X	X	X	Chl a: vol filtered 600 mL
13	Site 11	15/6/18 noon	W		5	X	X	X	X	X	X	X	X	Chl a: vol filtered 400 mL
14	DUP	16/6/18 noon	W		6	X	X	X	X	X	X	X		Duplicate of another site. 2 extra lab QA/QC amber bottles from this site.
15	FB	16/6/18 noon	W		4	X	X	X	X	X	X	X		Field blank sample
16	Site 24	18/6/18 noon	W		5	X	X	X	X	X	X	X	X	Chl a: vol filtered 250 mL
				TOTAL										

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CERTIFICATE OF ANALYSIS

Work Order	: **EB1814715**	Page	: 1 of 13
Client	: **ECO LOGICAL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Contact	: Customer Services EB
Address	: PO BOX 1422 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 02 8536 8667	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 18-Jun-2018 13:40
Order number	:	Date Analysis Commenced	: 19-Jun-2018
C-O-C number	: ----	Issue Date	: 22-Jun-2018 16:47
Sampler	: David Moore and Loren Appleby		
Site	:		
Quote number	: BN/142/18 V2		
No. of samples received	: 16		
No. of samples analysed	: 16		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP008 (Chlorphyll): The LOR has been raised due to the volume of filtered sample recieved
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 14	Site 42	Site 40	Site 39	Site 30
			Client sampling date / time	13-Jun-2018 12:00	12-Jun-2018 12:00	12-Jun-2018 12:00	12-Jun-2018 12:00	14-Jun-2018 12:00
Compound	CAS Number	LOR	Unit	EB1814715-001	EB1814715-002	EB1814715-003	EB1814715-004	EB1814715-005
				Result	Result	Result	Result	Result
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	<1	<1	<1	<1	<2
Volume	----	0.01	L	1	1	1	1	.6

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 27	Site 16	Site 1R	Site 2R	Site 3
			Client sampling date / time	15-Jun-2018 12:00	13-Jun-2018 12:00	16-Jun-2018 12:00	16-Jun-2018 12:00	17-Jun-2018 12:00
Compound	CAS Number	LOR	Unit	EB1814715-006	EB1814715-007	EB1814715-008	EB1814715-009	EB1814715-010
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	298	251	410
EA020EC: Salinity								
Salinity	----	0.01	g/kg	----	----	0.14	0.12	0.20
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	----	----	28	<5	<5
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	----	----	78	58	69
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	----	----	13	10	11
Magnesium	7439-95-4	1	mg/L	----	----	11	8	10
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	----	----	0.002	0.002	<0.001
Cadmium	7440-43-9	0.0001	mg/L	----	----	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	----	----	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	----	----	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	----	----	0.002	0.002	<0.001
Lead	7439-92-1	0.001	mg/L	----	----	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	----	----	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	----	----	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	----	----	0.02	0.02	0.04
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	----	----	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	----	----	<0.01	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	----	----	<0.01	<0.01	<0.01
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	----	----	0.6	0.5	0.8
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	----	----	0.6	0.5	0.8
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 27	Site 16	Site 1R	Site 2R	Site 3
			Client sampling date / time	15-Jun-2018 12:00	13-Jun-2018 12:00	16-Jun-2018 12:00	16-Jun-2018 12:00	17-Jun-2018 12:00
Compound	CAS Number	LOR	Unit	EB1814715-006	EB1814715-007	EB1814715-008	EB1814715-009	EB1814715-010
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	----	----	0.6	0.5	0.8
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	----	----	0.10	0.05	0.04
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	----	----	<0.01	0.01	<0.01
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	5	<4	<2	<1	<2
Volume	----	0.01	L	.425	.275	.5	.8	.6
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	----	----	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	----	----	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	----	----	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	----	----	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	----	----	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	----	----	23.5	24.4	25.2
2-Chlorophenol-D4	93951-73-6	1.0	%	----	----	66.8	67.9	69.3
2.4.6-Tribromophenol	118-79-6	1.0	%	----	----	43.0	39.7	39.2
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	----	----	76.3	80.3	80.7
Anthracene-d10	1719-06-8	1.0	%	----	----	77.6	78.4	77.2

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 27	Site 16	Site 1R	Site 2R	Site 3
			Client sampling date / time	15-Jun-2018 12:00	13-Jun-2018 12:00	16-Jun-2018 12:00	16-Jun-2018 12:00	17-Jun-2018 12:00
Compound	CAS Number	LOR	Unit	EB1814715-006	EB1814715-007	EB1814715-008	EB1814715-009	EB1814715-010
				Result	Result	Result	Result	Result
EP075(SIM)T: PAH Surrogates - Continued								
4-Terphenyl-d14	1718-51-0	1.0	%	----	----	86.2	91.6	90.0

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 6	Site 7	Site 11	DUP	FB
			Client sampling date / time	16-Jun-2018 12:00	17-Jun-2018 12:00	15-Jun-2018 12:00	16-Jun-2018 12:00	16-Jun-2018 12:00
Compound	CAS Number	LOR	Unit	EB1814715-011	EB1814715-012	EB1814715-013	EB1814715-014	EB1814715-015
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	352	356	315	352	2
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.17	0.17	0.15	0.17	0.01
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	20	18	15	11	<5
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	55	60	56	60	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	9	9	11	9	<1
Magnesium	7439-95-4	1	mg/L	8	9	7	9	<1
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	0.001	0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.03	0.04	0.02	0.04	<0.01
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.05	0.15	0.02	0.05	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.05	0.15	0.02	0.05	<0.01
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	0.8	0.9	0.9	0.8	<0.1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.8	0.9	0.9	0.8	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 6	Site 7	Site 11	DUP	FB
			Client sampling date / time	16-Jun-2018 12:00	17-Jun-2018 12:00	15-Jun-2018 12:00	16-Jun-2018 12:00	16-Jun-2018 12:00
Compound	CAS Number	LOR	Unit	EB1814715-011	EB1814715-012	EB1814715-013	EB1814715-014	EB1814715-015
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	0.8	1.0	0.9	0.8	<0.1
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.04	0.04	0.06	0.03	0.01
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	<2	<2	<2	----	----
Volume	----	0.01	L	.475	.6	.4	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	23.2	20.2	21.0	22.4	21.7
2-Chlorophenol-D4	93951-73-6	1.0	%	63.0	57.2	58.6	64.5	61.7
2.4.6-Tribromophenol	118-79-6	1.0	%	36.0	32.4	32.8	36.2	36.9
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	73.6	70.4	71.2	78.6	68.2
Anthracene-d10	1719-06-8	1.0	%	72.6	68.3	69.3	78.5	69.2

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 6	Site 7	Site 11	DUP	FB
			Client sampling date / time	16-Jun-2018 12:00	17-Jun-2018 12:00	15-Jun-2018 12:00	16-Jun-2018 12:00	16-Jun-2018 12:00
Compound	CAS Number	LOR	Unit	EB1814715-011	EB1814715-012	EB1814715-013	EB1814715-014	EB1814715-015
				Result	Result	Result	Result	Result
EP075(SIM)T: PAH Surrogates - Continued								
4-Terphenyl-d14	1718-51-0	1.0	%	85.1	78.9	82.4	94.3	85.0

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 24	----	----	----	----
			Client sampling date / time	18-Jun-2018 12:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB1814715-016	-------	-------	-------	-------
				Result	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	339	----	----	----	----
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.16	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	98	----	----	----	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	80	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	14	----	----	----	----
Magnesium	7439-95-4	1	mg/L	11	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	0.005	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.04	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	----	----	----	----
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	0.5	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.5	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 24	----	----	----	----
			Client sampling date / time	18-Jun-2018 12:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB1814715-016	-------	-------	-------	-------
				Result	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	**0.5**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.07**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	----	----	----	----
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	<4	----	----	----	----
Volume	----	0.01	L	**.25**	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	**21.2**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	**60.3**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	**32.3**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**72.2**	----	----	----	----
Anthracene-d10	1719-06-8	1.0	%	**72.1**	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 24	----	----	----	----
			Client sampling date / time	18-Jun-2018 12:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB1814715-016	-------	-------	-------	-------
				Result	----	----	----	----
EP075(SIM)T: PAH Surrogates - Continued								
4-Terphenyl-d14	1718-51-0	1.0	%	82.4	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	72
2-Chlorophenol-D4	93951-73-6	27	130
2.4.6-Tribromophenol	118-79-6	19	181
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	14	146
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	36	154

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EB1814715	Page	: 1 of 10
Client	: ECO LOGICAL AUSTRALIA PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 18-Jun-2018
Site	:	Issue Date	: 22-Jun-2018
Sampler	: David Moore and Loren Appleby	No. of samples received	: 16
Order number	:	No. of samples analysed	: 16

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method Container / Client Sample ID(s)		Extraction / Preparation Date extracted	Due for extraction	Days overdue	Analysis Date analysed	Due for analysis	Days overdue
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural							
Site 11		----	----	----	19-Jun-2018	17-Jun-2018	2
Clear Plastic Bottle - Natural							
Site 1R,	Site 2R,	----	----	----	19-Jun-2018	18-Jun-2018	1
Site 6,	DUP,						
FB							
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural							
Site 11		----	----	----	19-Jun-2018	17-Jun-2018	2
Clear Plastic Bottle - Natural							
Site 1R,	Site 2R,	----	----	----	19-Jun-2018	18-Jun-2018	1
Site 6,	DUP,						
FB							

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type Method	Count QC	Regular	Rate (%) Actual	Expected	Quality Control Specification
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	1	20	5.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	0	20	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation Date extracted	Due for extraction	Evaluation	Analysis Date analysed	Due for analysis	Evaluation

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P) Site 11	15-Jun-2018	----	----	----	21-Jun-2018	13-Jul-2018	✓
Clear Plastic Bottle - Natural (EA010-P) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	----	----	----	21-Jun-2018	14-Jul-2018	✓
Clear Plastic Bottle - Natural (EA010-P) Site 3, Site 7	17-Jun-2018	----	----	----	21-Jun-2018	15-Jul-2018	✓
Clear Plastic Bottle - Natural (EA010-P) Site 24	18-Jun-2018	----	----	----	21-Jun-2018	16-Jul-2018	✓
EA025: Total Suspended Solids dried at 104 ± 2°C							
Clear Plastic Bottle - Natural (EA025H) Site 11	15-Jun-2018	----	----	----	20-Jun-2018	22-Jun-2018	✓
Clear Plastic Bottle - Natural (EA025H) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	----	----	----	20-Jun-2018	23-Jun-2018	✓
Clear Plastic Bottle - Natural (EA025H) Site 3, Site 7	17-Jun-2018	----	----	----	20-Jun-2018	24-Jun-2018	✓
Clear Plastic Bottle - Natural (EA025H) Site 24	18-Jun-2018	----	----	----	21-Jun-2018	25-Jun-2018	✓
EA065: Total Hardness as CaCO3							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 11	15-Jun-2018	----	----	----	19-Jun-2018	13-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	----	----	----	19-Jun-2018	14-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 3, Site 7	17-Jun-2018	----	----	----	19-Jun-2018	15-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 24	18-Jun-2018	----	----	----	19-Jun-2018	16-Jul-2018	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 11	15-Jun-2018	----	----	----	19-Jun-2018	13-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	----	----	----	19-Jun-2018	14-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 3, Site 7	17-Jun-2018	----	----	----	19-Jun-2018	15-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 24	18-Jun-2018	----	----	----	19-Jun-2018	16-Jul-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / **Container** / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) Site 11	15-Jun-2018	----	----	----	19-Jun-2018	12-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	----	----	----	19-Jun-2018	13-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) Site 3, Site 7	17-Jun-2018	----	----	----	19-Jun-2018	14-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) Site 24	18-Jun-2018	----	----	----	19-Jun-2018	15-Dec-2018	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) Site 11	15-Jun-2018	----	----	----	19-Jun-2018	13-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	----	----	----	19-Jun-2018	14-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) Site 3, Site 7	17-Jun-2018	----	----	----	19-Jun-2018	15-Jul-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) Site 24	18-Jun-2018	----	----	----	19-Jun-2018	16-Jul-2018	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) Site 11	15-Jun-2018	----	----	----	19-Jun-2018	13-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	----	----	----	19-Jun-2018	14-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) Site 3, Site 7	17-Jun-2018	----	----	----	19-Jun-2018	15-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) Site 24	18-Jun-2018	----	----	----	19-Jun-2018	16-Jul-2018	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) Site 11	15-Jun-2018	----	----	----	19-Jun-2018	17-Jun-2018	×
Clear Plastic Bottle - Natural (EK057G) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	----	----	----	19-Jun-2018	18-Jun-2018	×
Clear Plastic Bottle - Natural (EK057G) Site 3, Site 7	17-Jun-2018	----	----	----	19-Jun-2018	19-Jun-2018	✓
Clear Plastic Bottle - Natural (EK057G) Site 24	18-Jun-2018	----	----	----	19-Jun-2018	20-Jun-2018	✓

Work Order : EB1814715
Client : ECO LOGICAL AUSTRALIA PTY LTD
Project : 10558 Inland Rail - Border to Gowie EIS

Matrix: **WATER**

Evaluation: ✘ = Holding time breach ; ✓ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 11	15-Jun-2018	----	----	----	19-Jun-2018	13-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	----	----	----	19-Jun-2018	14-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 3, Site 7	17-Jun-2018	----	----	----	19-Jun-2018	15-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 24	18-Jun-2018	----	----	----	19-Jun-2018	16-Jul-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 11	15-Jun-2018	19-Jun-2018	13-Jul-2018	✓	19-Jun-2018	13-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	19-Jun-2018	14-Jul-2018	✓	19-Jun-2018	14-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 3, Site 7	17-Jun-2018	19-Jun-2018	15-Jul-2018	✓	19-Jun-2018	15-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 24	18-Jun-2018	19-Jun-2018	16-Jul-2018	✓	19-Jun-2018	16-Jul-2018	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 11	15-Jun-2018	19-Jun-2018	13-Jul-2018	✓	19-Jun-2018	13-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	19-Jun-2018	14-Jul-2018	✓	19-Jun-2018	14-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 3, Site 7	17-Jun-2018	19-Jun-2018	15-Jul-2018	✓	19-Jun-2018	15-Jul-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 24	18-Jun-2018	19-Jun-2018	16-Jul-2018	✓	19-Jun-2018	16-Jul-2018	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G) Site 11	15-Jun-2018	----	----	----	19-Jun-2018	17-Jun-2018	✘
Clear Plastic Bottle - Natural (EK071G) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	----	----	----	19-Jun-2018	18-Jun-2018	✘
Clear Plastic Bottle - Natural (EK071G) Site 3, Site 7	17-Jun-2018	----	----	----	19-Jun-2018	19-Jun-2018	✓
Clear Plastic Bottle - Natural (EK071G) Site 24	18-Jun-2018	----	----	----	19-Jun-2018	20-Jun-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EP008: Chlorophyll a & Pheophytin a							
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 42, Site 40, Site 39	12-Jun-2018	----	----	----	19-Jun-2018	03-Jul-2018	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 14, Site 16	13-Jun-2018	----	----	----	19-Jun-2018	04-Jul-2018	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 30	14-Jun-2018	----	----	----	19-Jun-2018	05-Jul-2018	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 27, Site 11	15-Jun-2018	----	----	----	19-Jun-2018	06-Jul-2018	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 1R, Site 2R, Site 6	16-Jun-2018	----	----	----	19-Jun-2018	07-Jul-2018	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 3, Site 7	17-Jun-2018	----	----	----	19-Jun-2018	08-Jul-2018	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 24	18-Jun-2018	----	----	----	19-Jun-2018	09-Jul-2018	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 11	15-Jun-2018	20-Jun-2018	22-Jun-2018	✓	21-Jun-2018	30-Jul-2018	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 1R, Site 2R, Site 6, DUP, FB	16-Jun-2018	20-Jun-2018	23-Jun-2018	✓	21-Jun-2018	30-Jul-2018	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 3, Site 7	17-Jun-2018	20-Jun-2018	24-Jun-2018	✓	21-Jun-2018	30-Jul-2018	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 24	18-Jun-2018	20-Jun-2018	25-Jun-2018	✓	21-Jun-2018	30-Jul-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✘ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	3	28	10.71	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	20	5.00	10.00	✘	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	11	18.18	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	4	35	11.43	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chlorophyll a and Pheophytin a	EP008	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	4	35	11.43	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chlorophyll a and Pheophytin a	EP008	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	28	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	11	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✖ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		*Count*		*Rate (%)*			*Quality Control Specification*
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Method Blanks (MB) - Continued							
Suspended Solids (High Level)	EA025H	2	35	**5.71**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	20	**0.00**	**5.00**	✖	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Salinity	EA020-EC-P	WATER	In house: Referenced to APHA 2520B. Calculation from Electrical conductivity. This method is compliant with NEPM (2013) Schedule B(3)
Suspended Solids (High Level)	EA025H	WATER	In house: Referenced to APHA 2540D. A gravimetric procedure employed to determine the amount of `non-filterable` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (2013) Schedule B(3)
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Organic Nitrogen as N (TKN - NH3) (discrete analyser)	EK060G	WATER	In house: Referenced to APHA 4500-Norg/4500-NH3. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Chlorophyll a and Pheophytin a	EP008	WATER	In house: Referenced to APHA 10200 H. The pigments are extracted into aqueous acetone. The optical density of the extract before and after acidification at both 664 nm and 665 nm is determined spectrometrically.
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

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☐GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com
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Environmental Division
Brisbane
Work Order Reference
EB1829378

Telephone : + 61-7-3243 7222

CLIENT: Eco Logical Australia
OFFICE: Brisbane
PROJECT: Inland Rail - Border to Gowrie EIS — PROJECT NO 10558
ORDER NUMBER: — PURCHASE ORDER NO.:
PROJECT MANAGER: Miles Yeates — CONTACT PH: 0467 738 954
SAMPLER: David Moore and Peter Hancock — SAMPLER MOBILE:
COC Emailed to ALS? (YES / NO) — EDD FORMAT (or default):
Email Reports to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au
Email Invoice to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☐ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: BN/142/18 V2
COUNTRY OF ORIGIN: Australia

