DPM ENVIROSCIENCES

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

July 2023

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14 July 2023

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DPM Ref: DPM22006_RPT_14Jul2023.docx

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Mahalo North – Aquatic Habitat Assessment

14 July 2023

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EXECUTIVE SUMMARY

Comet Ridge Mahalo North Pty Ltd (Comet Ridge) is proposing to develop a greenfield Coal Seam Gas (CSG) project contained within ATP2048 (the Project). The Project area is situated in Central Queensland approximately 45 kilometres (km) north of Rolleston and lies within the Central Highlands Regional Council area. The Project will require the development of 34 CSG production wells and 34 lateral wells, water and gas gathering lines, a gas compression facility (GCF) and ancillary infrastructure. At this stage of the project the location of the export pipeline alignment is still under investigation. Therefore, the export pipeline is excluded from this assessment.

The scope of this assessment is to describe the aquatic values of the Project area, identify any conservation-significant aquatic species under the Queensland *Nature Conservation Act 1992* (NC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), to identify the presence of any surface expression Groundwater-dependent Ecosystems (GDEs), identify and describe any aquatic Matters of State and National Environmental Significance, and to identify proposed impact avoidance and mitigation measures to protect the natural values.

The waterways of the Project area range from small first order tributaries to the sixth order Humboldt Creek. Other named waterways in the Project area include the third order Rockland Creek. These waterways drain into the seventh order Comet River approximately 800 m downstream to the west of the Project area. State-mapped wetland waterbodies of the Project area include one palustrine wetland waterbody (field verified as not a wetland waterbody, nor a wetland Regional Ecosystem [RE]), and six modified lacustrine wetland waterbodies (largely farm dams).

The waterways of the Project area are likely ephemeral or episodic, experiencing flow only after sustained or intense rainfall and runoff in the catchment. Stream flows are highly variable, with most channels expected to dry up during winter to early spring when rainfall and runoff is expected to be low. Consequently, physical attributes, water quality, and the composition of aquatic flora and fauna communities are expected to be highly variable over time.

Aquatic habitat assessments were undertaken at 20 sites in August 2022 (dry season) and at 16 sites in March 2023 (wet season) within and surrounding the Project area. This included 13 riverine system drainage lines, three palustrine wetland waterbodies (two of which are State-mapped wetlands of High Ecological significance [HES wetlands]), three sites within a State-mapped palustrine wetland RE (State-mapped as a HES wetland), and four sites within State-mapped lacustrine wetland waterbodies. Targeted survey for the Critically Endangered (EPBC Act and NC Act) white-throated snapping turtle (*Elseya albagula*) was undertaken at two sites on the Comet River in March 2023.

Overall aquatic values within the Project area range from Low to High. The sites on Humboldt Creek and Rockland Creek were rated as having Moderate aquatic value, due to their importance as conduits for fish passage. The smaller, unnamed tributaries were rated as having Low aquatic value. The State-mapped HES wetlands were rated High aquatic value due to their mapped status. The lacustrine wetland waterbodies (mostly farm dams) were rated Low aquatic value, although still provide important watering and foraging resources for terrestrial fauna and some dry season refuge for Least Concern fish and turtle species. The sites on the adjoining Comet River in the broader Study area were rated as having High aquatic value as they provide both likely and known habitat for the Critically Endangered (EBPC Act and NC Act) white-throated snapping turtle.

Although the Critically Endangered (EPBC Act and NC Act) white-throated snapping turtle was recorded from the broader Study area, no conservation-significant aquatic flora or fauna species listed under the NC Act and/or EPBC Act were recorded from the Project area itself. Due to habitat

requirements and distributional range, it is unlikely that any conservation-significant aquatic flora or fauna species occur within the waterways or wetlands of the Project area as either resident or transient occurrences.

There are no wetlands of National or International Importance within the Project area. The nearest Wetland of National Importance is Lake Nuga Nuga, located approximately 100 km south of the Project area. The nearest Wetland of International Importance is the Shoalwater and Corio Bays Area, located approximately 230 km north-east of the Project area. Each are well removed from the Project area and are unlikely to be of relevance to the Project.