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

FOR L… Custody… Free ice… receipt? N/A … Random… N/A … Other c…

RELINQUISHED BY: [signature]
DATE/TIME: 11.50am 30/11/18

RECEIVED BY: DEAN M
DATE/TIME: 30-11-18 1245

RELINQUIS…
DATE/TIME

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY LAB ID	SAMPLE DETAILS MATRIX: Solid(S) Water(W) SAMPLE ID	DATE / TIME	MATRIX	CONTAINER INFORMATION TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EA020-EC-P Conductivity and Salinity	EA025H Total Suspended Solids (TSS)	NT-1C Total Hardness as CaCO3	NT-8A Nutrients suite - Ammonia as N, Nitrite, Nitrate, Total N, TKN, NOx, Reactive P and Total P	EK060 Organic Nitrogen	W-2 Dissolved metals - 8 metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn and Hg) - samples are field filtered	EP075B SIM PAHs (16 analytes)	EP008 Chlorophyll a (filter paper method)	Additional Information
1	Site 14	29/11/18	W		4	X	X	X	X	X	X	X		These samples are Batch 1 of a nine day field trip. A second batch of samples will follow in 3-4 days time. All metals samples are field filtered.
2	Site 2R	27/11/18	W		4	X	X	X	X	X	X	X		
3	Site 2	29/11/18	W		4	X	X	X	X	X	X	X		
4	Site 16	28/11/18	W		4	X	X	X	X	X	X	X		
5	Site 11	28/11/18	W		4	X	X	X	X	X	X	X		
6	Site 3	27/11/18	W		4	X	X	X	X	X	X	X		
7	DUP	27/11/18	W		6	X	X	X	X	X	X	X		2 QA/QC Amber bottles
8	FB	29/11/18	W		4	X	X	X	X	X	X	X		
9	Site 6	27/11/18	W		4	X	X	X	X	X	X	X		
10	Site 33	26/11/18	W		4	X	X	X	X	X	X	X		
11	Site 7	27/11/18	W		4	X	X	X	X	X	X	X		
				TOTAL	46									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1829378**	Page	: 1 of 9
Client	: **ECO LOGICAL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Contact	: Customer Services EB
Address	: PO BOX 1422 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 02 8536 8667	Telephone	: +61-7-3243 7222
Project	: Inland Rail - Border to Gowrie EIS	Date Samples Received	: 30-Nov-2018 12:45
Order number	: 10558	Date Analysis Commenced	: 01-Dec-2018
C-O-C number	: ----	Issue Date	: 07-Dec-2018 08:35
Sampler	: DAVID MOORE, PETER HANCOCK		
Site	:		
Quote number	: BN/142/18 V2		
No. of samples received	: 11		
No. of samples analysed	: 11		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Minh Wills	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Tom Maloney	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP075(SIM): Matrix spike shows poor recovery. Insufficient sample for re-extraction and re-analysis.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	14	2R	2	16	11
			Client sampling date / time	29-Nov-2018 00:00	27-Nov-2018 00:00	29-Nov-2018 00:00	28-Nov-2018 00:00	28-Nov-2018 00:00
Compound	CAS Number	LOR	Unit	EB1829378-001	EB1829378-002	EB1829378-003	EB1829378-004	EB1829378-005
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	232	214	213	359	274
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.11	0.10	0.10	0.17	0.13
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	43	27	56	14
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	50	67	71	100	57
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	5	12	12	27	13
Magnesium	7439-95-4	1	mg/L	9	9	10	8	6
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	0.001	0.003	0.003	0.001	0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.002	0.002	<0.001
Nickel	7440-02-0	0.001	mg/L	0.001	0.002	0.002	0.002	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	<0.01	<0.01	0.06	<0.01
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	0.02	<0.01	0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.02	<0.01	0.01	<0.01
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	0.7	0.5	0.5	1.3	1.2
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.7	0.5	0.5	1.4	1.2
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

			Client sample ID	14	2R	2	16	11
			Client sampling date / time	29-Nov-2018 00:00	27-Nov-2018 00:00	29-Nov-2018 00:00	28-Nov-2018 00:00	28-Nov-2018 00:00
Compound	CAS Number	LOR	Unit	EB1829378-001	EB1829378-002	EB1829378-003	EB1829378-004	EB1829378-005
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	0.7	0.5	0.5	1.4	1.2
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.03	0.15	0.12	0.17	0.11
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.04	0.04	<0.01	<0.01
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	28.7	26.6	21.4	22.9	20.0
2-Chlorophenol-D4	93951-73-6	1.0	%	76.6	69.6	62.1	61.7	55.8
2.4.6-Tribromophenol	118-79-6	1.0	%	58.3	52.3	47.0	44.7	42.0
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	97.9	73.9	85.2	82.1	75.9
Anthracene-d10	1719-06-8	1.0	%	95.9	90.7	80.6	79.9	74.3
4-Terphenyl-d14	1718-51-0	1.0	%	115	93.3	97.0	93.7	89.0

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

			Client sample ID	3	DUP	FB	6	33
			Client sampling date / time	27-Nov-2018 00:00	27-Nov-2018 00:00	29-Nov-2018 00:00	27-Nov-2018 00:00	26-Nov-2018 00:00
Compound	CAS Number	LOR	Unit	EB1829378-006	EB1829378-007	EB1829378-008	EB1829378-009	EB1829378-010
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	386	388	<1	411	198
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.19	0.19	<0.01	0.20	0.10
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	<5	<5	<5	14	15
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	76	76	<1	79	59
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	14	14	<1	15	12
Magnesium	7439-95-4	1	mg/L	10	10	<1	10	7
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	<0.001	0.002	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.001	<0.001	<0.001	<0.001	0.004
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.008
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	<0.01	0.03	<0.01	0.03
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	0.01	<0.01	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.01	<0.01	<0.01	<0.01
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	0.6	0.7	<0.1	0.7	1.0
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.6	0.7	<0.1	0.7	1.0
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	3	DUP	FB	6	33
			Client sampling date / time	27-Nov-2018 00:00	27-Nov-2018 00:00	29-Nov-2018 00:00	27-Nov-2018 00:00	26-Nov-2018 00:00
Compound	CAS Number	LOR	Unit	EB1829378-006	EB1829378-007	EB1829378-008	EB1829378-009	EB1829378-010
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	**0.6**	**0.7**	<0.1	**0.7**	**1.0**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.04**	**0.04**	<0.01	**0.05**	**0.23**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	**0.05**
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	**23.5**	**29.6**	**24.3**	**26.0**	**26.8**
2-Chlorophenol-D4	93951-73-6	1.0	%	**63.3**	**73.6**	**67.7**	**70.0**	**65.3**
2.4.6-Tribromophenol	118-79-6	1.0	%	**48.8**	**55.2**	**54.2**	**53.8**	**57.6**
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**68.3**	**71.5**	**81.2**	**73.9**	**76.1**
Anthracene-d10	1719-06-8	1.0	%	**88.1**	**89.0**	**76.0**	**107**	**84.0**
4-Terphenyl-d14	1718-51-0	1.0	%	**91.0**	**92.2**	**92.2**	**110**	**88.1**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	7	----	----	----	----
			Client sampling date / time	27-Nov-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB1829378-011	-------	-------	-------	-------
				Result	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**416**	----	----	----	----
EA020EC: Salinity								
Salinity	----	0.01	g/kg	**0.20**	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**9**	----	----	----	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**79**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**15**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**10**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.002**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.02**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.02**	----	----	----	----
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	**0.7**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.7**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	7	----	----	----	----
			Client sampling date / time	27-Nov-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB1829378-011	-------	-------	-------	-------
				Result	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	**0.7**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.06**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	----	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	----	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	----	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	----	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	----	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	----	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	----	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	----	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	----	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	----	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	----	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	----	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	----	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	----	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	----	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	----	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	----	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	**29.3**	----	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	**71.8**	----	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	**54.4**	----	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	**71.9**	----	----	----	----
Anthracene-d10	1719-06-8	1.0	%	**90.6**	----	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	**96.2**	----	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	72
2-Chlorophenol-D4	93951-73-6	27	130
2.4.6-Tribromophenol	118-79-6	19	181
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	14	146
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	36	154

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EB1829378	Page	: 1 of 11
Client	: **ECO LOGICAL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Telephone	: +61-7-3243 7222
Project	: Inland Rail - Border to Gowrie EIS	Date Samples Received	: 30-Nov-2018
Site	:	Issue Date	: 07-Dec-2018
Sampler	: DAVID MOORE, PETER HANCOCK	No. of samples received	: 11
Order number	: 10558	No. of samples analysed	: 11

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons	EB1829378--007	DUP	**Acenaphthene**	83-32-9	60.5 %	70-130%	**Recovery less than lower data quality objective**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural 33		----	----	----	01-Dec-2018	28-Nov-2018	3
Clear Plastic Bottle - Natural 2R, DUP, 7	3, 6,	----	----	----	01-Dec-2018	29-Nov-2018	2
Clear Plastic Bottle - Natural 16,	11	----	----	----	01-Dec-2018	30-Nov-2018	1
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural 33		----	----	----	01-Dec-2018	28-Nov-2018	3
Clear Plastic Bottle - Natural 2R, DUP, 7	3, 6,	----	----	----	01-Dec-2018	29-Nov-2018	2
Clear Plastic Bottle - Natural 16,	11	----	----	----	01-Dec-2018	30-Nov-2018	1

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	3	33	9.09	10.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for VOC in soils vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA010P: Conductivity by PC Titrator								
Clear Plastic Bottle - Natural (EA010-P) 33		26-Nov-2018	----	----	----	03-Dec-2018	24-Dec-2018	✓
Clear Plastic Bottle - Natural (EA010-P) 2R, DUP, 7	3, 6,	27-Nov-2018	----	----	----	03-Dec-2018	25-Dec-2018	✓
Clear Plastic Bottle - Natural (EA010-P) 16,	11	28-Nov-2018	----	----	----	03-Dec-2018	26-Dec-2018	✓
Clear Plastic Bottle - Natural (EA010-P) 14, FB	2,	29-Nov-2018	----	----	----	03-Dec-2018	27-Dec-2018	✓
EA025: Total Suspended Solids dried at 104 ± 2°C								
Clear Plastic Bottle - Natural (EA025H) 33		26-Nov-2018	----	----	----	03-Dec-2018	03-Dec-2018	✓
Clear Plastic Bottle - Natural (EA025H) 2R, DUP, 7	3, 6,	27-Nov-2018	----	----	----	03-Dec-2018	04-Dec-2018	✓
Clear Plastic Bottle - Natural (EA025H) 16,	11	28-Nov-2018	----	----	----	03-Dec-2018	05-Dec-2018	✓
Clear Plastic Bottle - Natural (EA025H) 14, FB	2,	29-Nov-2018	----	----	----	03-Dec-2018	06-Dec-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / ***Container*** / *Client Sample ID(s)*	***Sample Date***	*Extraction / Preparation*			*Analysis*		
		Date extracted	*Due for extraction*	*Evaluation*	***Date analysed***	*Due for analysis*	*Evaluation*
EA065: Total Hardness as CaCO3							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) 33	**26-Nov-2018**	----	----	----	**04-Dec-2018**	24-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) 2R, 3, DUP, 6, 7	**27-Nov-2018**	----	----	----	**04-Dec-2018**	25-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) 16, 11	**28-Nov-2018**	----	----	----	**04-Dec-2018**	26-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) 14, 2, FB	**29-Nov-2018**	----	----	----	**04-Dec-2018**	27-Dec-2018	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) 33	**26-Nov-2018**	----	----	----	**04-Dec-2018**	24-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) 2R, 3, DUP, 6, 7	**27-Nov-2018**	----	----	----	**04-Dec-2018**	25-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) 16, 11	**28-Nov-2018**	----	----	----	**04-Dec-2018**	26-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) 14, 2, FB	**29-Nov-2018**	----	----	----	**04-Dec-2018**	27-Dec-2018	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) 33	**26-Nov-2018**	----	----	----	**04-Dec-2018**	25-May-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) 2R, 3, DUP, 6, 7	**27-Nov-2018**	----	----	----	**04-Dec-2018**	26-May-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) 16, 11	**28-Nov-2018**	----	----	----	**04-Dec-2018**	27-May-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) 14, 2, FB	**29-Nov-2018**	----	----	----	**04-Dec-2018**	28-May-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) 33		26-Nov-2018	----	----	----	04-Dec-2018	24-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) 2R, DUP, 7	3, 6,	27-Nov-2018	----	----	----	04-Dec-2018	25-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) 16,	11	28-Nov-2018	----	----	----	04-Dec-2018	26-Dec-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) 14, FB	2,	29-Nov-2018	----	----	----	04-Dec-2018	27-Dec-2018	✓
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G) 33		26-Nov-2018	----	----	----	01-Dec-2018	24-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) 2R, DUP, 7	3, 6,	27-Nov-2018	----	----	----	01-Dec-2018	25-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) 16,	11	28-Nov-2018	----	----	----	01-Dec-2018	26-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) 14, FB	2,	29-Nov-2018	----	----	----	01-Dec-2018	27-Dec-2018	✓
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G) 33		26-Nov-2018	----	----	----	01-Dec-2018	28-Nov-2018	×
Clear Plastic Bottle - Natural (EK057G) 2R, DUP, 7	3, 6,	27-Nov-2018	----	----	----	01-Dec-2018	29-Nov-2018	×
Clear Plastic Bottle - Natural (EK057G) 16,	11	28-Nov-2018	----	----	----	01-Dec-2018	30-Nov-2018	×
Clear Plastic Bottle - Natural (EK057G) 14, FB	2,	29-Nov-2018	----	----	----	01-Dec-2018	01-Dec-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G) 33		26-Nov-2018	----	----	----	01-Dec-2018	24-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) 2R, DUP, 7	3, 6,	27-Nov-2018	----	----	----	01-Dec-2018	25-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) 16,	11	28-Nov-2018	----	----	----	01-Dec-2018	26-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) 14, FB	2,	29-Nov-2018	----	----	----	01-Dec-2018	27-Dec-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK061G) 33		26-Nov-2018	04-Dec-2018	24-Dec-2018	✓	04-Dec-2018	24-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) 2R, DUP, 7	3, 6,	27-Nov-2018	04-Dec-2018	25-Dec-2018	✓	04-Dec-2018	25-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) 16,	11	28-Nov-2018	04-Dec-2018	26-Dec-2018	✓	04-Dec-2018	26-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) 14, FB	2,	29-Nov-2018	04-Dec-2018	27-Dec-2018	✓	04-Dec-2018	27-Dec-2018	✓
EK067G: Total Phosphorus as P by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK067G) 33		26-Nov-2018	04-Dec-2018	24-Dec-2018	✓	04-Dec-2018	24-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) 2R, DUP, 7	3, 6,	27-Nov-2018	04-Dec-2018	25-Dec-2018	✓	04-Dec-2018	25-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) 16,	11	28-Nov-2018	04-Dec-2018	26-Dec-2018	✓	04-Dec-2018	26-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) 14, FB	2,	29-Nov-2018	04-Dec-2018	27-Dec-2018	✓	04-Dec-2018	27-Dec-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK071G: Reactive Phosphorus as P by discrete analyser								
Clear Plastic Bottle - Natural (EK071G) 33		**26-Nov-2018**	----	----	----	**01-Dec-2018**	28-Nov-2018	×
Clear Plastic Bottle - Natural (EK071G) 2R, DUP, 7	3, 6,	**27-Nov-2018**	----	----	----	**01-Dec-2018**	29-Nov-2018	×
Clear Plastic Bottle - Natural (EK071G) 16,	11	**28-Nov-2018**	----	----	----	**01-Dec-2018**	30-Nov-2018	×
Clear Plastic Bottle - Natural (EK071G) 14, FB	2,	**29-Nov-2018**	----	----	----	**01-Dec-2018**	01-Dec-2018	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP075(SIM)) 33		**26-Nov-2018**	**03-Dec-2018**	03-Dec-2018	✓	**03-Dec-2018**	12-Jan-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) 2R, DUP, 7	3, 6,	**27-Nov-2018**	**03-Dec-2018**	04-Dec-2018	✓	**03-Dec-2018**	12-Jan-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) 16,	11	**28-Nov-2018**	**05-Dec-2018**	05-Dec-2018	✓	**05-Dec-2018**	14-Jan-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) 14, FB	2,	**29-Nov-2018**	**05-Dec-2018**	06-Dec-2018	✓	**05-Dec-2018**	14-Jan-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		*Count*		*Rate (%)*			*Quality Control Specification*
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	3	27	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	3	33	**9.09**	**10.00**	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	27	**7.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	2	33	**6.06**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Method Blanks (MB) - Continued							
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	2	33	6.06	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Salinity	EA020-EC-P	WATER	In house: Referenced to APHA 2520B. Calculation from Electrical conductivity. This method is compliant with NEPM (2013) Schedule B(3)
Suspended Solids (High Level)	EA025H	WATER	In house: Referenced to APHA 2540D. A gravimetric procedure employed to determine the amount of `non-filterable` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (2013) Schedule B(3)
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Organic Nitrogen as N (TKN - NH3) (discrete analyser)	EK060G	WATER	In house: Referenced to APHA 4500-Norg/4500-NH3. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using 60mL DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

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☐GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com
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CLIENT: Eco Logical Australia
OFFICE: Brisbane
PROJECT: Inland Rail - Border to Gowrie EIS   PROJECT NO 10558
ORDER NUMBER: PURCHASE ORDER NO.:
PROJECT MANAGER: Miles Yeates   CONTACT PH: 0467 738 954
SAMPLER: David Moore and Byron Heffernan   SAMPLER MOBILE:
COC Emailed to ALS? (YES / NO)   EDD FORMAT (or default):
Email Reports to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au
Email Invoice to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au

TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)
☑ Standard TAT (List due date):
☐ Non Standard or urgent TAT (List due date):

ALS QUOTE NO.: BN/142/18 V2
COUNTRY OF ORIGIN: Australia

COC SEQUENCE NUMBER (Circle)
COC: 1 2 3 4 5 6 7
OF: 1 2 3 4 5 6 7

RELINQUISHED BY: David Moore
DATE/TIME: 3/12/2018 14:25

RECEIVED BY: ANDREA LT
DATE/TIME: 3.12.18 14.25

RELINQUISHED BY:
DATE/TIME:

FOR LABORA...
Custody Seal Inta...
Free ice / frozen i... receipt?
Random Sample...
Other comment:

Environmental Division
Brisbane
Work Order Reference
EB1829489

Telephone : + 61-7-3243 7222

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract ...) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle re...)

ALS USE ONLY: LAB ID	SAMPLE DETAILS MATRIX: Solid(S) Water(W): SAMPLE ID	DATE / TIME	MATRIX	CONTAINER INFORMATION: TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	EA020-EC-P Conductivity and Salinity	EA025H Total Suspended Solids (TSS)	NT-1C Total Hardness as CaCO3	NT-8A Nutrients suite - Ammonia as N, Nitrite, Nitrate, Total N, TKN, NOx, Reactive P and Total P	EK060 Organic Nitrogen	W-2 Dissolved metals - 8 metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn and Hg) - samples are field filtered	EP075B SIM PAHs (16 analytes)	EP008 Chlorophyll a (filter paper method)	These samples are Batch 2 of a seven day field trip. Batch 1 samples were delivered on Friday 30/11/18 (EB1829378). All metals samples are field filtered. Frozen Chlorophyll a filter paper samples are included in this work order for both batches. Filter paper is **47mm** GFF ~0.7 micron. Filtered volume is noted below and on jar. Filter paper was foil wrapped and kept frozen at minus 17°C up to delivery.
1	Site 14	29/11/18	W		1								X	Chl a: volume filtered 1,000 mL
2	Site 2R	27/11/18	W		1								X	Chl a: volume filtered 300 mL
3	Site 2	29/11/18	W		1								X	Chl a: volume filtered 300 mL
4	Site 16	28/11/18	W		1								X	Chl a: volume filtered 300 mL
5	Site 11	28/11/18	W		1			HT					X	Chl a: volume filtered 300 mL
6	Site 3	27/11/18	W		1								X	Chl a: volume filtered 500 mL
—	DUP	27/11/18	W											No analysis this batch
—	FB	29/11/18	W											No analysis this batch
7	Site 6	27/11/18	W		1								X	Chl a: volume filtered 450 mL
8	Site 33	26/11/18	W		1								X	Chl a: volume filtered 650 mL
9	Site 7	27/11/18	W		1								X	Chl a: volume filtered 600 mL
10	Site 24	30/11/18	W		5	X	X	X	X	X	X	X	X	Chl a: volume filtered 100 mL
11	Site 30	01/12/18	W		5	X	X	X	X	X	X	X	X	Chl a: volume filtered 150 mL
12	Site 39	01/12/18	W		5	X	X	X	X	X	X	X	X	Chl a: volume filtered 500 mL
13	Site 40	01/12/18	W		5	X	X	X	X	X	X	X	X	Chl a: volume filtered 1000 mL
14	Site 42	01/12/18	W		5	X	X	X	X	X	X	X	X	Chl a: volume filtered 1000 mL
				TOTAL	34									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1829489**	Page	: 1 of 8
Client	: **ECO LOGICAL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Contact	: Customer Services EB
Address	: PO BOX 1422 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 02 8536 8667	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 03-Dec-2018 14:25
Order number	:	Date Analysis Commenced	: 03-Dec-2018
C-O-C number	: ----	Issue Date	: 10-Dec-2018 17:21
Sampler	: DAVID MOORE AND BYRON HEFFERNON		
Site	:		
Quote number	: BN/142/18 V2		
No. of samples received	: 14		
No. of samples analysed	: 14		

NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Greg Vogel	Laboratory Manager	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Sarah Ashworth	Laboratory Manager - Brisbane	Brisbane Organics, Stafford, QLD
Tom Maloney	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Tom Maloney	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: FILTER (Matrix: WATER)			Client sample ID	Site 14	Site 2R	Site 2	Site 16	Site 11
			Client sampling date / time	29-Nov-2018 00:00	27-Nov-2018 00:00	29-Nov-2018 00:00	28-Nov-2018 00:00	28-Nov-2018 00:00
Compound	CAS Number	LOR	Unit	EB1829489-001	EB1829489-002	EB1829489-003	EB1829489-004	EB1829489-005
				Result	Result	Result	Result	Result
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	3	5	9	8	40
Volume	----	0.01	L	1	0.3	0.3	0.3	0.3

Analytical Results

Sub-Matrix: FILTER (Matrix: WATER)			Client sample ID	Site 3	Site 6	Site 33	Site 7	----
			Client sampling date / time	27-Nov-2018 00:00	27-Nov-2018 00:00	26-Nov-2018 00:00	27-Nov-2018 00:00	----
Compound	CAS Number	LOR	Unit	EB1829489-006	EB1829489-007	EB1829489-008	EB1829489-009	-------
				Result	Result	Result	Result	----
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m^3	7	4	3	5	----
Volume	----	0.01	L	0.5	0.45	0.65	0.6	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 24	Site 30	Site 39	Site 40	Site 42
			Client sampling date / time	30-Nov-2018 00:00	01-Dec-2018 00:00	01-Dec-2018 00:00	01-Dec-2018 00:00	01-Dec-2018 00:00
Compound	CAS Number	LOR	Unit	EB1829489-010	EB1829489-011	EB1829489-012	EB1829489-013	EB1829489-014
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	570	511	1710	678	1140
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.27	0.24	0.86	0.33	0.56
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	194	63	14	9	10
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	142	133	549	236	398
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	27	22	65	32	49
Magnesium	7439-95-4	1	mg/L	18	19	94	38	67
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.004	0.003	0.002	0.003	0.002
Nickel	7440-02-0	0.001	mg/L	0.006	0.004	0.007	0.004	0.002
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.08	0.10	0.05	0.06	0.05
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.01	<0.01	0.02	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.01	0.03	<0.01	0.72	0.82
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.01	0.04	<0.01	0.74	0.82
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	4.1	4.5	0.4	0.3	0.2
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	4.2	4.6	0.5	0.4	0.2
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 24	Site 30	Site 39	Site 40	Site 42
			Client sampling date / time	30-Nov-2018 00:00	01-Dec-2018 00:00	01-Dec-2018 00:00	01-Dec-2018 00:00	01-Dec-2018 00:00
Compound	CAS Number	LOR	Unit	EB1829489-010	EB1829489-011	EB1829489-012	EB1829489-013	EB1829489-014
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	4.2	4.6	0.5	1.1	1.0
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.51	0.39	0.11	0.20	0.17
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.03	0.05	<0.01	0.02	0.01
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	28	57	13	7	<1
Volume	----	0.01	L	0.1	0.15	0.5	1	1
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	21.4	21.1	23.6	22.8	19.7
2-Chlorophenol-D4	93951-73-6	1.0	%	50.6	56.7	62.5	64.2	56.1
2.4.6-Tribromophenol	118-79-6	1.0	%	39.1	48.8	52.1	58.9	43.3
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	85.2	81.5	84.3	94.4	80.5
Anthracene-d10	1719-06-8	1.0	%	91.2	87.6	90.1	95.7	90.8

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 24	Site 30	Site 39	Site 40	Site 42
			Client sampling date / time	30-Nov-2018 00:00	01-Dec-2018 00:00	01-Dec-2018 00:00	01-Dec-2018 00:00	01-Dec-2018 00:00
Compound	CAS Number	LOR	Unit	EB1829489-010	EB1829489-011	EB1829489-012	EB1829489-013	EB1829489-014
				Result	Result	Result	Result	Result
EP075(SIM)T: PAH Surrogates - Continued								
4-Terphenyl-d14	1718-51-0	1.0	%	117	114	118	124	130

Surrogate Control Limits

Sub-Matrix: **WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	72
2-Chlorophenol-D4	93951-73-6	27	130
2.4.6-Tribromophenol	118-79-6	19	181
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	14	146
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	36	154

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1829489**	Page	: 1 of 8
Client	: **ECO LOGICAL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 03-Dec-2018
Site	:	Issue Date	: 10-Dec-2018
Sampler	: DAVID MOORE AND BYRON HEFFERNON	No. of samples received	: 14
Order number	:	No. of samples analysed	: 14

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation: Date extracted	Due for extraction	Days overdue	Analysis: Date analysed	Due for analysis	Days overdue
EK057G: Nitrite as N by Discrete Analyser						
Clear Plastic Bottle - Natural						
Site 24	----	----	----	03-Dec-2018	02-Dec-2018	1
EK071G: Reactive Phosphorus as P by discrete analyser						
Clear Plastic Bottle - Natural						
Site 24	----	----	----	03-Dec-2018	02-Dec-2018	1

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type / Method	Count: QC	Regular	Rate (%): Actual	Expected	Quality Control Specification
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	0	19	0.00	10.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA010P: Conductivity by PC Titrator								
Clear Plastic Bottle - Natural (EA010-P)								
Site 30, Site 40,	Site 39, Site 42	01-Dec-2018	----	----	----	03-Dec-2018	29-Dec-2018	✓
Clear Plastic Bottle - Natural (EA010-P)								
Site 24		30-Nov-2018	----	----	----	03-Dec-2018	28-Dec-2018	✓
EA025: Total Suspended Solids dried at 104 ± 2°C								
Clear Plastic Bottle - Natural (EA025H)								
Site 30, Site 40,	Site 39, Site 42	01-Dec-2018	----	----	----	04-Dec-2018	08-Dec-2018	✓
Clear Plastic Bottle - Natural (EA025H)								
Site 24		30-Nov-2018	----	----	----	04-Dec-2018	07-Dec-2018	✓

Matrix: **WATER**

Evaluation: ✘ = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA065: Total Hardness as CaCO3								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 30,	Site 39,	01-Dec-2018	----	----	----	06-Dec-2018	29-Dec-2018	✓
Site 40,	Site 42							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 24		30-Nov-2018	----	----	----	06-Dec-2018	28-Dec-2018	✓
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 30,	Site 39,	01-Dec-2018	----	----	----	06-Dec-2018	29-Dec-2018	✓
Site 40,	Site 42							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 24		30-Nov-2018	----	----	----	06-Dec-2018	28-Dec-2018	✓
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
Site 30,	Site 39,	01-Dec-2018	----	----	----	06-Dec-2018	30-May-2019	✓
Site 40,	Site 42							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
Site 24		30-Nov-2018	----	----	----	06-Dec-2018	29-May-2019	✓
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
Site 30,	Site 39,	01-Dec-2018	----	----	----	06-Dec-2018	29-Dec-2018	✓
Site 40,	Site 42							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
Site 24		30-Nov-2018	----	----	----	06-Dec-2018	28-Dec-2018	✓
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
Site 30,	Site 39,	01-Dec-2018	----	----	----	06-Dec-2018	29-Dec-2018	✓
Site 40,	Site 42							
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
Site 24		30-Nov-2018	----	----	----	06-Dec-2018	28-Dec-2018	✓
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G)								
Site 30,	Site 39,	01-Dec-2018	----	----	----	03-Dec-2018	03-Dec-2018	✓
Site 40,	Site 42							
Clear Plastic Bottle - Natural (EK057G)								
Site 24		30-Nov-2018	----	----	----	03-Dec-2018	02-Dec-2018	✘
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G)								
Site 30,	Site 39,	01-Dec-2018	----	----	----	06-Dec-2018	29-Dec-2018	✓
Site 40,	Site 42							
Clear Plastic Bottle - Sulfuric Acid (EK059G)								
Site 24		30-Nov-2018	----	----	----	06-Dec-2018	28-Dec-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 30, Site 40,	Site 39, Site 42	**01-Dec-2018**	**05-Dec-2018**	29-Dec-2018	✓	**05-Dec-2018**	29-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 24		**30-Nov-2018**	**05-Dec-2018**	28-Dec-2018	✓	**05-Dec-2018**	28-Dec-2018	✓
EK067G: Total Phosphorus as P by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 30, Site 40,	Site 39, Site 42	**01-Dec-2018**	**05-Dec-2018**	29-Dec-2018	✓	**05-Dec-2018**	29-Dec-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 24		**30-Nov-2018**	**05-Dec-2018**	28-Dec-2018	✓	**05-Dec-2018**	28-Dec-2018	✓
EK071G: Reactive Phosphorus as P by discrete analyser								
Clear Plastic Bottle - Natural (EK071G) Site 30, Site 40,	Site 39, Site 42	**01-Dec-2018**	----	----	----	**03-Dec-2018**	03-Dec-2018	✓
Clear Plastic Bottle - Natural (EK071G) Site 24		**30-Nov-2018**	----	----	----	**03-Dec-2018**	02-Dec-2018	×
EP008: Chlorophyll a & Pheophytin a								
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 30, Site 40,	Site 39, Site 42	**01-Dec-2018**	----	----	----	**04-Dec-2018**	22-Dec-2018	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 33		**26-Nov-2018**	----	----	----	**04-Dec-2018**	17-Dec-2018	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 2R, Site 6,	Site 3, Site 7	**27-Nov-2018**	----	----	----	**04-Dec-2018**	18-Dec-2018	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 16,	Site 11	**28-Nov-2018**	----	----	----	**04-Dec-2018**	19-Dec-2018	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 14,	Site 2	**29-Nov-2018**	----	----	----	**04-Dec-2018**	20-Dec-2018	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 24		**30-Nov-2018**	----	----	----	**04-Dec-2018**	21-Dec-2018	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 30, Site 40,	Site 39, Site 42	**01-Dec-2018**	**06-Dec-2018**	08-Dec-2018	✓	**06-Dec-2018**	15-Jan-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 24		**30-Nov-2018**	**06-Dec-2018**	07-Dec-2018	✓	**06-Dec-2018**	15-Jan-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✘ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		*Count*		*Rate (%)*			*Quality Control Specification*
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	14	14.29	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	8	25.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	17	11.76	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	14	14.29	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	0	19	0.00	10.00	✘	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	20.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chlorophyll a and Pheophytin a	EP008	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	16	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chlorophyll a and Pheophytin a	EP008	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	8	12.50	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	17	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	6.25	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	20.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Method Blanks (MB) - Continued							
Suspended Solids (High Level)	EA025H	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Salinity	EA020-EC-P	WATER	In house: Referenced to APHA 2520B. Calculation from Electrical conductivity. This method is compliant with NEPM (2013) Schedule B(3)
Suspended Solids (High Level)	EA025H	WATER	In house: Referenced to APHA 2540D. A gravimetric procedure employed to determine the amount of `non-filterable` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (2013) Schedule B(3)
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Organic Nitrogen as N (TKN - NH3) (discrete analyser)	EK060G	WATER	In house: Referenced to APHA 4500-Norg/4500-NH3. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Chlorophyll a and Pheophytin a	EP008	WATER	In house: Referenced to APHA 10200 H. The pigments are extracted into aqueous acetone. The optical density of the extract before and after acidification at both 664 nm and 665 nm is determined spectrometrically.
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.

ALS

CHAIN OF CUSTODY

ALS Laboratory: please tick →

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Brisbane
Work Order Reference
EB1903762

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nvironmental@alsglobal.com

h Black Drive, Nth Wollongong NSW 2500
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CLIENT: Eco Logical Australia	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)	☒ Standard TAT (List due date): ☐ Non Standard or urgent TAT (List due date):
OFFICE: Brisbane		
PROJECT: Inland Rail - Border to Gowrie EIS **PROJECT NO** 10558	**ALS QUOTE NO.:** BN/142/18 V2	**COC SEQUENCE** COC: 1 2 3 OF: 1 2 3
ORDER NUMBER: **PURCHASE ORDER NO.:**	**COUNTRY OF ORIGIN:** Australia	
PROJECT MANAGER: Miles Yeates **CONTACT PH:** 0467 738 954		
SAMPLER: David Moore and Emma Blacklock **SAMPLER MOBILE:**	**RELINQUISHED BY:** David Moore DATE/TIME: 16:50 14/2/2019	**RECEIVED BY:** Liam C DATE/TIME: 16:50 14/2/19
COC Emailed to ALS? (YES / NO) **EDD FORMAT (or default):**		
Email Reports to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au		
Email Invoice to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au		

.Y (Circle)

	Yes	No	N/A
pon	Yes	No	N/A
ceipt:		°C	

DATE/TIME:

RECEIVED BY:

DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (*refer to codes below*)	TOTAL BOTTLES	EA020-EC-P Conductivity and Salinity	EA025H Total Suspended Solids (TSS)	NT-1C Total Hardness as CaCO3	NT-8A Nutrients suite - Ammonia as N, Nitrite, Nitrate, Total N, TKN, NOx, Reactive P and Total P	EK060 Organic Nitrogen	W-2 Dissolved metals - 8 metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn and Hg) - samples are field filtered	EP075B SIM PAHs (16 analytes)	EP008 Chlorophyll a (filter paper method)	All metals samples are field filtered. Frozen Chlorophyll a filter paper samples are included in this work order. Filter paper is 47mm GFF ~0.7 micron. Filtered volume is noted below and on jar. Filter paper was foil wrapped and kept frozen at minus 17°C up to delivery.
1	Site 2	11/2/19 - 12 noon	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 500 mL
2	Site 2R	11/2/19 - 12 noon	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 500 mL
3	Site 23	12/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 1,000 mL
4	Site 18	12/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 700 mL
5	Site 7	12/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 600 mL
6	Site 6	12/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 500 mL
7	Site 3	12/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 500 mL
8	Site 14	13/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 250 mL
9	Site 27	13/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 100 mL
10	Site 16	13/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 50 mL
11	Site 24	13/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 250 mL
12	Site 11	13/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 250 mL
13	Site 28	13/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 100 mL
14	Site 30	14/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 210 mL
15	Site 32	14/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 150 mL
16	Site 39	14/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 350 mL
17	Site 42	14/02/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 1,000 mL
18	DUP	12/02/2019 - 7 am	W		6	X	X	X	X	X	X	X		2 extra amber bottles QA/QC
19	FB	12/02/2019 - 7 am	W		4	X	X	X	X	X	X	X		
				TOTAL	95									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1903762**	Page	: 1 of 15
Client	: **ECO LOGICAL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Contact	: Customer Services EB
Address	: PO BOX 1422 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 02 8536 8667	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 14-Feb-2019 16:50
Order number	:	Date Analysis Commenced	: 14-Feb-2019
C-O-C number	: ----	Issue Date	: 21-Feb-2019 17:17
Sampler	: DAVID MOORE AND EMMA BLACKLOCK		
Site	:		
Quote number	: BN/142/18 V2		
No. of samples received	: 19		
No. of samples analysed	: 19		

ilac-MRA NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Minh Wills	2IC Organic Chemist	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP075(SIM): Sample EB1903762-018 (DUP) shows poor matrix spike recovery due to matrix interference. Insufficient sample for re-extraction and re-analysis.
- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Work Order : EB1903762
Client : ECO LOGICAL AUSTRALIA PTY LTD
Project : 10558 Inland Rail - Border to Gowie EIS

Analytical Results

Sub-Matrix: FILTER (Matrix: WATER)			Client sample ID	Site 2	Site 2R	Site 23	Site 18	Site 7
			Client sampling date / time	11-Feb-2019 12:00	11-Feb-2019 12:00	12-Feb-2019 07:00	12-Feb-2019 07:00	12-Feb-2019 07:00
Compound	CAS Number	LOR	Unit	EB1903762-001	EB1903762-002	EB1903762-003	EB1903762-004	EB1903762-005
				Result	Result	Result	Result	Result
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m^3	2	2	2	7	6
Volume	----	0.01	L	.5	.5	1	.7	.6

Analytical Results

Sub-Matrix: FILTER (Matrix: WATER)			Client sample ID	Site 6	Site 3	Site 14	Site 27	Site 16
			Client sampling date / time	12-Feb-2019 07:00	12-Feb-2019 07:00	13-Feb-2019 07:00	13-Feb-2019 07:00	13-Feb-2019 07:00
Compound	CAS Number	LOR	Unit	EB1903762-006	EB1903762-007	EB1903762-008	EB1903762-009	EB1903762-010
				Result	Result	Result	Result	Result
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m^3	5	12	6	53	54
Volume	----	0.01	L	.5	.5	.25	.1	.05

Analytical Results

Sub-Matrix: FILTER (Matrix: WATER)			Client sample ID	Site 24	Site 11	Site 28	Site 30	Site 32
			Client sampling date / time	13-Feb-2019 07:00	13-Feb-2019 07:00	13-Feb-2019 07:00	14-Feb-2019 07:00	14-Feb-2019 07:00
Compound	CAS Number	LOR	Unit	EB1903762-011	EB1903762-012	EB1903762-013	EB1903762-014	EB1903762-015
				Result	Result	Result	Result	Result
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m^3	9	23	56	50	90
Volume	----	0.01	L	.25	.25	.1	.21	.15

Analytical Results

Sub-Matrix: FILTER (Matrix: WATER)			Client sample ID	Site 39	Site 42	----	----	----
			Client sampling date / time	14-Feb-2019 07:00	14-Feb-2019 07:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1903762-016	EB1903762-017	-------	-------	-------
				Result	Result	----	----	----
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	12	3	----	----	----
Volume	----	0.01	L	.35	1	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 2	Site 2R	Site 23	Site 18	Site 7
			Client sampling date / time	11-Feb-2019 12:00	11-Feb-2019 12:00	12-Feb-2019 07:00	12-Feb-2019 07:00	12-Feb-2019 07:00
Compound	CAS Number	LOR	Unit	EB1903762-001	EB1903762-002	EB1903762-003	EB1903762-004	EB1903762-005
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	228	230	289	339	450
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.11	0.11	0.14	0.16	0.21
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	23	24	8	18	12
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	78	78	90	99	88
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	13	13	23	28	17
Magnesium	7439-95-4	1	mg/L	11	11	8	7	11
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	0.004	0.004	0.003	0.002	0.002
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.07	0.03	0.03	0.03	0.05
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.17	0.16	<0.01	<0.01	0.03
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.17	0.16	<0.01	<0.01	0.03
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	0.5	0.6	1.4	1.2	1.0
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.6	0.6	1.4	1.2	1.0
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 2	Site 2R	Site 23	Site 18	Site 7
			Client sampling date / time	11-Feb-2019 12:00	11-Feb-2019 12:00	12-Feb-2019 07:00	12-Feb-2019 07:00	12-Feb-2019 07:00
Compound	CAS Number	LOR	Unit	EB1903762-001	EB1903762-002	EB1903762-003	EB1903762-004	EB1903762-005
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	0.8	0.8	1.4	1.2	1.0
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.16	0.16	0.10	0.10	0.04
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.13	0.13	0.02	<0.01	<0.01
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	24.8	27.3	19.7	32.5	23.4
2-Chlorophenol-D4	93951-73-6	1.0	%	63.4	69.0	55.3	80.1	61.0
2.4.6-Tribromophenol	118-79-6	1.0	%	45.4	48.7	43.8	58.7	43.4
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	72.5	79.8	74.9	96.5	77.0
Anthracene-d10	1719-06-8	1.0	%	77.0	85.3	53.5	66.5	53.8
4-Terphenyl-d14	1718-51-0	1.0	%	78.0	85.3	53.7	66.4	54.8

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)