One State-mapped Wetland Protection Area (WPA) occurs within the Project area. This includes a HES wetland comprising State-mapped palustrine wetland RE 11.5.16 (palustrine wetland dominated by *Acacia harpophylla* and/or *Casuarina cristata* open forest). A larger area of RE 11.5.16 had been mapped in an earlier version of the Queensland RE mapping, which formed the basis for the extent of the State-mapped HES wetland. The latest version of RE mapping (version 12.02, Department of Resources 2023a) has removed the cleared component of this polygon comprising the eastern half of the State-mapped HES wetland. The remaining half is State-mapped as RE 11.5.16, although was field verified at one location (site HES1) as being RE 11.5.3 (*Eucalyptus populnea* on Cainozoic sand plains; not a wetland). Despite the mapping discrepancies, the Proponent does not intend to challenge the State-mapped HES wetland and will instead avoid it by maintaining a separation of at least 200 m for the proposed works.

The proposed construction of gathering lines and associated access tracks for the Project would result in minor modification of aquatic habitat at the location of proposed waterway crossings. These habitats comprise waterways with ephemeral to episodic flow, and one semi-permanent lacustrine wetland waterbody (farm dam). The aquatic habitats of the Project area are unlikely to support aquatic species of conservation-significance listed under the NC Act and/or EPBC Act, given the lack of suitable habitat features. However, the Comet River, downstream of the Project area, supports aquatic species of conservation-significance. With suitably implemented water quality management and erosion and sediment controls in place, the Project is expected to be able to negate downstream indirect impacts.

The Project requires several waterway crossings, which each create the potential for barriers to fish passage. However, the Project is unlikely to have a significant impact on Waterways Providing for Fish Passage given waterway crossings would be constructed in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (Department of Agriculture and Fisheries [DAF] 2018).

Surface expression GDEs were considered as part of this assessment. Seasonal field surveys were undertaken to field verify State-mapped 'derived' surface expression GDEs of moderate confidence (Department of Environment and Science [DES] 2023c). No surface expression GDEs were encountered within the Project area, nor are they considered likely to occur. The Project is unlikely to result in significant impacts on surface expression GDEs as no surface expression GDEs are likely to occur within the Project area or broader Study area.

Indirect impacts that have been considered in this assessment include potential impacts associated with changes in water quality, hydrological changes, and potential cumulative impacts. It is concluded that the Project is unlikely to have a significant impact on aquatic ecology as a result of these potential indirect impacts.

To mitigate unavoidable adverse impacts on aquatic ecology values associated with the Project, the following mitigation and management measures are proposed, including:

- implementing a 200 m buffer from HES wetlands to well pads or other high impact earthworks;
- designing and constructing waterway crossings consistent with the *Accepted Development Requirements for Operational Work that is Constructing or Raising Waterway Barrier Works* (DAF 2018);

- designing and constructing watercourse crossings consistent with the *Riverine Protection Permit Exemption Requirements* (Department of Regional Development, Manufacturing and Water [DRDMW] 2023);
- avoiding the release of produced water; and
- implementing a CSG Water Management Plan and Erosion and Sediment Control Plan.

With effective implementation of the above mitigation and management measures, the Project is unlikely to result in significant impacts on aquatic Matters of State and National Environmental Significance.

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APPENDICES

Appendix A: EPBC Act Protected Matters Report
Appendix B: Aquatic Survey Site Profiles
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Acronyms

Acronym	Description
ACA	Aquatic Conservation Assessment (associated with AquaBAMM)
ALA	Atlas of Living Australia
AquaBAMM	Aquatic Biodiversity Assessment Mapping Methodology
AusRivAS	Australian River Assessment System
BoT	Back on Track
CE	Critically Endangered (threatened fauna species conservation status)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAF	Queensland Department of Agriculture and Fisheries
DAFF	The former Queensland Department of Agriculture, Fisheries and Forestry
DAWE	The former Commonwealth Department of Agriculture, Water and the Environment
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DEHP	The former Queensland Department of Environment and Heritage Protection
DERM	The former Queensland Department of Environment and Resource Management
DES	Queensland Department of Environment and Science
DNRM	The former Queensland Department of Natural Resources and Mines
DNRME	The former Queensland Department of Natural Resources, Mines and Energy
DO	Dissolved Oxygen
DoR	Queensland Department of Resources
DotE	The former Commonwealth Department of the Environment
DRDMW	Queensland Department of Regional Development, Manufacturing and Water
DSITI	The former Queensland Department of Science, Information Technology and Innovation
DSITIA	The former Queensland Department of Science, Information Technology, Innovation and the Arts
E	Endangered (threatened species conservation status)
EA	Environmental Authority
EC	Electrical Conductivity
EO Act	Queensland *Environmental Offsets Act 2014*
EO Regulation	Queensland Environmental Offsets Regulation 2014
EP Act	Queensland *Environmental Protection Act 1994*
EP Regulation	Queensland Environmental Protection Regulation 2019
EPP 2019	Environmental Protection (Wetland and Water Biodiversity) Policy 2019
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EV	Environmental values
EVNT	Endangered, Vulnerable or Near Threatened (threatened fauna species)
GBR	Great Barrier Reef

GDA	Geocentric Datum of Australia
GDE	Groundwater-dependent Ecosystem
GES	General Ecological Significance
HES	High Ecological Significance
IESC	Independent Expert Scientific Committee
IECA	International Erosion Control Association (Australasia)
LC	Least Concern species conservation status under the NC Act
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
NC Act	Queensland *Nature Conservation Act 1992*
NRM	Natural Resource Management
NT	Near Threatened (species conservation status)
RE	Regional Ecosystem
SLC	Special Least Concern
SO	Strahler Stream Order
TEC	Threatened Ecological Community
V	Vulnerable (threatened species status)
WoNS	Weeds of National Significance
WPA	Wetland Protection Area
WQO	Water Quality Objective

Definitions

Term	Description
Aquatic fauna	An aquatic animal is either a vertebrate or invertebrate that lives in water for most or all of its life. It does not include amphibians or waterbirds (which are considered terrestrial fauna).
Aquatic flora	Plants that have adapted to living in aquatic environments (saltwater or freshwater). They are also referred to as hydrophytes or macrophytes. These plants require special adaptations for living submerged in water, or at the water's surface.
Biosecurity matter	A living thing, other than a human or part of a human; or a pathogenic agent that can cause disease in a living thing, other than a human, or a pathogenic agent that can cause disease in a human, by the transmission of a pathogenic agent from an animal to a human; or a disease; or a contaminant.
Ephemeral (wetland or flow)	Only filled after unpredictable rainfall and runoff. Flows cease within days of commencing. Surface water may dry within days of filling.
Episodic (wetland or flow)	Dry or lacking flow most of the time with irregular wet phases that may persist for months.
Groundwater-dependent Ecosystem	Groundwater-dependent Ecosystems (or GDEs) are ecosystems that rely upon groundwater for their continued existence. They may be 100% dependent on groundwater, such as aquifer GDEs, or may access groundwater intermittently to supplement their water requirements, such as riparian tree species in arid and semi-arid areas.
Intermittent (wetland or flow)	Alternatively wet and dry but less frequently and regularly than seasonal wetlands and waterways. Surface water in intermittent wetlands persists for months to years.
Project	The proposed Mahalo North Coal Seam Gas Project.
Project area	The Petroleum Lease Application area within ATP2048 (Figure 2).
Proponent	Comet Ridge Limited
Restricted matter	Listed in Schedule 2 of the Queensland *Biosecurity Act 2014* and refers to biosecurity matter that are currently found in Queensland and that are known to have a significant impact on human health, social amenity, the economy or the environment.
Search area	The Project area and 10 km buffer used in the EPBC Act Protected Matters Search.
Seasonal (wetland or flow)	Alternatively wet and dry every year, according to season. Usually fills (or flows) during the wet part of the year and dries predictably and annually. Surface water (or flow) persists for months, long enough for some macroscopic plants and animals to complete the aquatic stages of their life cycles.
Study area	The area of investigation subject to field survey, encompassing the Project area and surrounding areas of interest.
Waterway	Waterways include riverine systems, rivers, creeks, streams, watercourses, waterways, drainage lines or drainage features identified in the Queensland Wetlands Mapping, *Fisheries Act 1994*, Queensland Waterways for Waterway Barrier Works, and DoR Watercourse identification map (*Water Act 2000*).
Watercourse	The watercourse definition applying to petroleum projects is as per Schedule 4 of the *Environmental Protection Act 1994*, and means any river, creek or stream in which water flows permanently or intermittently.
Wetland	Wetlands include marine, estuarine, riverine, lacustrine and palustrine waterbodies and wetland REs identified in the Queensland Wetlands Map 2009, Wetlands of International

Term	Description
Aquatic fauna	An aquatic animal is either a vertebrate or invertebrate that lives in water for most or all of its life. It does not include amphibians or waterbirds (which are considered terrestrial fauna).
Aquatic flora	Plants that have adapted to living in aquatic environments (saltwater or freshwater). They are also referred to as hydrophytes or macrophytes. These plants require special adaptations for living submerged in water, or at the water's surface.
	Importance (EPBC Act), Wetlands of National Importance (EPBC Act) and GES, HES and WPA wetlands identified in the Map of Referrable Wetlands.