Compound	CAS Number	LOR	Unit	Site 6	Site 3	Site 14	Site 27	Site 16
Client sampling date / time				12-Feb-2019 07:00	12-Feb-2019 07:00	13-Feb-2019 07:00	13-Feb-2019 07:00	13-Feb-2019 07:00
				EB1903762-006	EB1903762-007	EB1903762-008	EB1903762-009	EB1903762-010
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	428	392	335	546	688
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.20	0.19	0.16	0.26	0.33
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	12	8	39	74	170
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	81	79	64	195	112
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	16	15	6	37	25
Magnesium	7439-95-4	1	mg/L	10	10	12	25	12
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.002	0.002	0.003
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.002
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	0.007	0.002
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.05	0.04	0.05	0.05	0.06
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	0.01	0.02
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	<0.01	0.01	0.02
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	1.2	1.0	1.6	2.2	4.1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.2	1.0	1.6	2.2	4.2
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 6	Site 3	Site 14	Site 27	Site 16
			Client sampling date / time	12-Feb-2019 07:00	12-Feb-2019 07:00	13-Feb-2019 07:00	13-Feb-2019 07:00	13-Feb-2019 07:00
Compound	CAS Number	LOR	Unit	EB1903762-006	EB1903762-007	EB1903762-008	EB1903762-009	EB1903762-010
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	1.2	1.0	1.6	2.2	4.2
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.06	0.06	0.07	0.23	0.31
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	24.5	25.5	27.4	23.7	25.1
2-Chlorophenol-D4	93951-73-6	1.0	%	62.8	60.7	61.4	56.5	58.9
2.4.6-Tribromophenol	118-79-6	1.0	%	39.6	35.3	33.0	31.5	42.6
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	77.4	74.0	81.7	75.7	76.5
Anthracene-d10	1719-06-8	1.0	%	55.1	50.8	57.9	53.3	54.4
4-Terphenyl-d14	1718-51-0	1.0	%	56.2	52.2	59.0	53.5	54.3

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 24	Site 11	Site 28	Site 30	Site 32
			Client sampling date / time	13-Feb-2019 07:00	13-Feb-2019 07:00	13-Feb-2019 07:00	14-Feb-2019 07:00	14-Feb-2019 07:00
Compound	CAS Number	LOR	Unit	EB1903762-011	EB1903762-012	EB1903762-013	EB1903762-014	EB1903762-015
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	306	259	557	406	614
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.14	0.12	0.27	0.19	0.30
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	60	23	73	35	95
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	65	55	156	128	204
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	13	12	26	25	37
Magnesium	7439-95-4	1	mg/L	8	6	22	16	27
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	0.003	0.003	0.005	0.001	0.003
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.001	<0.001	0.002	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	0.006	<0.001	0.012	0.003	0.011
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.04	0.04	0.07	0.06	0.09
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	1.8	2.2	5.1	1.4	3.7
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.8	2.2	5.2	1.5	3.8
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 24	Site 11	Site 28	Site 30	Site 32
			Client sampling date / time	13-Feb-2019 07:00	13-Feb-2019 07:00	13-Feb-2019 07:00	14-Feb-2019 07:00	14-Feb-2019 07:00
Compound	*CAS Number*	*LOR*	*Unit*	EB1903762-011	EB1903762-012	EB1903762-013	EB1903762-014	EB1903762-015
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	1.8	2.2	5.2	1.5	3.8
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.35	0.15	0.43	0.18	0.43
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.07	<0.01	0.02	<0.01	0.03
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	25.9	25.7	21.6	19.8	25.4
2-Chlorophenol-D4	93951-73-6	1.0	%	65.7	66.7	38.5	49.0	63.0
2.4.6-Tribromophenol	118-79-6	1.0	%	43.0	50.6	19.8	23.5	49.2
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	79.3	79.1	68.8	69.7	75.2
Anthracene-d10	1719-06-8	1.0	%	56.6	54.1	45.6	49.1	52.7
4-Terphenyl-d14	1718-51-0	1.0	%	55.0	54.1	45.8	49.0	52.2

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 39	Site 42	DUP	FB	----
			Client sampling date / time	14-Feb-2019 07:00	14-Feb-2019 07:00	12-Feb-2019 07:00	12-Feb-2019 07:00	----
Compound	CAS Number	LOR	Unit	EB1903762-016	EB1903762-017	EB1903762-018	EB1903762-019	-------
				Result	Result	Result	Result	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**2850**	**1450**	**424**	**1**	----
EA020EC: Salinity								
Salinity	----	0.01	g/kg	**1.48**	**0.73**	**0.20**	<0.01	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**30**	**8**	**14**	<5	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**801**	**482**	**81**	<1	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**42**	**43**	**16**	<1	----
Magnesium	7439-95-4	1	mg/L	**169**	**91**	**10**	<1	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	**0.002**	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	**0.006**	**0.002**	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.06**	**0.06**	**0.06**	**0.01**	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	**0.02**	<0.01	<0.01	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	**0.69**	<0.01	<0.01	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	**0.71**	<0.01	<0.01	----
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	**0.9**	**0.3**	**0.9**	<0.1	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.0**	**0.4**	**1.0**	<0.1	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 39	Site 42	DUP	FB	----
			Client sampling date / time	14-Feb-2019 07:00	14-Feb-2019 07:00	12-Feb-2019 07:00	12-Feb-2019 07:00	----
Compound	CAS Number	LOR	Unit	EB1903762-016	EB1903762-017	EB1903762-018	EB1903762-019	-------
				Result	Result	Result	Result	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	1.0	1.1	1.0	<0.1	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.08	0.02	0.06	<0.01	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	21.8	25.4	25.8	28.6	----
2-Chlorophenol-D4	93951-73-6	1.0	%	47.1	57.4	62.8	68.1	----
2.4.6-Tribromophenol	118-79-6	1.0	%	31.7	40.5	55.4	77.7	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	64.9	75.5	74.3	74.8	----
Anthracene-d10	1719-06-8	1.0	%	44.9	52.1	50.4	84.6	----
4-Terphenyl-d14	1718-51-0	1.0	%	46.5	54.7	52.7	103	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	72
2-Chlorophenol-D4	93951-73-6	27	130
2.4.6-Tribromophenol	118-79-6	19	181
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	14	146
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	36	154

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EB1903762	Page	: 1 of 13
Client	: ECO LOGICAL AUSTRALIA PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 14-Feb-2019
Site	:	Issue Date	: 21-Feb-2019
Sampler	: DAVID MOORE AND EMMA BLACKLOCK	No. of samples received	: 19
Order number	:	No. of samples analysed	: 19

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons	EB1903762--018	DUP	Pyrene	129-00-0	61.8 %	70-130%	Recovery less than lower data quality objective

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural							
Site 2,	Site 2R	----	----	----	14-Feb-2019	13-Feb-2019	1
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural							
Site 2,	Site 2R	----	----	----	14-Feb-2019	13-Feb-2019	1

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type	Count		Rate (%)		Quality Control Specification
Method	QC	Regular	Actual	Expected	
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	1	35	2.86	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	1	35	2.86	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method	Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010P: Conductivity by PC Titrator								
Clear Plastic Bottle - Natural (EA010-P)								
Site 2,	Site 2R	11-Feb-2019	----	----	----	19-Feb-2019	11-Mar-2019	✓
Clear Plastic Bottle - Natural (EA010-P)								
Site 23,	Site 18,	12-Feb-2019	----	----	----	19-Feb-2019	12-Mar-2019	✓
Site 7,	Site 6,							
Site 3,	DUP,							
FB								
Clear Plastic Bottle - Natural (EA010-P)								
Site 14,	Site 27,	13-Feb-2019	----	----	----	19-Feb-2019	13-Mar-2019	✓
Site 16,	Site 24,							
Site 11,	Site 28							
Clear Plastic Bottle - Natural (EA010-P)								
Site 30,	Site 32,	14-Feb-2019	----	----	----	19-Feb-2019	14-Mar-2019	✓
Site 39,	Site 42							
EA025: Total Suspended Solids dried at 104 ± 2°C								
Clear Plastic Bottle - Natural (EA025H)								
Site 2,	Site 2R	11-Feb-2019	----	----	----	15-Feb-2019	18-Feb-2019	✓
Clear Plastic Bottle - Natural (EA025H)								
Site 23,	Site 18,	12-Feb-2019	----	----	----	15-Feb-2019	19-Feb-2019	✓
Site 7,	Site 6,							
Site 3,	DUP,							
FB								
Clear Plastic Bottle - Natural (EA025H)								
Site 14,	Site 27,	13-Feb-2019	----	----	----	15-Feb-2019	20-Feb-2019	✓
Site 16,	Site 24,							
Site 11,	Site 28							
Clear Plastic Bottle - Natural (EA025H)								
Site 30,	Site 32,	14-Feb-2019	----	----	----	15-Feb-2019	21-Feb-2019	✓
Site 39,	Site 42							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation Date extracted	 Due for extraction	 Evaluation	Analysis Date analysed	 Due for analysis	 Evaluation
EA065: Total Hardness as CaCO3							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 2, Site 2R	**11-Feb-2019**	----	----	----	**19-Feb-2019**	11-Mar-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 23, Site 18, Site 7, Site 6, Site 3, DUP, FB	**12-Feb-2019**	----	----	----	**19-Feb-2019**	12-Mar-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 14, Site 27, Site 16, Site 24, Site 11, Site 28	**13-Feb-2019**	----	----	----	**19-Feb-2019**	13-Mar-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 30, Site 32, Site 39, Site 42	**14-Feb-2019**	----	----	----	**19-Feb-2019**	14-Mar-2019	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 2, Site 2R	**11-Feb-2019**	----	----	----	**19-Feb-2019**	11-Mar-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 23, Site 18, Site 7, Site 6, Site 3, DUP, FB	**12-Feb-2019**	----	----	----	**19-Feb-2019**	12-Mar-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 14, Site 27, Site 16, Site 24, Site 11, Site 28	**13-Feb-2019**	----	----	----	**19-Feb-2019**	13-Mar-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 30, Site 32, Site 39, Site 42	**14-Feb-2019**	----	----	----	**19-Feb-2019**	14-Mar-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
Site 2,	Site 2R	11-Feb-2019	----	----	----	19-Feb-2019	10-Aug-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
Site 23, Site 7, Site 3, FB	Site 18, Site 6, DUP,	12-Feb-2019	----	----	----	19-Feb-2019	11-Aug-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
Site 14, Site 16, Site 11,	Site 27, Site 24, Site 28	13-Feb-2019	----	----	----	19-Feb-2019	12-Aug-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
Site 30, Site 39,	Site 32, Site 42	14-Feb-2019	----	----	----	19-Feb-2019	13-Aug-2019	✓
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
Site 2,	Site 2R	11-Feb-2019	----	----	----	19-Feb-2019	11-Mar-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
Site 23, Site 7, Site 3, FB	Site 18, Site 6, DUP,	12-Feb-2019	----	----	----	19-Feb-2019	12-Mar-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
Site 14, Site 16, Site 11,	Site 27, Site 24, Site 28	13-Feb-2019	----	----	----	19-Feb-2019	13-Mar-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
Site 30, Site 39,	Site 32, Site 42	14-Feb-2019	----	----	----	19-Feb-2019	14-Mar-2019	✓

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
Site 2,	Site 2R	11-Feb-2019	----	----	----	15-Feb-2019	11-Mar-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
Site 23,	Site 18,	12-Feb-2019	----	----	----	15-Feb-2019	12-Mar-2019	✓
Site 7,	Site 6,							
Site 3,	DUP,							
FB								
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
Site 14,	Site 27,	13-Feb-2019	----	----	----	15-Feb-2019	13-Mar-2019	✓
Site 16,	Site 24,							
Site 11,	Site 28							
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
Site 30,	Site 32,	14-Feb-2019	----	----	----	15-Feb-2019	14-Mar-2019	✓
Site 39,	Site 42							
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G)								
Site 2,	Site 2R	11-Feb-2019	----	----	----	14-Feb-2019	13-Feb-2019	✗
Clear Plastic Bottle - Natural (EK057G)								
Site 23,	Site 18,	12-Feb-2019	----	----	----	14-Feb-2019	14-Feb-2019	✓
Site 7,	Site 6,							
Site 3,	DUP,							
FB								
Clear Plastic Bottle - Natural (EK057G)								
Site 14,	Site 27,	13-Feb-2019	----	----	----	14-Feb-2019	15-Feb-2019	✓
Site 16,	Site 24,							
Site 11,	Site 28							
Clear Plastic Bottle - Natural (EK057G)								
Site 30,	Site 32,	14-Feb-2019	----	----	----	14-Feb-2019	16-Feb-2019	✓
Site 39,	Site 42							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK059G)								
Site 2,	Site 2R	11-Feb-2019	----	----	----	15-Feb-2019	11-Mar-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G)								
Site 23,	Site 18,	12-Feb-2019	----	----	----	15-Feb-2019	12-Mar-2019	✓
Site 7,	Site 6,							
Site 3,	DUP,							
FB								
Clear Plastic Bottle - Sulfuric Acid (EK059G)								
Site 14,	Site 27,	13-Feb-2019	----	----	----	15-Feb-2019	13-Mar-2019	✓
Site 16,	Site 24,							
Site 11,	Site 28							
Clear Plastic Bottle - Sulfuric Acid (EK059G)								
Site 30,	Site 32,	14-Feb-2019	----	----	----	15-Feb-2019	14-Mar-2019	✓
Site 39,	Site 42							
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK061G)								
Site 2,	Site 2R	11-Feb-2019	20-Feb-2019	11-Mar-2019	✓	20-Feb-2019	11-Mar-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G)								
Site 23,	Site 18,	12-Feb-2019	20-Feb-2019	12-Mar-2019	✓	20-Feb-2019	12-Mar-2019	✓
Site 7,	Site 6,							
Site 3,	DUP,							
FB								
Clear Plastic Bottle - Sulfuric Acid (EK061G)								
Site 14,	Site 27,	13-Feb-2019	20-Feb-2019	13-Mar-2019	✓	20-Feb-2019	13-Mar-2019	✓
Site 16,	Site 24,							
Site 11,	Site 28							
Clear Plastic Bottle - Sulfuric Acid (EK061G)								
Site 30,	Site 32,	14-Feb-2019	20-Feb-2019	14-Mar-2019	✓	20-Feb-2019	14-Mar-2019	✓
Site 39,	Site 42							

Matrix: **WATER**

Evaluation: ✗ = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation Date extracted	Due for extraction	Evaluation	Analysis Date analysed	Due for analysis	Evaluation
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 2, Site 2R	**11-Feb-2019**	**20-Feb-2019**	11-Mar-2019	✓	**20-Feb-2019**	11-Mar-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 23, Site 18, Site 7, Site 6, Site 3, DUP, FB	**12-Feb-2019**	**20-Feb-2019**	12-Mar-2019	✓	**20-Feb-2019**	12-Mar-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 14, Site 27, Site 16, Site 24, Site 11, Site 28	**13-Feb-2019**	**20-Feb-2019**	13-Mar-2019	✓	**20-Feb-2019**	13-Mar-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 30, Site 32, Site 39, Site 42	**14-Feb-2019**	**20-Feb-2019**	14-Mar-2019	✓	**20-Feb-2019**	14-Mar-2019	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G) Site 2, Site 2R	**11-Feb-2019**	----	----	----	**14-Feb-2019**	13-Feb-2019	✗
Clear Plastic Bottle - Natural (EK071G) Site 23, Site 18, Site 7, Site 6, Site 3, DUP, FB	**12-Feb-2019**	----	----	----	**14-Feb-2019**	14-Feb-2019	✓
Clear Plastic Bottle - Natural (EK071G) Site 14, Site 27, Site 16, Site 24, Site 11, Site 28	**13-Feb-2019**	----	----	----	**14-Feb-2019**	15-Feb-2019	✓
Clear Plastic Bottle - Natural (EK071G) Site 30, Site 32, Site 39, Site 42	**14-Feb-2019**	----	----	----	**14-Feb-2019**	16-Feb-2019	✓
EP008: Chlorophyll a & Pheophytin a							
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 2, Site 2R	**11-Feb-2019**	----	----	----	**14-Feb-2019**	04-Mar-2019	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 23, Site 18, Site 7, Site 6, Site 3	**12-Feb-2019**	----	----	----	**14-Feb-2019**	05-Mar-2019	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 14, Site 27, Site 16, Site 24, Site 11, Site 28	**13-Feb-2019**	----	----	----	**14-Feb-2019**	06-Mar-2019	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 30, Site 32, Site 39, Site 42	**14-Feb-2019**	----	----	----	**14-Feb-2019**	07-Mar-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP075(SIM))								
Site 2,	Site 2R	**11-Feb-2019**	**15-Feb-2019**	18-Feb-2019	✓	**19-Feb-2019**	27-Mar-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM))								
Site 23, Site 7, Site 3, FB	Site 18, Site 6, DUP,	**12-Feb-2019**	**18-Feb-2019**	19-Feb-2019	✓	**19-Feb-2019**	30-Mar-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM))								
Site 14, Site 16, Site 11,	Site 27, Site 24, Site 28	**13-Feb-2019**	**18-Feb-2019**	20-Feb-2019	✓	**19-Feb-2019**	30-Mar-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM))								
Site 30, Site 39,	Site 32, Site 42	**14-Feb-2019**	**18-Feb-2019**	21-Feb-2019	✓	**19-Feb-2019**	30-Mar-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	4	34	11.76	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	3	29	10.34	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	4	37	10.81	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	4	30	13.33	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	4	31	12.90	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	3	24	12.50	10.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	35	2.86	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	3	22	13.64	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	4	31	12.90	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	19	10.53	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	2	34	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chlorophyll a and Pheophytin a	EP008	2	24	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	29	6.90	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	37	5.41	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	31	6.45	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	24	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	2	35	5.71	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	22	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	4	31	12.90	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	2	34	5.88	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chlorophyll a and Pheophytin a	EP008	2	24	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	29	6.90	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	37	5.41	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	30	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	31	6.45	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	24	8.33	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	2	35	5.71	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	22	9.09	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		*Count*		*Rate (%)*			*Quality Control Specification*
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Method Blanks (MB) - Continued							
Suspended Solids (High Level)	EA025H	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	2	34	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	37	**5.41**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	31	**6.45**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	35	**2.86**	**5.00**	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	22	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Salinity	EA020-EC-P	WATER	In house: Referenced to APHA 2520B. Calculation from Electrical conductivity. This method is compliant with NEPM (2013) Schedule B(3)
Suspended Solids (High Level)	EA025H	WATER	In house: Referenced to APHA 2540D. A gravimetric procedure employed to determine the amount of \`non-filterable\` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (2013) Schedule B(3)
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45μm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45μm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Organic Nitrogen as N (TKN - NH3) (discrete analyser)	EK060G	WATER	In house: Referenced to APHA 4500-Norg/4500-NH3. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Chlorophyll a and Pheophytin a	EP008	WATER	In house: Referenced to APHA 10200 H. The pigments are extracted into aqueous acetone. The optical density of the extract before and after acidification at both 664 nm and 665 nm is determined spectrometrically.
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.

CHAIN OF CUSTODY

ALS Laboratory: *please tick →*

☐ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8162 5130 E: adelaide@alsglobal.com
☐BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com
☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
☐SYDNEY 277-289 W... Ph: 02 8784 ...
☐TOWNSVIL... Ph: 07 4796 ...
☐WOLLONG... Ph: 02 4225 ...