1 INTRODUCTION

Comet Ridge Mahalo North Pty Ltd (Comet Ridge) is proposing to develop a greenfield Coal Seam Gas (CSG) project contained within ATP2048 (the Project). The Project area is situated in Central Queensland approximately 45 kilometres (km) north of Rolleston and lies within the Central Highlands Regional Council area. The Project will require the development of 34 CSG production wells and 34 lateral wells, water and gas gathering lines, a gas compression facility (GCF) and ancillary infrastructure. At this stage of the project the location of the export pipeline alignment is still under investigation. Therefore, the export pipeline is excluded from this assessment.

Specialist studies are being undertaken to inform a new Environmental Authority (EA) Application under the Queensland *Environmental Protection Act 1994* (EP Act) and a referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

DPM Enviros ciences Pty Ltd (DPM Enviros ciences) has been commissioned to undertake aquatic habitat assessments and to prepare an Aquatic Values Assessment report for the Project.

1.1 Purpose

The purpose of the Aquatic Values Assessment is to provide an overview of the aquatic values of the Project area as relevant to current Commonwealth and State legislation, including surface expression groundwater-dependent ecosystems (GDEs).

Consideration of subterranean and terrestrial GDEs is excluded from the scope, as is sampling and analysis of fish and aquatic macroinvertebrate communities.

This report presents an overview of the aquatic values of the Project area based on a desktop assessment of readily available information and seasonal habitat assessments of representative waterways and wetlands of the Project area and within 2 km downstream of the Project area (the Study area). Targeted survey effort has been undertaken for threatened turtle species (listed under the EPBC Act and NC Act) with the potential to occur in the adjoining Comet River.

1.2 Scope of work

The scope of work for this Aquatic Values Assessment includes the following tasks:

- conduct a desktop review of available literature and previous studies in the vicinity of the Project area, and conduct database searches for conservation-significant aquatic species;
- undertake aquatic habitat assessment throughout the Study area to:
  - describe aquatic habitats and their value and importance, including features such as substrate, stream type, water quality condition, and surrounding land uses;
  - describe aquatic flora and habitat for aquatic fauna;
  - identify and describe any listed threatened aquatic species, and any introduced aquatic species, that are present or likely to be present in the Project area;
  - consider relevant State and Commonwealth guidelines associated with threatened species likely to occur in the Study area;
  - identify and describe wetlands present, and their value and importance; and
  - identify and describe surface expression GDEs.
- prepare an Aquatic Values Assessment that identifies the methods and results of the desktop and field studies.

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REGIONAL CONTEXT

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

FIGURE 1

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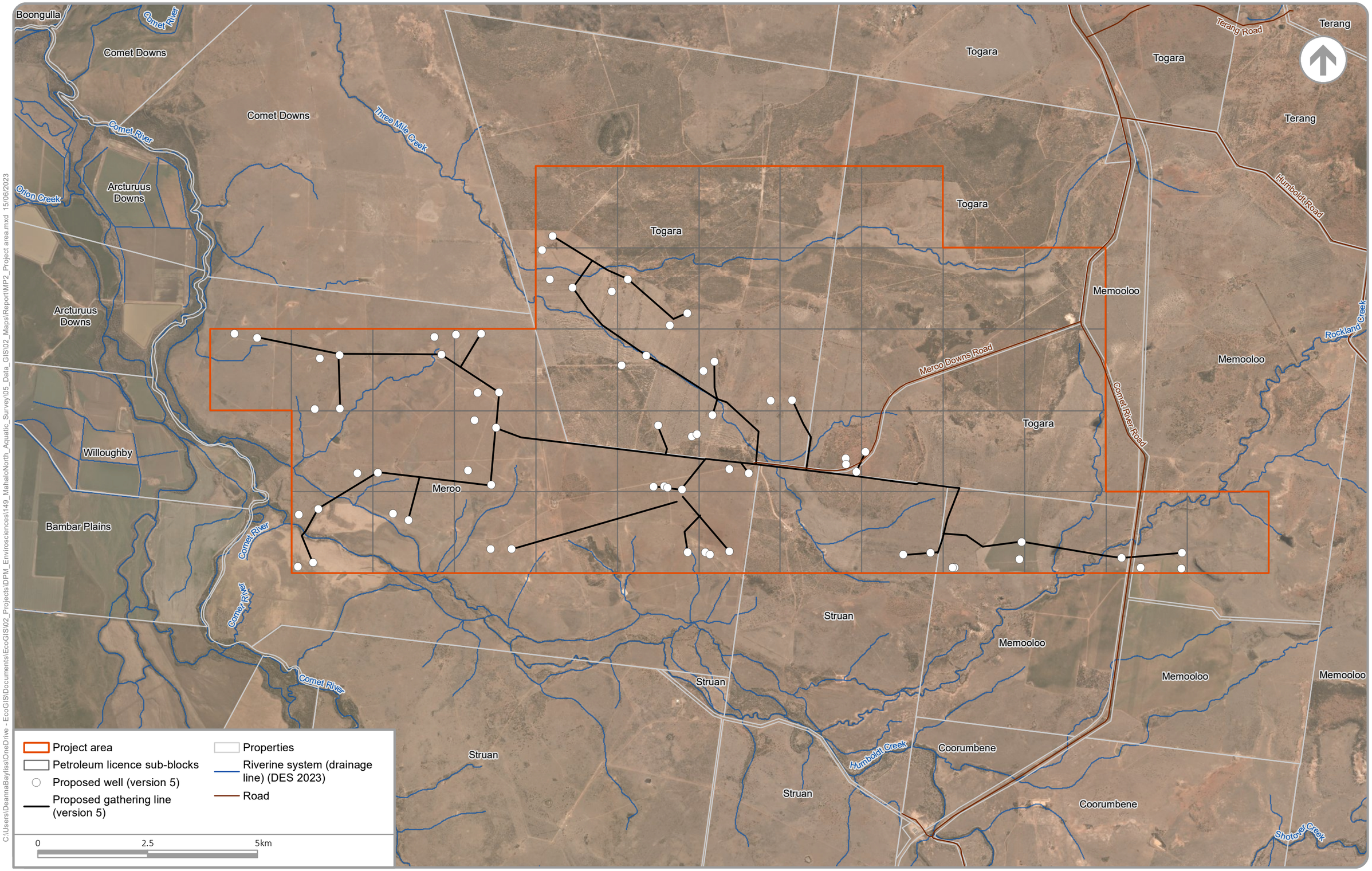

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DPM ENVIROSCIENCES

PROJECT AREA

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

FIGURE 2

2 EXISTING ENVIRONMENT

2.1 Regional setting

The Project area is located approximately 45 km north of Rolleston and 45 km south of Comet in the Central Highlands Regional Council Local Government Area (Figure 1).

2.2 Climate and weather

The climate of the Project area is sub-tropical with December through to February typically the warmest months, with mean maximum daily temperatures of around mid-30°C recorded at Rolleston Airport station 35129 over the period 2010 to 2023 and mean minimum daily temperatures of around 10˚C recorded for the winter months (The Bureau 2023a).

Average annual rainfall of 612 mm has been recorded from the nearby Somerby Bureau of Meteorology station 35063 (approximately 14 km to the south) over the period 1924 to 2023, with the summer months generally the wettest when, on average, 50% of the annual rainfall occurs (Figure 3) (The Bureau 2023b). Dry season surveys were undertaken in August 2022. Wet season surveys were undertaken in March 2023, following a wet season that incurred well-above-average rainfall in October and November 2022 (Figure 3). Survey timing is discussed further in Section 3.5.1.