Environmental Division Brisbane
Work Order Reference
EB1911202

Telephone : + 61-7-3243 7222

CLIENT: Eco Logical Australia	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☒ Standard TAT (List due date): ☐ Non Standard or urgent TAT (List due date):	FOR LABORAT... Custody Seal Intac...
OFFICE: Brisbane			
PROJECT: Inland Rail - Border to Gowrie EIS — PROJECT NO 10558	ALS QUOTE NO.: BN/142/18 V2	COC SEQUENCE NUMBER (Circle)	Free Ice / frozen ic... receipt?
ORDER NUMBER: — PURCHASE ORDER NO.:	COUNTRY OF ORIGIN: Australia	COC: 1 2 3 4 5 6 7	Random Sample T...
PROJECT MANAGER: Miles Yeates — CONTACT PH: 0467 738 954		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: David Moore and Emma Blacklock — SAMPLER MOBILE:	RELINQUISHED BY: D Moore	RECEIVED BY: Dan	RELINQUISHED BY:
COC Emailed to ALS? (YES) — EDD FORMAT (or default):			
Email Reports to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au	DATE/TIME: 2/5/19	DATE/TIME: 2/5/19 16:35	DATE/TIME:
Email Invoice to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: -18°C & 4°C

ALS USE ONLY: LAB ID	SAMPLE DETAILS MATRIX: Solid(S) Water(W): SAMPLE ID	DATE / TIME	MATRIX	CONTAINER INFORMATION: TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES	EA020-EC-P Conductivity and Salinity	EA025H Total Suspended Solids (TSS)	NT-1C Total Hardness as CaCO3	NT-8A Nutrients suite - Ammonia as N, Nitrite, Nitrate, Total N, TKN, NOx, Reactive P and Total P	EK060 Organic Nitrogen	W-2 Dissolved metals - 8 metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn and Hg) - samples are field filtered	EP075B SIM PAHs (16 analytes)	EP008 Chlorophyll a (filter paper method)	Additional Information: All metals samples are field filtered. Frozen Chlorophyll a filter paper samples are included in this work order. Filter paper is 47mm GFF ~0.7 micron. Filtered volume is noted below and on jar. Filter paper was foil wrapped and kept frozen at minus 17°C up to delivery.
1	Site 2	29/04/19 - 12 noon	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 850 mL
2	Site 2R	29/04/19 - 12 noon	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 850 mL
3	Site 3	30/04/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 250 mL
4	Site 6	30/04/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 800 mL
5	Site 7	30/04/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 750 mL
6	Site 11	30/04/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 250 mL
7	Site 14	1/05/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 250 mL
8	Site 16	1/05/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 12 mL
9	Site 18	1/05/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 1,000 mL
10	Site 20R	1/05/2019 - 7 am	W	HT	5	X	X	X	X	X	X	X	X	Chl a volume filtered: 500 mL
11	Site 23	1/05/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 600 mL
12	Site 27	2/05/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 125 mL
13	Site 28	1/05/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 75 mL
14	Site 29	1/05/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 300 mL
15	Site 30	2/05/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 150 mL
16	Site 39	2/05/2019 - 7 am	W		7	X	X	X	X	X	X	X	X	Chl a volume filtered: 700 mL. Two additional QA/QC bottles
17	Site 40	2/05/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 550 mL
18	Site 42	2/05/2019 - 7 am	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 1,000 mL
19	DUP	30/04/2019 - 7 am	W		4	X	X	X	X	X	X	X		
20	FB	30/04/2019 - 7 am	W		4	X	X	X	X	X	X	X		
				TOTAL	100									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CERTIFICATE OF ANALYSIS

Work Order	: **EB1911202**	Page	: 1 of 15
Client	: **ECO LOGICAL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Contact	: Customer Services EB
Address	: PO BOX 1422 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 02 8536 8667	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 02-May-2019 16:35
Order number	:	Date Analysis Commenced	: 02-May-2019
C-O-C number	: ----	Issue Date	: 10-May-2019 14:11
Sampler	: DAVID MOORE, EMMA BLACKLOCK		
Site	:		
Quote number	: BN/142/18 V2		
No. of samples received	: 20		
No. of samples analysed	: 20		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Santusha Pandra	Organic Chemist	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 2	Site 2R	Site 3	Site 6	Site 7
			Client sampling date / time	29-Apr-2019 12:00	29-Apr-2019 12:00	30-Apr-2019 07:00	30-Apr-2019 07:00	30-Apr-2019 07:00
Compound	CAS Number	LOR	Unit	EB1911202-001	EB1911202-002	EB1911202-003	EB1911202-004	EB1911202-005
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	210	211	419	428	425
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.10	0.10	0.20	0.21	0.21
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	10	7	12	10	6
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	93	93	99	99	102
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	16	16	20	20	21
Magnesium	7439-95-4	1	mg/L	13	13	12	12	12
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	0.003	0.003	0.002	0.001	0.002
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.001	0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	0.003	0.002	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.03	0.02	0.02	0.03	0.03
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	0.09
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	0.09
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	0.5	0.4	1.6	1.1	1.1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.5	0.4	1.6	1.1	1.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	Site 2	Site 2R	Site 3	Site 6	Site 7
Client sampling date / time				29-Apr-2019 12:00	29-Apr-2019 12:00	30-Apr-2019 07:00	30-Apr-2019 07:00	30-Apr-2019 07:00
				EB1911202-001	EB1911202-002	EB1911202-003	EB1911202-004	EB1911202-005
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	0.5	0.4	1.6	1.1	1.2
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.08	0.06	0.08	0.04	0.04
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.04	0.03	<0.01	<0.01	<0.01
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	5	4	65	10	14
Volume	----	0.01	L	0.85	0.85	0.25	0.8	0.75
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	33.3	36.2	31.4	29.2	30.8
2-Chlorophenol-D4	93951-73-6	1.0	%	74.4	82.3	71.4	67.9	70.6
2.4.6-Tribromophenol	118-79-6	1.0	%	62.5	69.1	61.5	60.0	59.0
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	83.6	91.6	78.5	75.6	77.7
Anthracene-d10	1719-06-8	1.0	%	73.4	76.6	71.3	67.2	68.0

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 2	Site 2R	Site 3	Site 6	Site 7
			Client sampling date / time	29-Apr-2019 12:00	29-Apr-2019 12:00	30-Apr-2019 07:00	30-Apr-2019 07:00	30-Apr-2019 07:00
Compound	CAS Number	LOR	Unit	EB1911202-001	EB1911202-002	EB1911202-003	EB1911202-004	EB1911202-005
				Result	Result	Result	Result	Result
EP075(SIM)T: PAH Surrogates - Continued								
4-Terphenyl-d14	1718-51-0	1.0	%	81.8	88.2	78.5	73.6	73.6

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	Site 11	Site 14	Site 16	Site 18	Site 20R
Client sampling date / time				30-Apr-2019 07:00	01-May-2019 07:00	01-May-2019 07:00	01-May-2019 07:00	01-May-2019 07:00
				EB1911202-006	EB1911202-007	EB1911202-008	EB1911202-009	EB1911202-010
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	293	349	1240	314	152
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.14	0.17	0.62	0.15	0.08
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	104	44	2170	8	10
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	73	83	179	118	72
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	16	7	42	34	19
Magnesium	7439-95-4	1	mg/L	8	16	18	8	6
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	0.004	0.001	0.003
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.002	0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	0.002	0.002	0.009	0.002	0.004
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	0.008
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.02	0.03	1.50	0.02	0.02
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.05	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	0.02	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.07	<0.01	<0.01
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	5.7	2.3	29.6	0.8	1.6
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	5.7	2.3	31.1	0.8	1.6
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 11	Site 14	Site 16	Site 18	Site 20R
			Client sampling date / time	30-Apr-2019 07:00	01-May-2019 07:00	01-May-2019 07:00	01-May-2019 07:00	01-May-2019 07:00
Compound	CAS Number	LOR	Unit	EB1911202-006	EB1911202-007	EB1911202-008	EB1911202-009	EB1911202-010
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	5.7	2.3	31.2	0.8	1.6
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.33	0.10	3.93	0.04	0.32
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	0.10
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	460	16	545	4	21
Volume	----	0.01	L	0.25	0.25	0.012	1	0.5
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	28.3	25.5	28.2	30.9	25.8
2-Chlorophenol-D4	93951-73-6	1.0	%	67.4	60.4	67.3	71.6	64.6
2.4.6-Tribromophenol	118-79-6	1.0	%	64.9	39.8	60.8	48.6	49.8
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	71.6	59.4	57.6	69.3	61.4
Anthracene-d10	1719-06-8	1.0	%	67.0	66.1	59.8	52.9	68.9

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 11	Site 14	Site 16	Site 18	Site 20R
			Client sampling date / time	30-Apr-2019 07:00	01-May-2019 07:00	01-May-2019 07:00	01-May-2019 07:00	01-May-2019 07:00
Compound	CAS Number	LOR	Unit	EB1911202-006	EB1911202-007	EB1911202-008	EB1911202-009	EB1911202-010
				Result	Result	Result	Result	Result
EP075(SIM)T: PAH Surrogates - Continued								
4-Terphenyl-d14	1718-51-0	1.0	%	74.0	75.4	67.6	85.6	77.7

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

			Client sample ID	Site 23	Site 27	Site 28	Site 29	Site 30
			Client sampling date / time	01-May-2019 07:00	02-May-2019 07:00	01-May-2019 07:00	01-May-2019 07:00	02-May-2019 07:00
Compound	CAS Number	LOR	Unit	EB1911202-011	EB1911202-012	EB1911202-013	EB1911202-014	EB1911202-015
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	286	230	307	300	445
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.14	0.11	0.15	0.14	0.21
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	18	214	175	48	70
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	116	102	149	177	192
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	30	21	30	33	34
Magnesium	7439-95-4	1	mg/L	10	12	18	23	26
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	0.002	0.001	0.001	0.003	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	0.002	0.005	0.005	0.001
Nickel	7440-02-0	0.001	mg/L	0.003	0.008	0.011	0.015	0.006
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.02	0.08	0.04	0.03	0.03
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	0.9	1.4	1.5	1.8	3.3
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.9	1.5	1.5	1.8	3.3
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 23	Site 27	Site 28	Site 29	Site 30
			Client sampling date / time	01-May-2019 07:00	02-May-2019 07:00	01-May-2019 07:00	01-May-2019 07:00	02-May-2019 07:00
Compound	CAS Number	LOR	Unit	EB1911202-011	EB1911202-012	EB1911202-013	EB1911202-014	EB1911202-015
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	0.9	1.5	1.5	1.8	3.3
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.06	0.51	0.31	0.66	0.38
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.04	0.01	0.37	<0.01
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	7	24	26	18	72
Volume	----	0.01	L	0.6	0.125	0.075	0.3	0.15
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	29.5	26.4	26.2	23.7	24.3
2-Chlorophenol-D4	93951-73-6	1.0	%	70.6	62.8	58.8	59.2	60.8
2.4.6-Tribromophenol	118-79-6	1.0	%	51.0	41.5	30.4	41.7	41.2
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	66.4	59.6	66.8	61.6	60.9
Anthracene-d10	1719-06-8	1.0	%	78.9	69.0	74.8	68.9	69.8

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 23	Site 27	Site 28	Site 29	Site 30
			Client sampling date / time	01-May-2019 07:00	02-May-2019 07:00	01-May-2019 07:00	01-May-2019 07:00	02-May-2019 07:00
Compound	CAS Number	LOR	Unit	EB1911202-011	EB1911202-012	EB1911202-013	EB1911202-014	EB1911202-015
				Result	Result	Result	Result	Result
EP075(SIM)T: PAH Surrogates - Continued								
4-Terphenyl-d14	1718-51-0	1.0	%	92.2	81.3	87.4	81.2	83.7

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

			Client sample ID	Site 39	Site 40	Site 42	DUP	FB
			Client sampling date / time	02-May-2019 07:00	02-May-2019 07:00	02-May-2019 07:00	30-Apr-2019 07:00	30-Apr-2019 07:00
Compound	CAS Number	LOR	Unit	EB1911202-016	EB1911202-017	EB1911202-018	EB1911202-019	EB1911202-020
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1810	673	835	433	<1
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.92	0.33	0.41	0.21	<0.01
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	20	26	12	9	<5
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	720	290	367	99	<1
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	87	37	48	20	<1
Magnesium	7439-95-4	1	mg/L	122	48	60	12	<1
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.002	0.002	0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	0.010	0.003	0.003	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.04	0.02	0.05	0.03	0.02
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.02	0.02	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.07	0.90	1.25	<0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.07	0.92	1.27	<0.01	<0.01
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	0.6	0.3	0.2	1.0	<0.1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.6	0.3	0.2	1.0	<0.1
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	Site 39	Site 40	Site 42	DUP	FB
			Client sampling date / time	02-May-2019 07:00	02-May-2019 07:00	02-May-2019 07:00	30-Apr-2019 07:00	30-Apr-2019 07:00
				EB1911202-016	EB1911202-017	EB1911202-018	EB1911202-019	EB1911202-020
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	0.7	1.2	1.5	1.0	<0.1
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.06	0.06	0.04	0.04	<0.01
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.02	0.02	<0.01	<0.01
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m³	31	4	2	----	----
Volume	----	0.01	L	0.7	0.55	1	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	28.2	23.5	28.8	30.9	32.6
2-Chlorophenol-D4	93951-73-6	1.0	%	65.5	58.5	66.4	70.2	79.1
2.4.6-Tribromophenol	118-79-6	1.0	%	36.8	32.8	49.2	57.8	64.5
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	72.8	60.7	69.6	76.4	86.3
Anthracene-d10	1719-06-8	1.0	%	84.2	70.3	66.0	71.8	81.4

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 39	Site 40	Site 42	DUP	FB
			Client sampling date / time	02-May-2019 07:00	02-May-2019 07:00	02-May-2019 07:00	30-Apr-2019 07:00	30-Apr-2019 07:00
Compound	CAS Number	LOR	Unit	EB1911202-016	EB1911202-017	EB1911202-018	EB1911202-019	EB1911202-020
				Result	Result	Result	Result	Result
EP075(SIM)T: PAH Surrogates - Continued								
4-Terphenyl-d14	1718-51-0	1.0	%	100	87.3	75.1	75.8	93.3

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	72
2-Chlorophenol-D4	93951-73-6	27	130
2.4.6-Tribromophenol	118-79-6	19	181
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	14	146
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	36	154

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1911202**	Page	: 1 of 13
Client	: **ECO LOGICAL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 02-May-2019
Site	:	Issue Date	: 10-May-2019
Sampler	: DAVID MOORE, EMMA BLACKLOCK	No. of samples received	: 20
Order number	:	No. of samples analysed	: 20

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Due for extraction	Days overdue	Analysis: Date analysed	Due for analysis	Days overdue
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural							
Site 2,	Site 2R	----	----	----	02-May-2019	01-May-2019	1
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural							
Site 2,	Site 2R	----	----	----	02-May-2019	01-May-2019	1

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type / Method	Count: QC	Regular	Rate (%): Actual	Expected	Quality Control Specification
Laboratory Duplicates (DUP)					
PAH/Phenols (GC/MS - SIM)	1	39	2.56	10.00	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)					
Suspended Solids (High Level)	4	30	13.33	15.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH/Phenols (GC/MS - SIM)	1	39	2.56	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010P: Conductivity by PC Titrator								
Clear Plastic Bottle - Natural (EA010-P)								
Site 14, Site 18, Site 23, Site 29	Site 16, Site 20R, Site 28,	01-May-2019	----	----	----	03-May-2019	29-May-2019	✓
Clear Plastic Bottle - Natural (EA010-P)								
Site 27, Site 39, Site 42	Site 30, Site 40,	02-May-2019	----	----	----	03-May-2019	30-May-2019	✓
Clear Plastic Bottle - Natural (EA010-P)								
Site 2,	Site 2R	29-Apr-2019	----	----	----	03-May-2019	27-May-2019	✓
Clear Plastic Bottle - Natural (EA010-P)								
Site 3, Site 7, DUP,	Site 6, Site 11, FB	30-Apr-2019	----	----	----	03-May-2019	28-May-2019	✓
EA025: Total Suspended Solids dried at 104 ± 2°C								
Clear Plastic Bottle - Natural (EA025H)								
Site 14, Site 18, Site 23, Site 29	Site 16, Site 20R, Site 28,	01-May-2019	----	----	----	03-May-2019	08-May-2019	✓
Clear Plastic Bottle - Natural (EA025H)								
Site 27, Site 39, Site 42	Site 30, Site 40,	02-May-2019	----	----	----	03-May-2019	09-May-2019	✓
Clear Plastic Bottle - Natural (EA025H)								
Site 2,	Site 2R	29-Apr-2019	----	----	----	03-May-2019	06-May-2019	✓
Clear Plastic Bottle - Natural (EA025H)								
Site 3, Site 7, DUP,	Site 6, Site 11, FB	30-Apr-2019	----	----	----	03-May-2019	07-May-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EA065: Total Hardness as CaCO3								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 14,	Site 16,	01-May-2019	----	----	----	08-May-2019	29-May-2019	✓
Site 18,	Site 20R,							
Site 23,	Site 28,							
Site 29								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 27,	Site 30,	02-May-2019	----	----	----	08-May-2019	30-May-2019	✓
Site 39,	Site 40,							
Site 42								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 2,	Site 2R	29-Apr-2019	----	----	----	08-May-2019	27-May-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 3,	Site 6,	30-Apr-2019	----	----	----	08-May-2019	28-May-2019	✓
Site 7,	Site 11,							
DUP,	FB							
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 14,	Site 16,	01-May-2019	----	----	----	08-May-2019	29-May-2019	✓
Site 18,	Site 20R,							
Site 23,	Site 28,							
Site 29								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 27,	Site 30,	02-May-2019	----	----	----	08-May-2019	30-May-2019	✓
Site 39,	Site 40,							
Site 42								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 2,	Site 2R	29-Apr-2019	----	----	----	08-May-2019	27-May-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)								
Site 3,	Site 6,	30-Apr-2019	----	----	----	08-May-2019	28-May-2019	✓
Site 7,	Site 11,							
DUP,	FB							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
Site 14,	Site 16,	01-May-2019	----	----	----	08-May-2019	28-Oct-2019	✓
Site 18,	Site 20R,							
Site 23,	Site 28,							
Site 29								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
Site 27,	Site 30,	02-May-2019	----	----	----	08-May-2019	29-Oct-2019	✓
Site 39,	Site 40,							
Site 42								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
Site 2,	Site 2R	29-Apr-2019	----	----	----	08-May-2019	26-Oct-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)								
Site 3,	Site 6,	30-Apr-2019	----	----	----	08-May-2019	27-Oct-2019	✓
Site 7,	Site 11,							
DUP,	FB							
EG035F: Dissolved Mercury by FIMS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
Site 14,	Site 16,	01-May-2019	----	----	----	08-May-2019	29-May-2019	✓
Site 18,	Site 20R,							
Site 23,	Site 28,							
Site 29								
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
Site 27,	Site 30,	02-May-2019	----	----	----	08-May-2019	30-May-2019	✓
Site 39,	Site 40,							
Site 42								
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
Site 2,	Site 2R	29-Apr-2019	----	----	----	08-May-2019	27-May-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)								
Site 3,	Site 6,	30-Apr-2019	----	----	----	08-May-2019	28-May-2019	✓
Site 7,	Site 11,							
DUP,	FB							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK055G: Ammonia as N by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
Site 14,	Site 16,	01-May-2019	----	----	----	02-May-2019	29-May-2019	✓
Site 18,	Site 20R,							
Site 23,	Site 28,							
Site 29								
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
Site 27,	Site 30,	02-May-2019	----	----	----	02-May-2019	30-May-2019	✓
Site 39,	Site 40,							
Site 42								
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
Site 2,	Site 2R	29-Apr-2019	----	----	----	02-May-2019	27-May-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G)								
Site 3,	Site 6,	30-Apr-2019	----	----	----	02-May-2019	28-May-2019	✓
Site 7,	Site 11,							
DUP,	FB							
EK057G: Nitrite as N by Discrete Analyser								
Clear Plastic Bottle - Natural (EK057G)								
Site 14,	Site 16,	01-May-2019	----	----	----	02-May-2019	03-May-2019	✓
Site 18,	Site 20R,							
Site 23,	Site 28,							
Site 29								
Clear Plastic Bottle - Natural (EK057G)								
Site 27,	Site 30,	02-May-2019	----	----	----	02-May-2019	04-May-2019	✓
Site 39,	Site 40,							
Site 42								
Clear Plastic Bottle - Natural (EK057G)								
Site 2,	Site 2R	29-Apr-2019	----	----	----	02-May-2019	01-May-2019	×
Clear Plastic Bottle - Natural (EK057G)								
Site 3,	Site 6,	30-Apr-2019	----	----	----	02-May-2019	02-May-2019	✓
Site 7,	Site 11,							
DUP,	FB							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)	Sample Date	Extraction / Preparation Date extracted	Due for extraction	Evaluation	Analysis Date analysed	Due for analysis	Evaluation
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 14, Site 16, Site 18, Site 20R, Site 23, Site 28, Site 29	01-May-2019	----	----	----	02-May-2019	29-May-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 27, Site 30, Site 39, Site 40, Site 42	02-May-2019	----	----	----	02-May-2019	30-May-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 2, Site 2R	29-Apr-2019	----	----	----	02-May-2019	27-May-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 3, Site 6, Site 7, Site 11, DUP, FB	30-Apr-2019	----	----	----	02-May-2019	28-May-2019	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 14, Site 16, Site 18, Site 20R, Site 23, Site 28, Site 29	01-May-2019	07-May-2019	29-May-2019	✓	07-May-2019	29-May-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 27, Site 30, Site 39, Site 40, Site 42	02-May-2019	07-May-2019	30-May-2019	✓	07-May-2019	30-May-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 2, Site 2R	29-Apr-2019	07-May-2019	27-May-2019	✓	07-May-2019	27-May-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 3, Site 6, Site 7, Site 11, DUP, FB	30-Apr-2019	07-May-2019	28-May-2019	✓	07-May-2019	28-May-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / *Container / Client Sample ID(s)*		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK067G: Total Phosphorus as P by Discrete Analyser								
Clear Plastic Bottle - Sulfuric Acid (EK067G)								
Site 14,	Site 16,	01-May-2019	07-May-2019	29-May-2019	✓	07-May-2019	29-May-2019	✓
Site 18,	Site 20R,							
Site 23,	Site 28,							
Site 29								
Clear Plastic Bottle - Sulfuric Acid (EK067G)								
Site 27,	Site 30,	02-May-2019	07-May-2019	30-May-2019	✓	07-May-2019	30-May-2019	✓
Site 39,	Site 40,							
Site 42								
Clear Plastic Bottle - Sulfuric Acid (EK067G)								
Site 2,	Site 2R	29-Apr-2019	07-May-2019	27-May-2019	✓	07-May-2019	27-May-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G)								
Site 3,	Site 6,	30-Apr-2019	07-May-2019	28-May-2019	✓	07-May-2019	28-May-2019	✓
Site 7,	Site 11,							
DUP,	FB							
EK071G: Reactive Phosphorus as P by discrete analyser								
Clear Plastic Bottle - Natural (EK071G)								
Site 14,	Site 16,	01-May-2019	----	----	----	02-May-2019	03-May-2019	✓
Site 18,	Site 20R,							
Site 23,	Site 28,							
Site 29								
Clear Plastic Bottle - Natural (EK071G)								
Site 27,	Site 30,	02-May-2019	----	----	----	02-May-2019	04-May-2019	✓
Site 39,	Site 40,							
Site 42								
Clear Plastic Bottle - Natural (EK071G)								
Site 2,	Site 2R	29-Apr-2019	----	----	----	02-May-2019	01-May-2019	×
Clear Plastic Bottle - Natural (EK071G)								
Site 3,	Site 6,	30-Apr-2019	----	----	----	02-May-2019	02-May-2019	✓
Site 7,	Site 11,							
DUP,	FB							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP008: Chlorophyll a & Pheophytin a								
Glass Fibre Filter Paper (Chlorophyll) (EP008)								
Site 14, Site 18, Site 23, Site 29	Site 16, Site 20R, Site 28,	01-May-2019	----	----	----	02-May-2019	22-May-2019	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008)								
Site 27, Site 39, Site 42	Site 30, Site 40,	02-May-2019	----	----	----	02-May-2019	23-May-2019	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008)								
Site 2,	Site 2R	29-Apr-2019	----	----	----	02-May-2019	20-May-2019	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008)								
Site 3, Site 7,	Site 6, Site 11	30-Apr-2019	----	----	----	02-May-2019	21-May-2019	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Amber Glass Bottle - Unpreserved (EP075(SIM))								
Site 14, Site 18, Site 23, Site 29	Site 16, Site 20R, Site 28,	01-May-2019	07-May-2019	08-May-2019	✓	07-May-2019	16-Jun-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM))								
Site 27, Site 39, Site 42	Site 30, Site 40,	02-May-2019	07-May-2019	09-May-2019	✓	07-May-2019	16-Jun-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM))								
Site 2,	Site 2R	29-Apr-2019	03-May-2019	06-May-2019	✓	07-May-2019	12-Jun-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM))								
Site 3, Site 7, DUP,	Site 6, Site 11, FB	30-Apr-2019	03-May-2019	07-May-2019	✓	07-May-2019	12-Jun-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	3	26	11.54	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	4	35	11.43	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	4	39	10.26	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	3	26	11.54	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	39	2.56	10.00	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	3	30	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	2	26	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chlorophyll a and Pheophytin a	EP008	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	10.00	10.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	35	5.71	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	26	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	3	39	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	4	30	13.33	15.00	✗	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	2	26	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Chlorophyll a and Pheophytin a	EP008	1	18	5.56	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	35	5.71	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	39	5.13	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	26	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	3	39	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Method Blanks (MB) - Continued							
Suspended Solids (High Level)	EA025H	2	30	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	2	26	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	35	5.71	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	26	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	39	2.56	5.00	✗	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Salinity	EA020-EC-P	WATER	In house: Referenced to APHA 2520B. Calculation from Electrical conductivity. This method is compliant with NEPM (2013) Schedule B(3)
Suspended Solids (High Level)	EA025H	WATER	In house: Referenced to APHA 2540D. A gravimetric procedure employed to determine the amount of \`non-filterable\` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (2013) Schedule B(3)
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45μm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45μm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	Method	Matrix	Method Descriptions
Organic Nitrogen as N (TKN - NH3) (discrete analyser)	EK060G	WATER	In house: Referenced to APHA 4500-Norg/4500-NH3. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Chlorophyll a and Pheophytin a	EP008	WATER	In house: Referenced to APHA 10200 H. The pigments are extracted into aqueous acetone. The optical density of the extract before and after acidification at both 664 nm and 665 nm is determined spectrometrically.
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.