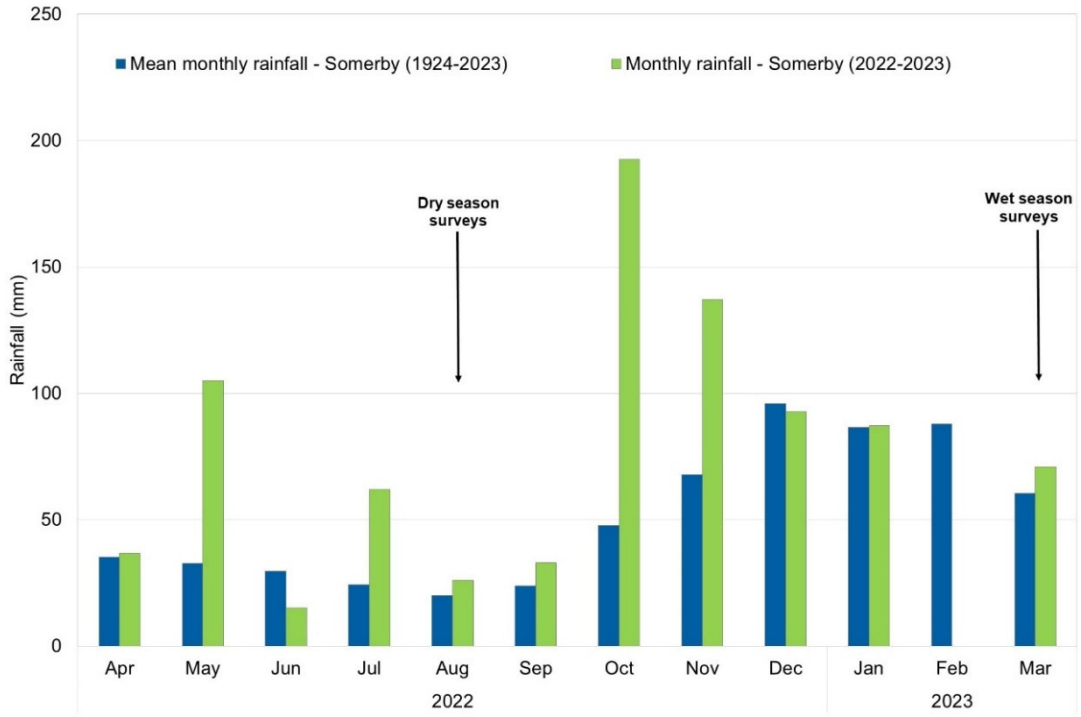

Figure 3 Rainfall statistics for Somerby (Bureau station 35063, The Bureau 2023b)

2.3 Hydrology

The Project area is located within the Comet River drainage sub-basin of the greater Fitzroy Basin. The Project area is intersected by the sixth order (Strahler 1952) Humboldt Creek, the third order Rockland Creek and a number of smaller, unnamed tributaries, all of which flow into the seventh order Comet River west of the Project area (Figure 2). The adjoining Comet River continues in a general northern direction for approximately 80 km to where the Comet River converges with the Nogoa River to form the Mackenzie River just north of the township of Comet.

The Mackenzie River ultimately joins the Fitzroy River, which flows initially north and then east towards the east coast of Queensland and discharges into the Coral Sea south-east of Rockhampton near Port Alma.

At a regional scale, the Comet River drainage sub-basin (to the junction with the Nogoa River) is approximately 17,275 km² of the total Fitzroy River drainage basin of 142,483 km² (Department of Environment and Science [DES] 2023a), or if represented as a percentage, accounts for approximately 12% of the overall Fitzroy River drainage basin.

The *Environmental Protection (Water) Policy 2009: Comet River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Comet River Sub-basin* (DEHP 2011) and accompanying maps identify Environmental Values (EVs) relevant to the Study area. This includes Evs for the 'Eastern tributaries' and 'Comet main channel', each comprising:

- aquatic ecosystems;
- irrigation;
- farm supply;
- stock water;
- human consumer;
- primary, secondary and visual recreation;
- drinking water;
- industrial use; and
- cultural and spiritual values.

Historical flow monitoring data (2007-2023) for the Comet River at Springsure Creek (Department of Regional Development, Manufacturing and Water [DRDMW] monitoring station 1302510A), located approximately 25 km downstream of the Project area, provides an indication of the local flow regime (Figure 4). Flow in the Comet River is seasonal, alternatively wet and dry most years, according to season. Stream flows are highly variable, with the channel typically drying during winter to early spring when rainfall and runoff is historically low, although some pools may persist in deeper sections and on substrates with higher clay content. Surface flows are more likely in the wetter months from November to March (Figure 4).

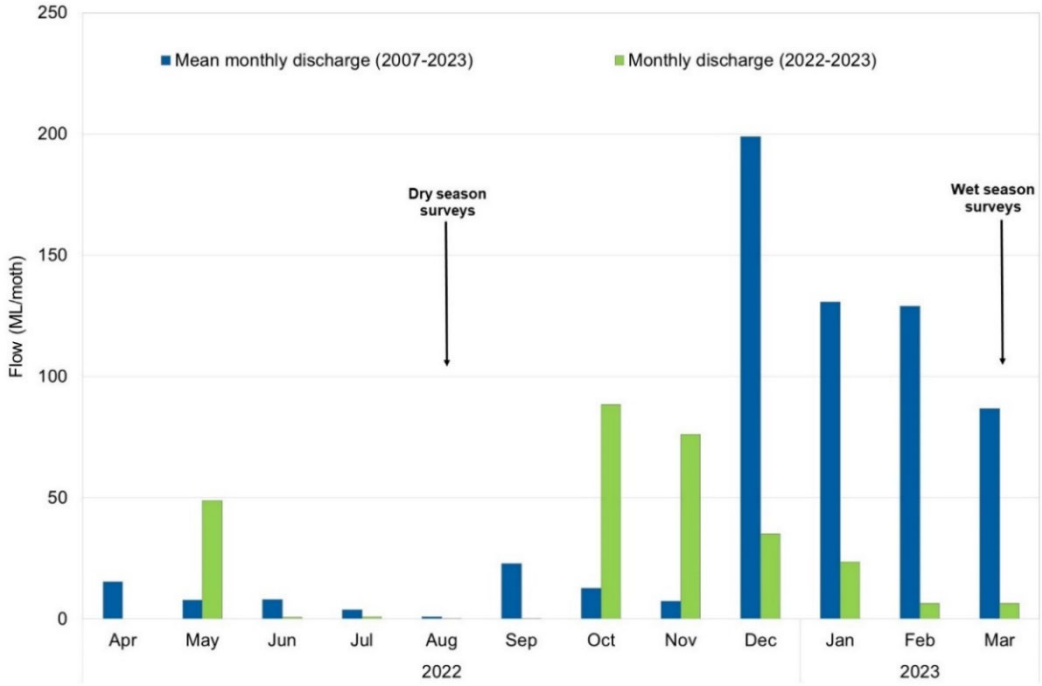

Figure 4 Flow volume statistics and observations for the Comet River at Springsure Creek (DNRME station 1302510A)

2.4 Land Zones

The Project area contains a diversity of land zones (Department of Resources [DoR] 2023a), comprising:

- Land Zone 3 – alluvial river and creek flats;
- Land Zone 4 – clay plains;
- Land Zone 5 – old loamy and sandy plains; and
- Land Zone 8 – basalt plains and hills.

2.5 Topography

The elevation of the Project area ranges from about 280 (metres above Australian Height Datum) (mAHD) on a basalt hill in the south-east corner of the Project area, down to about 175 mAHD on the Comet River.

2.6 Land use

Land within the Project area is used predominately for cattle grazing, with small areas showing some evidence of opportunistic cropping. The land has been largely cleared through past agricultural practices; however, large patches of remnant vegetation remain (or have regrown) in the central and northern portions of the Project area.

There are four properties intersected by the Project area, comprising Togara, Meroo, Memooloo and Struan (Figure 2).

3 METHODS

3.1 Taxonomic nomenclature

Scientific names of flora and fauna used in this report are consistent with those used by DES in its Wetland*Info* and WildNet databases.

3.2 Determination of significance level

Endangered, Vulnerable or Near Threatened (EVNT) species are defined as those taxa listed in the EPBC Act or NC Act as Critically Endangered (CE), Endangered (E), Vulnerable (V) or Near Threatened (NT). Priority species are those listed as such in the Back on Track (BoT) Actions for Biodiversity for the Fitzroy Natural Resource Management (NRM) Region (DERM 2010) or in the Expert Panel Reports of the Aquatic Conservation Assessments (ACA) for riverine and non-riverine wetlands of the Fitzroy section of the Great Barrier Reef (GBR) catchment (Inglis and Howell 2009; Rollason and Howell 2012). All other native species are Special Least Concern (SLC) or Least Concern (LC) under the NC Act.

The Priority status of aquatic flora and fauna species does not necessarily reflect the conservation status of species but rather reflects their general ecological importance, such as Priority flora species that provide important feeding and breeding habitat for aquatic and terrestrial fauna assemblages. Consequently, the Priority species have been factored into the aquatic values ratings applied to this assessment (Section 3.5.8).

3.3 EVNT species likelihood of occurrence

EVNT species identified from the desktop assessment (and subsequent field surveys) were assigned a likelihood of occurrence based on the criteria identified in Table 1. Targeted searches were undertaken in the field for species identified as either being likely to occur, or having potential to occur within the Project area, based on the desktop sources (identified in Section 3.4). The assessment was applied again after surveys to determine the likelihood of occurrence once site-based information became available.

Table 1 Criteria adopted for the likelihood of EVNT species, identified from the desktop assessment, occurring within the Project area

Likelihood of occurrence	Description
Known	The species was positively identified and recorded in the Mahalo North Project area during the field assessment; previous records of occurrence within the Mahalo North Project area.
Likely	The species was not recorded during the field survey or previously; however, there are known records within the nearby surrounding area and suitable habitat exists on site.
Potential	Habitat in the Mahalo North Project area might be suitable or marginal; however, the species was not recorded during the field survey, and no known records of the species exist within the surrounding area.
Unlikely	Habitat in the Mahalo North Project area might be suitable or marginal; however, the species was not recorded during the field survey, and no known records of the species exist within the surrounding area.