Environmental Division
Brisbane
Work Order Reference
EB1912777

Telephone : + 61-7-3243 7222

CHAIN OF CUSTODY

ALS Laboratory: please tick →

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☐BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
☐GLADSTONE 48 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com
☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
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☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
☐NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
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☐SYDNEY 277-289 Ph: 02 8784 8555 E:
☐TOWNSVILLE 14- Ph: 07 4796 0600 E
☐WOLLONGONG 1 Ph: 02 4225 3125 E

CLIENT: Eco Logical Australia	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)	☒ Standard TAT (List due date): ☐ Non Standard or urgent TAT (List due date):	FOR LABORATORY Custody Seal Intact?
OFFICE: Brisbane			Free ice / frozen ice bri
PROJECT: Inland Rail - Border to Gowrie EIS PROJECT NO 10558	ALS QUOTE NO.: BN/142/18 V2	COC SEQUENCE NUMBER (Circle)	Random Sample Temperature on Receipt: °C
ORDER NUMBER: PURCHASE ORDER NO.:	COUNTRY OF ORIGIN: Australia	COC: 1 2 3 4 5 6 7	Other comment:
PROJECT MANAGER: Miles Yeates CONTACT PH: 0467 738 954		OF: 1 2 3 4 5 6 7	

SAMPLER: David Moore and Emily Messer	SAMPLER MOBILE:	RELINQUISHED BY:	RECEIVED BY: Andrea CT	RELINQUISHED BY:	RECEIVED BY: Don
COC Emailed to ALS? (NO)	EDD FORMAT (or default):	DATE/TIME: 20/5/19 7:50am	DATE/TIME: 20.5.19 7.50	DATE/TIME:	DATE/TIME: 20/5/19 7.50
Email Reports to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au					
Email Invoice to (will default to PM if no other addresses are listed): milesy@ecoaus.com.au					

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES	EA020-EC-P Conductivity and Salinity	EA025H Total Suspended Solids (TSS)	NT-1C Total Hardness as CaCO3	NT-8A Nutrients suite - Ammonia as N, Nitrite, Nitrate, Total N, TKN, NOx, Reactive P and Total P	EK060 Organic Nitrogen	W-2 Dissolved metals - 8 metals suite (As, Cd, Cr, Cu, Ni, Pb, Zn and Hg) - samples are field filtered	EP075B SIM PAHs (16 analytes)	EP008 Chlorophyll a (filter paper method)	All metals samples are field filtered. Frozen Chlorophyll a filter paper samples are included in this work order. Filter paper is 47mm GFF ~0.7 micron. Filtered volume is noted below and on jar. Filter paper was foil wrapped and kept frozen at minus 17°C up to delivery.
1	Site 2	16/5/19 1200	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 650mL
2	Site 6R	16/5/19 1200	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 500 mL
3	Site 7	16/5/19 1200	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 1,000mL
4	Site 18	17/5/19 1200	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 1,000mL
5	Site 42	18/5/19 1200	W		5	X	X	X	X	X	X	X	X	Chl a volume filtered: 1,000 mL
6	DUP	16/5/19 1200	W		6	X	X	X	X	X	X	X		+2 QA/QC bottles
7	FB	16/5/19 1200	W		4	X	X	X	X	X	X	X		
				TOTAL	35									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

HT

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1912777**	Page	: 1 of 8
Client	: **ECO LOGICAL AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Contact	: Customer Services EB
Address	: PO BOX 1422 FORTITUDE VALLEY QLD 4006	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 02 8536 8667	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 20-May-2019 07:50
Order number	:	Date Analysis Commenced	: 20-May-2019
C-O-C number	: ----	Issue Date	: 28-May-2019 09:01
Sampler	: DAVID MOORE, EMILY MESSER		
Site	:		
Quote number	: BN/142/18 V2		
No. of samples received	: 7		
No. of samples analysed	: 7		

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	WB Water Lab Brisbane, Stafford, QLD
Santusha Pandra	Organic Chemist	Brisbane Organics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Benzo(a)pyrene Toxicity Equivalent Quotient (TEQ) per the NEPM (2013) is the sum total of the concentration of the eight carcinogenic PAHs multiplied by their Toxicity Equivalence Factor (TEF) relative to Benzo(a)pyrene. TEF values are provided in brackets as follows: Benz(a)anthracene (0.1), Chrysene (0.01), Benzo(b+j) & Benzo(k)fluoranthene (0.1), Benzo(a)pyrene (1.0), Indeno(1.2.3.cd)pyrene (0.1), Dibenz(a.h)anthracene (1.0), Benzo(g.h.i)perylene (0.01). Less than LOR results for 'TEQ Zero' are treated as zero.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 2	Site 6R	Site 7	Site 18	Site 42
			Client sampling date / time	16-May-2019 12:00	16-May-2019 12:00	16-May-2019 12:00	17-May-2019 12:00	18-May-2019 12:00
Compound	CAS Number	LOR	Unit	EB1912777-001	EB1912777-002	EB1912777-003	EB1912777-004	EB1912777-005
				Result	Result	Result	Result	Result
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	290	437	440	320	1290
EA020EC: Salinity								
Salinity	----	0.01	g/kg	0.14	0.21	0.21	0.15	0.64
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	12	11	6	14	<5
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	70	86	93	101	509
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	15	18	19	29	62
Magnesium	7439-95-4	1	mg/L	8	10	11	7	86
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	0.002	0.001	0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	0.002	0.002
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.02	0.03	0.05	0.02	0.03
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	0.02
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	0.02	<0.01	0.24	<0.01	1.38
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.02	<0.01	0.24	<0.01	1.40
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	0.7	1.1	1.0	0.8	0.2
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.7	1.1	1.0	0.8	0.2
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 2	Site 6R	Site 7	Site 18	Site 42
			Client sampling date / time	16-May-2019 12:00	16-May-2019 12:00	16-May-2019 12:00	17-May-2019 12:00	18-May-2019 12:00
Compound	CAS Number	LOR	Unit	EB1912777-001	EB1912777-002	EB1912777-003	EB1912777-004	EB1912777-005
				Result	Result	Result	Result	Result
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	0.7	1.1	1.2	0.8	1.6
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.03	0.03	0.02	0.04	<0.01
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EP008: Chlorophyll a & Pheophytin a								
Chlorophyll a	----	1	mg/m^3	7	11	7	5	1
Volume	----	0.01	L	0.65	0.5	1	1	1
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	<1.0	<1.0	<1.0
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	<0.5	<0.5	<0.5
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	30.4	28.9	25.5	34.0	27.9
2-Chlorophenol-D4	93951-73-6	1.0	%	84.6	80.4	68.5	93.3	69.9
2.4.6-Tribromophenol	118-79-6	1.0	%	60.0	54.1	40.3	51.4	25.2
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	82.5	80.7	79.6	95.6	84.0
Anthracene-d10	1719-06-8	1.0	%	57.3	57.4	77.9	104	83.3

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	Site 2	Site 6R	Site 7	Site 18	Site 42
			Client sampling date / time	16-May-2019 12:00	16-May-2019 12:00	16-May-2019 12:00	17-May-2019 12:00	18-May-2019 12:00
Compound	CAS Number	LOR	Unit	EB1912777-001	EB1912777-002	EB1912777-003	EB1912777-004	EB1912777-005
				Result	Result	Result	Result	Result
EP075(SIM)T: PAH Surrogates - Continued								
4-Terphenyl-d14	1718-51-0	1.0	%	60.8	61.4	82.5	112	89.7

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	DUP	FB	----	----	----
			Client sampling date / time	16-May-2019 12:00	16-May-2019 12:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1912777-006	EB1912777-007	-------	-------	-------
				Result	Result	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**435**	<1	----	----	----
EA020EC: Salinity								
Salinity	----	0.01	g/kg	**0.21**	<0.01	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C								
Suspended Solids (SS)	----	5	mg/L	**7**	<5	----	----	----
EA065: Total Hardness as CaCO3								
Total Hardness as CaCO3	----	1	mg/L	**93**	<1	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**19**	<1	----	----	----
Magnesium	7439-95-4	1	mg/L	**11**	<1	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.001**	<0.001	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	----	----	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.05**	<0.01	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.24**	<0.01	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.24**	<0.01	----	----	----
EK060G:Organic Nitrogen as N (TKN-NH3) By Discrete Analyser								
Organic Nitrogen as N	----	0.1	mg/L	**1.0**	<0.1	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.0**	<0.1	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	DUP	FB	----	----	----
			Client sampling date / time	16-May-2019 12:00	16-May-2019 12:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1912777-006	EB1912777-007	-------	-------	-------
				Result	Result	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	1.2	<0.1	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	0.02	<0.01	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	----	----	----
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthylene	208-96-8	1.0	µg/L	<1.0	<1.0	----	----	----
Acenaphthene	83-32-9	1.0	µg/L	<1.0	<1.0	----	----	----
Fluorene	86-73-7	1.0	µg/L	<1.0	<1.0	----	----	----
Phenanthrene	85-01-8	1.0	µg/L	<1.0	<1.0	----	----	----
Anthracene	120-12-7	1.0	µg/L	<1.0	<1.0	----	----	----
Fluoranthene	206-44-0	1.0	µg/L	<1.0	<1.0	----	----	----
Pyrene	129-00-0	1.0	µg/L	<1.0	<1.0	----	----	----
Benz(a)anthracene	56-55-3	1.0	µg/L	<1.0	<1.0	----	----	----
Chrysene	218-01-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(k)fluoranthene	207-08-9	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(a)pyrene	50-32-8	0.5	µg/L	<0.5	<0.5	----	----	----
Indeno(1.2.3.cd)pyrene	193-39-5	1.0	µg/L	<1.0	<1.0	----	----	----
Dibenz(a.h)anthracene	53-70-3	1.0	µg/L	<1.0	<1.0	----	----	----
Benzo(g.h.i)perylene	191-24-2	1.0	µg/L	<1.0	<1.0	----	----	----
^ Sum of polycyclic aromatic hydrocarbons	----	0.5	µg/L	<0.5	<0.5	----	----	----
^ Benzo(a)pyrene TEQ (zero)	----	0.5	µg/L	<0.5	<0.5	----	----	----
EP075(SIM)S: Phenolic Compound Surrogates								
Phenol-d6	13127-88-3	1.0	%	25.6	29.6	----	----	----
2-Chlorophenol-D4	93951-73-6	1.0	%	70.1	78.5	----	----	----
2.4.6-Tribromophenol	118-79-6	1.0	%	39.0	34.8	----	----	----
EP075(SIM)T: PAH Surrogates								
2-Fluorobiphenyl	321-60-8	1.0	%	72.4	82.0	----	----	----
Anthracene-d10	1719-06-8	1.0	%	57.3	89.2	----	----	----
4-Terphenyl-d14	1718-51-0	1.0	%	63.3	95.6	----	----	----

Surrogate Control Limits

Sub-Matrix: **WATER**

Compound	CAS Number	Recovery Limits (%) Low	Recovery Limits (%) High
EP075(SIM)S: Phenolic Compound Surrogates			
Phenol-d6	13127-88-3	10	72
2-Chlorophenol-D4	93951-73-6	27	130
2.4.6-Tribromophenol	118-79-6	19	181
EP075(SIM)T: PAH Surrogates			
2-Fluorobiphenyl	321-60-8	14	146
Anthracene-d10	1719-06-8	35	137
4-Terphenyl-d14	1718-51-0	36	154

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: EB1912777	Page	: 1 of 9
Client	: ECO LOGICAL AUSTRALIA PTY LTD	Laboratory	: Environmental Division Brisbane
Contact	: MILES YEATES	Telephone	: +61-7-3243 7222
Project	: 10558 Inland Rail - Border to Gowie EIS	Date Samples Received	: 20-May-2019
Site	:	Issue Date	: 28-May-2019
Sampler	: DAVID MOORE, EMILY MESSER	No. of samples received	: 7
Order number	:	No. of samples analysed	: 7

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)		Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural							
Site 2, Site 7, FB	Site 6R, DUP,	----	----	----	20-May-2019	18-May-2019	2
Clear Plastic Bottle - Natural							
Site 18		----	----	----	20-May-2019	19-May-2019	1
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural							
Site 2, Site 7, FB	Site 6R, DUP,	----	----	----	20-May-2019	18-May-2019	2
Clear Plastic Bottle - Natural							
Site 18		----	----	----	20-May-2019	19-May-2019	1

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA010P: Conductivity by PC Titrator								
Clear Plastic Bottle - Natural (EA010-P)								
Site 2, Site 7, FB	Site 6R, DUP,	16-May-2019	----	----	----	22-May-2019	13-Jun-2019	✓
Clear Plastic Bottle - Natural (EA010-P)								
Site 18		17-May-2019	----	----	----	22-May-2019	14-Jun-2019	✓
Clear Plastic Bottle - Natural (EA010-P)								
Site 42		18-May-2019	----	----	----	22-May-2019	15-Jun-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA025: Total Suspended Solids dried at 104 ± 2°C								
Clear Plastic Bottle - Natural (EA025H) Site 2, Site 7, FB	Site 6R, DUP,	16-May-2019	----	----	----	21-May-2019	23-May-2019	✓
Clear Plastic Bottle - Natural (EA025H) Site 18		17-May-2019	----	----	----	21-May-2019	24-May-2019	✓
Clear Plastic Bottle - Natural (EA025H) Site 42		18-May-2019	----	----	----	21-May-2019	25-May-2019	✓
EA065: Total Hardness as CaCO3								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 2, Site 7, FB	Site 6R, DUP,	16-May-2019	----	----	----	25-May-2019	13-Jun-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 18		17-May-2019	----	----	----	25-May-2019	14-Jun-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 42		18-May-2019	----	----	----	25-May-2019	15-Jun-2019	✓
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 2, Site 7, FB	Site 6R, DUP,	16-May-2019	----	----	----	25-May-2019	13-Jun-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 18		17-May-2019	----	----	----	25-May-2019	14-Jun-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F) Site 42		18-May-2019	----	----	----	25-May-2019	15-Jun-2019	✓
EG020F: Dissolved Metals by ICP-MS								
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) Site 2, Site 7, FB	Site 6R, DUP,	16-May-2019	----	----	----	25-May-2019	12-Nov-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) Site 18		17-May-2019	----	----	----	25-May-2019	13-Nov-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F) Site 42		18-May-2019	----	----	----	25-May-2019	14-Nov-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) Site 2, Site 6R, Site 7, DUP, FB	**16-May-2019**	----	----	----	**27-May-2019**	13-Jun-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) Site 18	**17-May-2019**	----	----	----	**27-May-2019**	14-Jun-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F) Site 42	**18-May-2019**	----	----	----	**27-May-2019**	15-Jun-2019	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G) Site 2, Site 6R, Site 7, DUP, FB	**16-May-2019**	----	----	----	**20-May-2019**	13-Jun-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) Site 18	**17-May-2019**	----	----	----	**20-May-2019**	14-Jun-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G) Site 42	**18-May-2019**	----	----	----	**20-May-2019**	15-Jun-2019	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G) Site 2, Site 6R, Site 7, DUP, FB	**16-May-2019**	----	----	----	**20-May-2019**	18-May-2019	×
Clear Plastic Bottle - Natural (EK057G) Site 18	**17-May-2019**	----	----	----	**20-May-2019**	19-May-2019	×
Clear Plastic Bottle - Natural (EK057G) Site 42	**18-May-2019**	----	----	----	**20-May-2019**	20-May-2019	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 2, Site 6R, Site 7, DUP, FB	**16-May-2019**	----	----	----	**20-May-2019**	13-Jun-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 18	**17-May-2019**	----	----	----	**20-May-2019**	14-Jun-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G) Site 42	**18-May-2019**	----	----	----	**20-May-2019**	15-Jun-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Due for extraction	Evaluation	Analysis: Date analysed	Due for analysis	Evaluation
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 2, Site 6R, Site 7, DUP, FB	16-May-2019	22-May-2019	13-Jun-2019	✓	22-May-2019	13-Jun-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 18	17-May-2019	22-May-2019	14-Jun-2019	✓	22-May-2019	14-Jun-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G) Site 42	18-May-2019	22-May-2019	15-Jun-2019	✓	22-May-2019	15-Jun-2019	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 2, Site 6R, Site 7, DUP, FB	16-May-2019	22-May-2019	13-Jun-2019	✓	22-May-2019	13-Jun-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 18	17-May-2019	22-May-2019	14-Jun-2019	✓	22-May-2019	14-Jun-2019	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G) Site 42	18-May-2019	22-May-2019	15-Jun-2019	✓	22-May-2019	15-Jun-2019	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G) Site 2, Site 6R, Site 7, DUP, FB	16-May-2019	----	----	----	20-May-2019	18-May-2019	×
Clear Plastic Bottle - Natural (EK071G) Site 18	17-May-2019	----	----	----	20-May-2019	19-May-2019	×
Clear Plastic Bottle - Natural (EK071G) Site 42	18-May-2019	----	----	----	20-May-2019	20-May-2019	✓
EP008: Chlorophyll a & Pheophytin a							
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 2, Site 6R, Site 7	16-May-2019	----	----	----	21-May-2019	06-Jun-2019	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 18	17-May-2019	----	----	----	21-May-2019	07-Jun-2019	✓
Glass Fibre Filter Paper (Chlorophyll) (EP008) Site 42	18-May-2019	----	----	----	21-May-2019	08-Jun-2019	✓
EP075(SIM)B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 2, Site 6R, Site 7, DUP, FB	16-May-2019	21-May-2019	23-May-2019	✓	23-May-2019	30-Jun-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 18	17-May-2019	21-May-2019	24-May-2019	✓	23-May-2019	30-Jun-2019	✓
Amber Glass Bottle - Unpreserved (EP075(SIM)) Site 42	18-May-2019	21-May-2019	25-May-2019	✓	23-May-2019	30-Jun-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Laboratory Duplicates (DUP)							
Ammonia as N by Discrete analyser	EK055G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	3	29	**10.34**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Ammonia as N by Discrete analyser	EK055G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chlorophyll a and Pheophytin a	EP008	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Suspended Solids (High Level)	EA025H	6	29	**20.69**	**15.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chlorophyll a and Pheophytin a	EP008	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: ✗ = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*	
Method Blanks (MB) - Continued							
Suspended Solids (High Level)	EA025H	2	29	6.90	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	14	7.14	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	15	6.67	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	13	7.69	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	1	7	14.29	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	19	5.26	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	5.00	5.00	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Salinity	EA020-EC-P	WATER	In house: Referenced to APHA 2520B. Calculation from Electrical conductivity. This method is compliant with NEPM (2013) Schedule B(3)
Suspended Solids (High Level)	EA025H	WATER	In house: Referenced to APHA 2540D. A gravimetric procedure employed to determine the amount of `non-filterable` residue in a aqueous sample. The prescribed GFC (1.2um) filter is rinsed with deionised water, oven dried and weighed prior to analysis. A well-mixed sample is filtered through a glass fibre filter (1.2um). The residue on the filter paper is dried at 104+/-2C . This method is compliant with NEPM (2013) Schedule B(3)
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)

Analytical Methods	*Method*	*Matrix*	*Method Descriptions*
Organic Nitrogen as N (TKN - NH3) (discrete analyser)	EK060G	WATER	In house: Referenced to APHA 4500-Norg/4500-NH3. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Chlorophyll a and Pheophytin a	EP008	WATER	In house: Referenced to APHA 10200 H. The pigments are extracted into aqueous acetone. The optical density of the extract before and after acidification at both 664 nm and 665 nm is determined spectrometrically.
PAH/Phenols (GC/MS - SIM)	EP075(SIM)	WATER	In house: Referenced to USEPA SW 846 - 8270D Sample extracts are analysed by Capillary GC/MS in SIM Mode and quantification is by comparison against an established 5 point calibration curve. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510B 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM (2013) Schedule B(3) . ALS default excludes sediment which may be resident in the container.

APPENDIX
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Aquatic Ecology Technical Report

Appendix E Significant Impact Assessment—Murray Cod

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

IR_1534

Appendix E: Significant Impact Assessment – Murray Cod

A significant impact assessment is completed in the following tables in relation to the Significant Impact Guidelines of the EPBC Act (DotE 2013) and the draft referral guidelines for the Murray Cod (DotE 2016).

Significant Impact Guidelines of the EPBC Act for Vulnerable species (DotE 2013)

Significant impact criteria	Significant impact	Response to criteria
Lead to a long-term decrease in the size of an important population of a species	No	The recovery plan for Murray Cod identifies two important populations in the impact assessment area – the Queensland Border Rivers and upland reaches of the Condamine River. These are recognised for their representation as upland populations, evidence of natural recruitment and largely intact fish community. The Project will result in only localised disturbance to habitat for Murray Cod in a small number of locations. Impacts are not expected to affect the species at a population level.
Reduce the area of occupancy of an important population	No	The recovery plan for Murray Cod identifies two important populations in the impact assessment area – the Queensland Border Rivers and upland reaches of the Condamine River. These are recognised for their representation as upland populations, evidence of natural recruitment and largely intact fish community. The area of occupancy is unlikely to be affected by the Project. Bridges will be constructed over waterways in preference to culverts and fish passage will be accommodated in accordance with requirements of the *Fisheries Act 1994*. This will avoid reducing occupancy of a population or fragmenting a population.
Fragment an existing important population into two or more populations	No	
Adversely affect habitat critical to the survival of the species	No	Habitat critical to the survival of the species is defined in the draft referral guidelines (DotE 2016) as follows: "Any section of a waterway that comprises a connected system of habitats suitable for sustained use by a Murray cod population for sheltering, foraging, breeding and upstream and downstream movement is considered by the Department to be habitat critical to the survival of the species." Habitat critical to survival of the species is present within the impact assessment area, including in the Macintyre River and Macintyre Brook. However, impacts on these areas will be small in scale and localised. With the implementation of mitigation

Significant impact criteria	Significant impact	Response to criteria
		measures, habitat critical to the survival of the species will not be adversely affected.
Disrupt the breeding cycle of an important population	No	The recovery plan for Murray Cod identifies two important populations in the impact assessment area – the Queensland Border Rivers and upland reaches of the Condamine River. These are recognised for their representation as upland populations, evidence of natural recruitment and largely intact fish community. Impacts on hydrology of the watercourses and waterways (important for breeding) will be minimised through design and fish passage will be maintained. This is an important mitigation measure to avoid impacts to important populations in upland areas.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No	Impacts to habitat will be localised and very small in scale, confined to a small number of crossings of large river systems in the impact assessment area. Bridges will be constructed at crossings in preference to culverts, minimising the disturbance of habitat features on stream banks and beds.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	No	A range of invasive weed species are known to occur within the impact assessment area and the surrounding landscape. The clearing for infrastructure may facilitate the spread of invasive weed species in to species habitat. Hygiene procedures and a weed management plan is to be implemented to minimise the risk of introduction of weed species. The proposed Project is unlikely to heighten the risk of harm from existing pest species. The project is unlikely to introduce any non-native fish species, which is a key threat to the Murray Cod.
Introduce disease that may cause the species to decline	No	Currently, there is little known about diseases harmful to Murray Cod. Most relate to the introduction of noxious species from overseas. There is no evidence to suggest that the presence of Project infrastructure would introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	No	The Project is unlikely to interfere substantially with the recovery of the species, given the small scale of impacts on habitat and localised nature of disturbance.

Draft Referral Guidelines for the Murray Cod (DotE 2016)

The draft referral guidelines for Murray Cod provide species specific guidance on what factors may be high, medium and low risk of having significant impacts on the Murray Cod. An analysis of the potential impacts from the Project against the high and medium risk factors has been undertaken below.

Referral Guidelines risk factors for significant impacts	Significant impact	Response to Guidelines
Adverse affects on habitat critical to survival of the species		
Removing, modifying or degrading the structural elements of a significant proportion of the habitat	No	Where disturbance occurs to habitat critical to survival of the Murray Cod, this will be limited to small and localised areas and will not affect a significant proportion of habitat.
Causing the sedimentation of a significant proportion of the habitat causing a divergence of greater than 1.5 °C from the monthly median water temperature of a waterway in which the habitat occurs	No	The Project will have only localised impacts to water temperature and will not influence the overall temperature of waterways in which Murray Cod has been found. Localised changes to water temperature arising from shading from bridge structures or clearing of riparian vegetation are unlikely to influence the monthly median water temperature by more than 1.5 °C.
Reducing the water quality (especially relating to temperature, dissolved oxygen, acidity, salinity, chemical pollutants) of a significant proportion of the habitat outside the applicable minimum or maximum thresholds presented in the Australian and New Zealand guidelines for fresh and marine water quality: Volume 1 (2000) (ANZECC guidelines)	No	Water quality studies for the Project have demonstrated that water quality is impaired throughout the waterways of the impact assessment area due to current and ongoing land uses. Impacts on water quality from the Project are expected to be short-term during construction and localised to the immediate area surrounding works.
Creating a barrier which fragments habitat or alters the existing flow regime or hydrology of the habitat, for example eliminating flood pulse flows, creating weir pool effects or degrading spawning sites with low-flow accumulations of algal/periphytic growth or silt	No	Impacts of the Project on hydrology are likely to be minor and localised. Fish passage will be retained.
Adverse affects on an important population of the species		
Removing, modifying or degrading the structural elements of a significant proportion of habitat which the population may rely on for sheltering, foraging or breeding	No	Alterations to structural elements of habitat will be localised in scale and will not affect a significant proportion of habitat.

Referral Guidelines risk factors for significant impacts	Significant impact	Response to Guidelines
Fragmenting the population or substantially inhibiting the population's breeding cycle, larval recruitment or the exchange of genetic material by restricting the upstream or downstream movement of the population, including freely drifting larvae	No	The Project will not cause fragmentation of the population of Murray Cod. Fish passage will be retained.
Disrupting the activity of a breeding population in a manner which is likely to substantially diminish recruitment of larvae into the local population during a single breeding season	No	The activity of a breeding population will not be disrupted. Where possible, works in locations occupied by important populations (e.g. Macintyre River and Macintyre Brook) will be avoided during the Murray Cod breeding season.
Reducing its genetic diversity	No	The Project will not impact on the genetic diversity of the species.
Decreasing the size of the population or of any given life-history cohort of that population over the long-term	No	The Project is highly unlikely to decrease the size of the Murray Cod population or of a particular cohort of the species in the long term. Any impacts on individuals within the population will be short term, during construction, and are likely to result in the displacement of individuals for short distances.
Substantially decreasing the size of the population, or of any given life-history cohort of that population, to the extent that its reproductive capacity is likely to be substantially diminished in the succeeding one or more breeding seasons	No	
introducing a predatory or competitive native or alien fish species or pathogen that is likely to be detrimental to the population	No	The Project is unlikely to result in the introduction of a predatory or competitive fish species. Biosecurity procedures will be in place to avoid introducing exotic fish species from farm dams that are dewatered during Project activities.
Other criteria for assessment		
An action that is likely to adversely affect a large area of habitat, which does not meet the description in these guidelines of habitat critical to the survival of the species, by: • substantially reducing the water quality (especially relating to temperature, dissolved oxygen, acidity, salinity, chemical pollutants) outside the applicable minimum or maximum thresholds presented in the ANZECC guidelines	No	Water quality studies for the Project have demonstrated that water quality is impaired throughout the waterways of the impact assessment area due to current and ongoing land uses. Impacts on water quality and hydrology will be minor and localised to the immediate area surrounding works. Impacts will not be substantial in scale.

Referral Guidelines risk factors for significant impacts	Significant impact	Response to Guidelines
• substantially altering the existing flow regime or hydrology of the aquatic system		
An action that is likely to adversely affect a population, which is not considered an important population as indicated in these guidelines, by: • causing a long-term or substantial short-term decrease in the size of the population or of any given life-history cohort of that population, for example through an organised recreational fishing operation or event involving multiple anglers taking multiple Murray cod from an important population over a relatively short time period • causing a large reduction in the area of occupancy of the population • fragmenting the population or preventing the upstream or downstream movement of the population and the flow of genetic material • disrupting the activity of the breeding population in a manner which is likely to substantially diminish recruitment of larvae into the local population during a single breeding season • reducing the genetic diversity of the population • introducing a predatory or competitive native or alien fish species or pathogen that is likely to be detrimental to the population (such an impact could result from the action of an individual angler)	No	The Project does not involve angling or the take of Murray Cod. Any impacts on the species will be short term, localised and will not affect the area of occupancy of the species. Fish passage will be retained, allowing for continued movement of individuals and prey of the species. This will allow breeding migrations to continue. Larval recruitment of the species is unlikely to be affected by the project, with minimal, short term and localised impacts on hydrology and water quality. Biosecurity procedures will mitigate the risk of introducing pest species to habitat of the Murray Cod.

APPENDIX K

Aquatic Ecology Technical Report

Appendix F Maps Showing the Location of Waterways that Provide Fish Passage

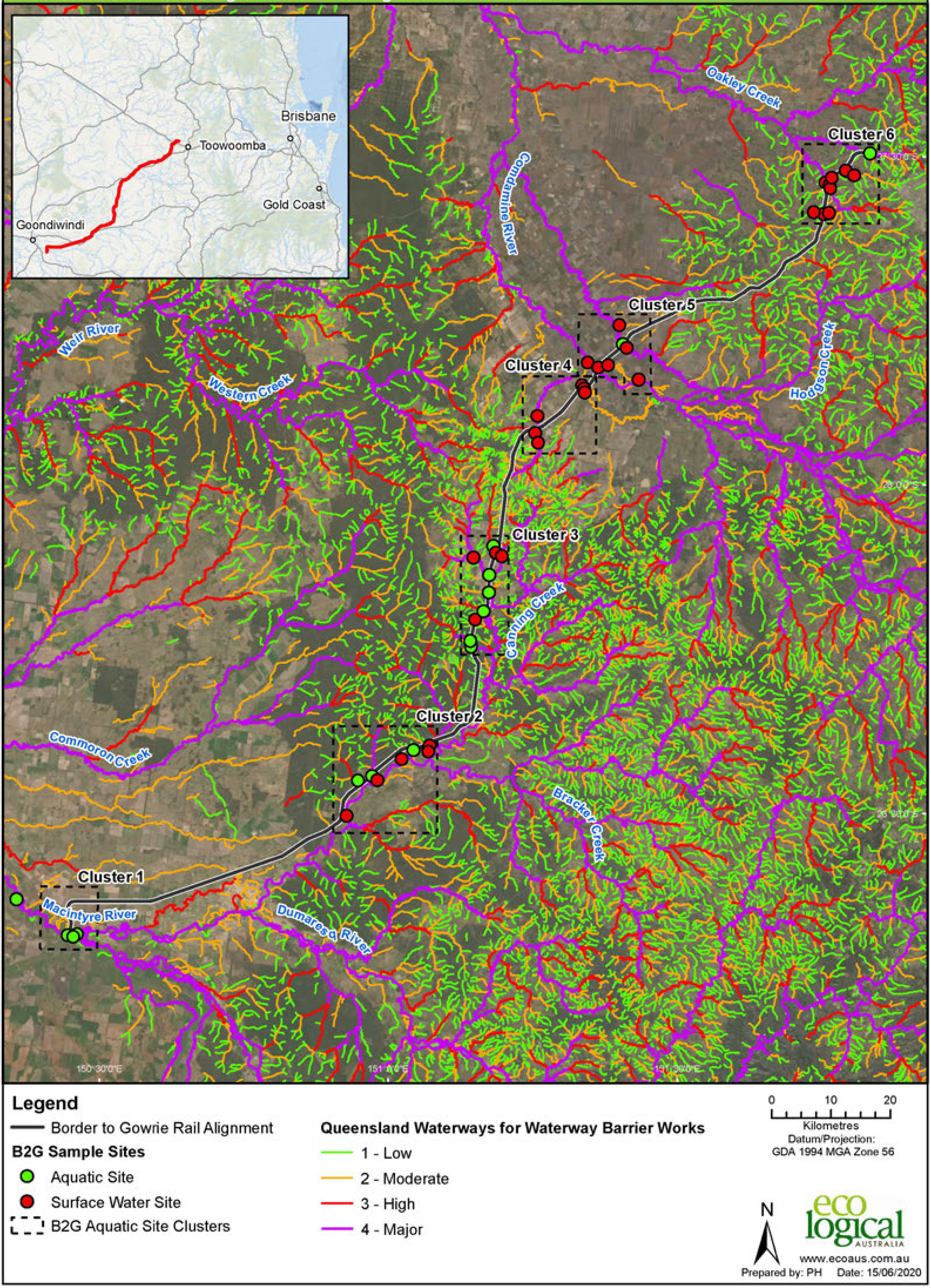
INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

IR_1534

Appendix F: Maps showing the location of waterways that provide fish passage

The following map series shows the location of waterways that provide fish passage, as defined in the *Fisheries Act 1994*. Waterways are zoned according to the risk of impact on fish movement: Low risk (green), Moderate risk (amber), High risk (red) and Major risk (purple).

Queensland Waterways for Waterway Barrier Works



Macintyre Barwon Floodplain Water Quality Zone (Cluster 1 of 6)

Legend

Border to Gowrie Rail Alignment

B2G Sample Sites

- Aquatic Site
- Surface Water Site

Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 4 - Major

0 1

Kilometers

Datum/Projection:
GDA 1994 MGA Zone 56

N

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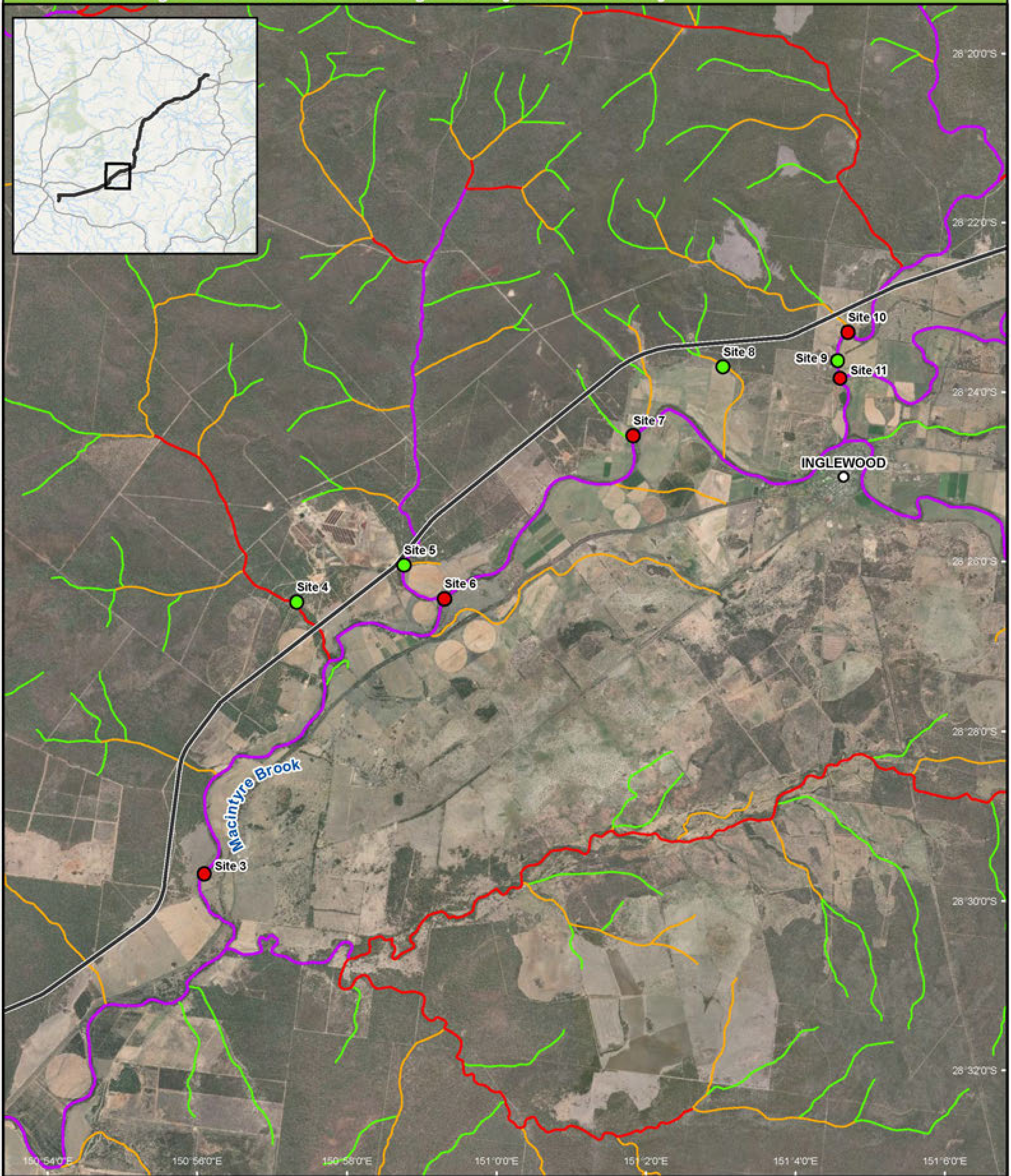
Prepared by: PH Date: 15/06/2020

Lower Macintyre Brook Water Quality Zone (Cluster 2 of 6)



Legend

Border to Gowrie Rail Alignment

B2G Sample Sites

- Aquatic Site
- Surface Water Site

Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major

0 1 2
Kilometers
Datum/Projection:
GDA 1994 MGA Zone 56

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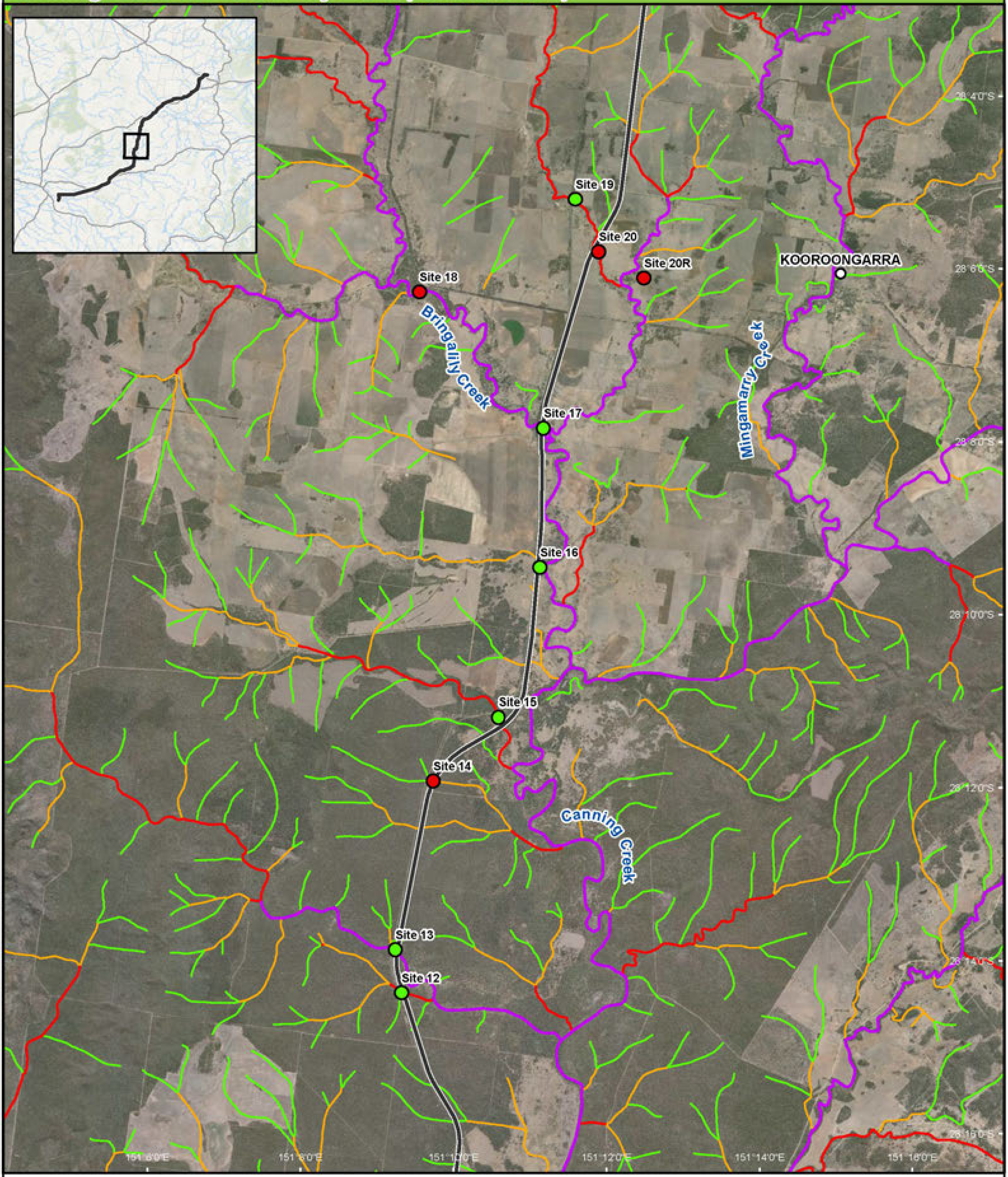
Canning Creek Water Quality Zone (Cluster 3 of 6)



Legend

— Border to Gowrie Rail Alignment

B2G Sample Sites

- Aquatic Site
- Surface Water Site

Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major

0 1 2
Kilometers
Datum/Projection:
GDA 1994 MGA Zone 56

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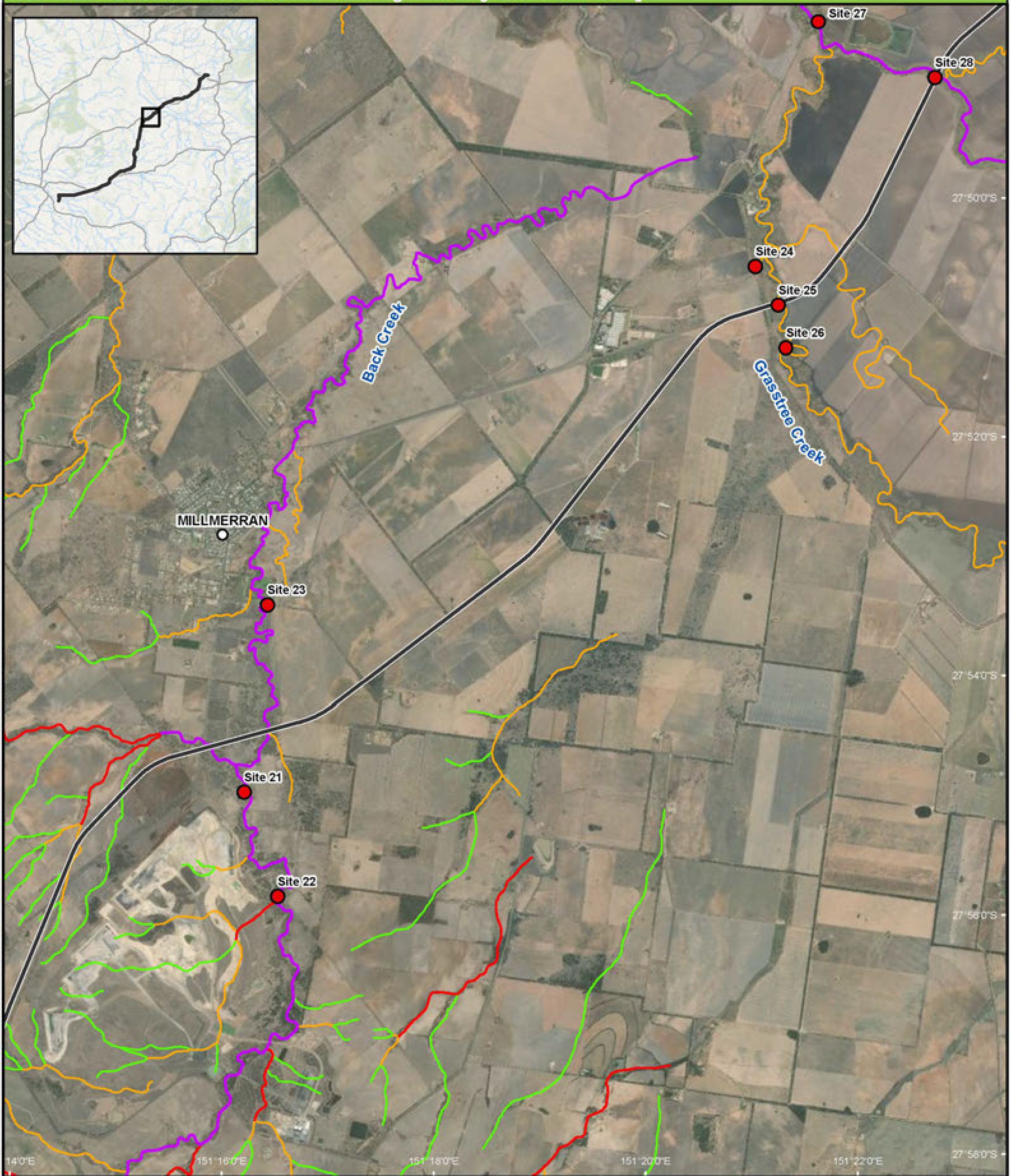
Southern Condamine Water Quality Zone (Cluster 4 of 6)



Legend

— Border to Gowrie Rail Alignment

B2G Sample Sites

- Aquatic Site
- Surface Water Site

Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major

0 1 2 Kilometers

Datum/Projection: GDA 1994 MGA Zone 56

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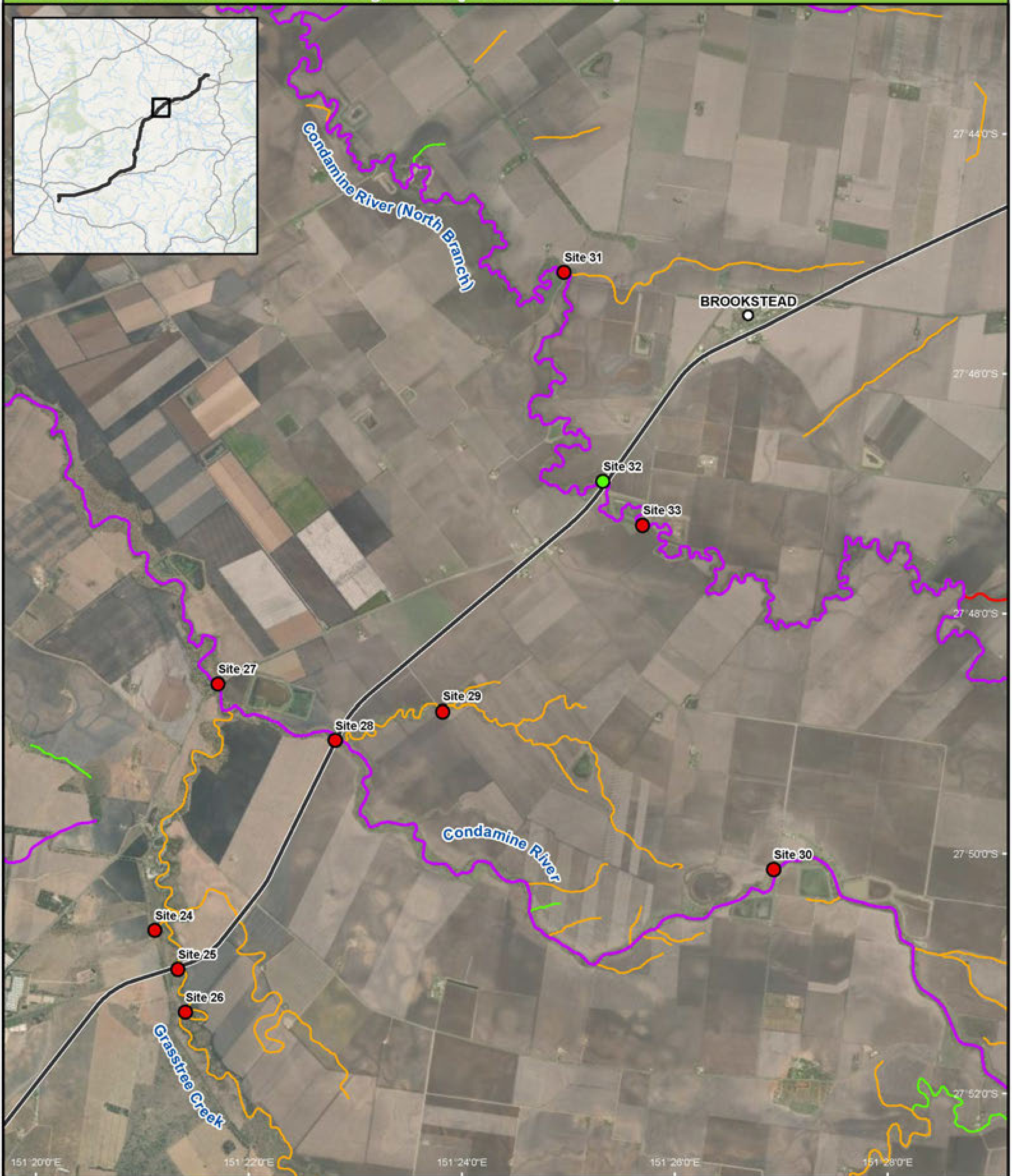
Central Condamine Water Quality Zone (Cluster 5 of 6)



Legend

Border to Gowrie Rail Alignment

B2G Sample Sites

- Aquatic Site
- Surface Water Site

Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major

0 1 2
Kilometers
Datum/Projection:
GDA 1994 MGA Zone 56

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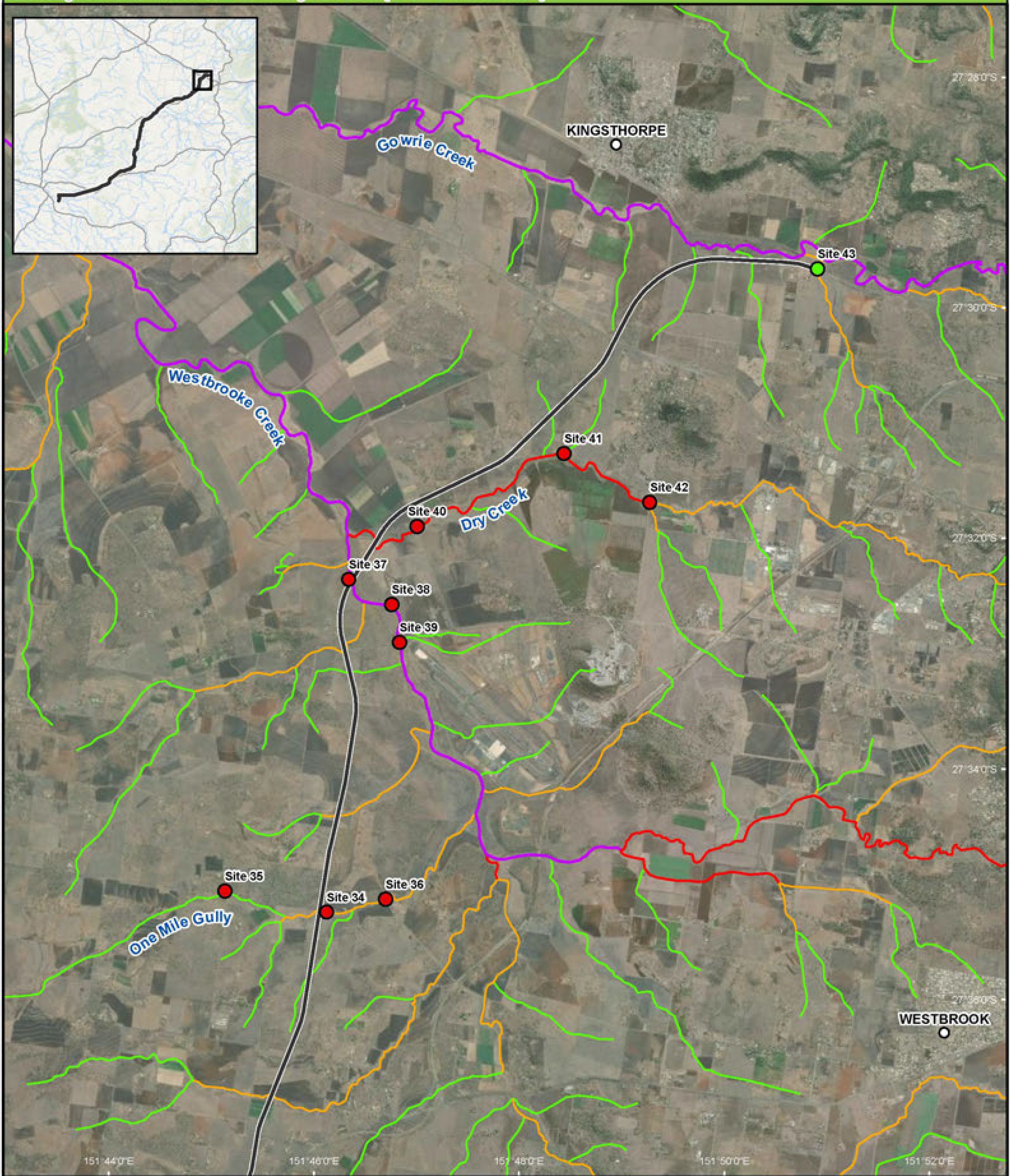
Oakey Creek Water Quality Zone (Cluster 6 of 6)



Legend

Border to Gowrie Rail Alignment

B2G Sample Sites

- Aquatic Site
- Surface Water Site

Queensland Waterways for Waterway Barrier Works

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major

0 1 2
Kilometers
Datum/Projection:
GDA 1994 MGA Zone 56

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