3.4 Desktop assessment

Desktop searches were undertaken prior to the initial aquatic habitat assessments in August 2022 and were revised in March 2023. This included a review of the following:

- Department of Climate Change, Energy, the Environment and Water (DCCEEW) EPBC Act Protected Matters Search Tool, to identify aquatic Matters of National Environmental Significance (MNES) within approximately 10 km of the Project area (i.e. the Search area, Appendix A) (DCCEEW 2023a).
- Department of State Development, Infrastructure, Local Government and Planning (DSDILGP) State Planning Policy (SPP) Interactive Mapping System of Matters of State Environmental Significance (DSDILGP 2023), to identify aquatic matters of state interest under the SPP and Environmental Offsets Regulation 2014.
- Queensland Wetland Data Series version 5 – Queensland Wetlands Map (DES 2023b), to determine the classification, extent and significance of lacustrine, palustrine and riverine systems within the Project area.
- Regional Ecosystem Mapping version 12.02 (DoR 2023a).
- Wetland*Info* Wetland Summary Information (DES 2023a) (including species listings) for the Comet River drainage sub-basin, the Mackenzie River drainage sub-basin, and the broader Fitzroy Basin, incorporating data from the DES WildNet database, Queensland Museum and Queensland Herbarium.
- Atlas of Living Australia (ALA) (2023), to interrogate existing species records.
- Queensland Waterways for Waterway Barrier Works mapping (Queensland Department of Agriculture and Fisheries [DAF] 2023).
- Queensland Groundwater-dependent Ecosystems (GDE) and Potential GDE Aquifer Mapping 2018 (DES 2023c).
- Queensland Map of Great Barrier Reef Wetland Protection Areas (DES 2023d).
- Queensland Map of Queensland Wetland Environmental Values (DES 2019).
- Queensland Watercourse Identification Map (Department of Resources [DoR] 2023b).
- The Fitzroy Natural Resource Management Region Back-on-Track Actions for Biodiversity (the former Queensland Department of Environment and Mines [DERM] 2010).
- Aquatic Conservation Assessments (ACAs) for the riverine (Inglis and Howell 2009) and non-riverine (Rollason and Howell 2012) wetlands of the Great Barrier Reef catchment, and associated mapping (DES 2023e).
- Published ecological information on EVNT and SLC aquatic flora and fauna species.
- Previous studies relating to aquatic ecology in the Project area, including:
  - BHP Blackwater Mine Southern Lease – Aquatic Ecology Baseline Surveys (EMM Consulting and DPM Enviros ciences 2020); and
  - Comet Ridge Mahalo (South) Project – Aquatic Habitat Assessments (Golder and DPM Enviros ciences 2018).
- Relevant survey guidelines, including the Survey Guidelines for Australia's Threatened Reptiles (the former Commonwealth Department of Sustainability, Environment, Water, Population and Communities [DSEWPC] 2011) and the Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (DES 2022).

3.5 Field survey

3.5.1 Survey timing, site selection and effort

Aquatic habitat assessments were undertaken by DPM Enviros ciences on the following occasions:

- dry season aquatic habitat assessment 15-19 August 2022; and
- wet season aquatic habitat assessment (and targeted survey effort) 13-16 March 2023.

Desktop investigations, including review of available aerial imagery and review of the Queensland Wetlands Map (DES 2023b), were used to identify representative stream reaches and wetland waterbodies for field assessment. Aquatic habitat assessment was undertaken at 20 sites in August 2022 and at 16 sites in March 2023 (Figure 5), including:

- 13 riverine system drainage lines:
  - three Strahler (1952) stream order (SO) 1 sites;
  - two SO 2 sites;
  - one SO 3 site – Rockland Creek;
  - two SO 5 sites – Humboldt Creek;
  - one SO 6 site – Humboldt Creek; and
  - four SO 7 sites – Comet River;
- three palustrine wetland waterbodies, two of which are State-mapped (DES 2023d and DSDILGP 2023) as wetlands of High Ecological Significance (HES wetlands);
- three sites within another State-mapped (DES 2023d and DSDILGP 2023) HES wetland; and
- four waterbodies State-mapped as lacustrine wetland waterbodies (DES 2023b).

The sampling sites and survey effort are identified in Table 2.

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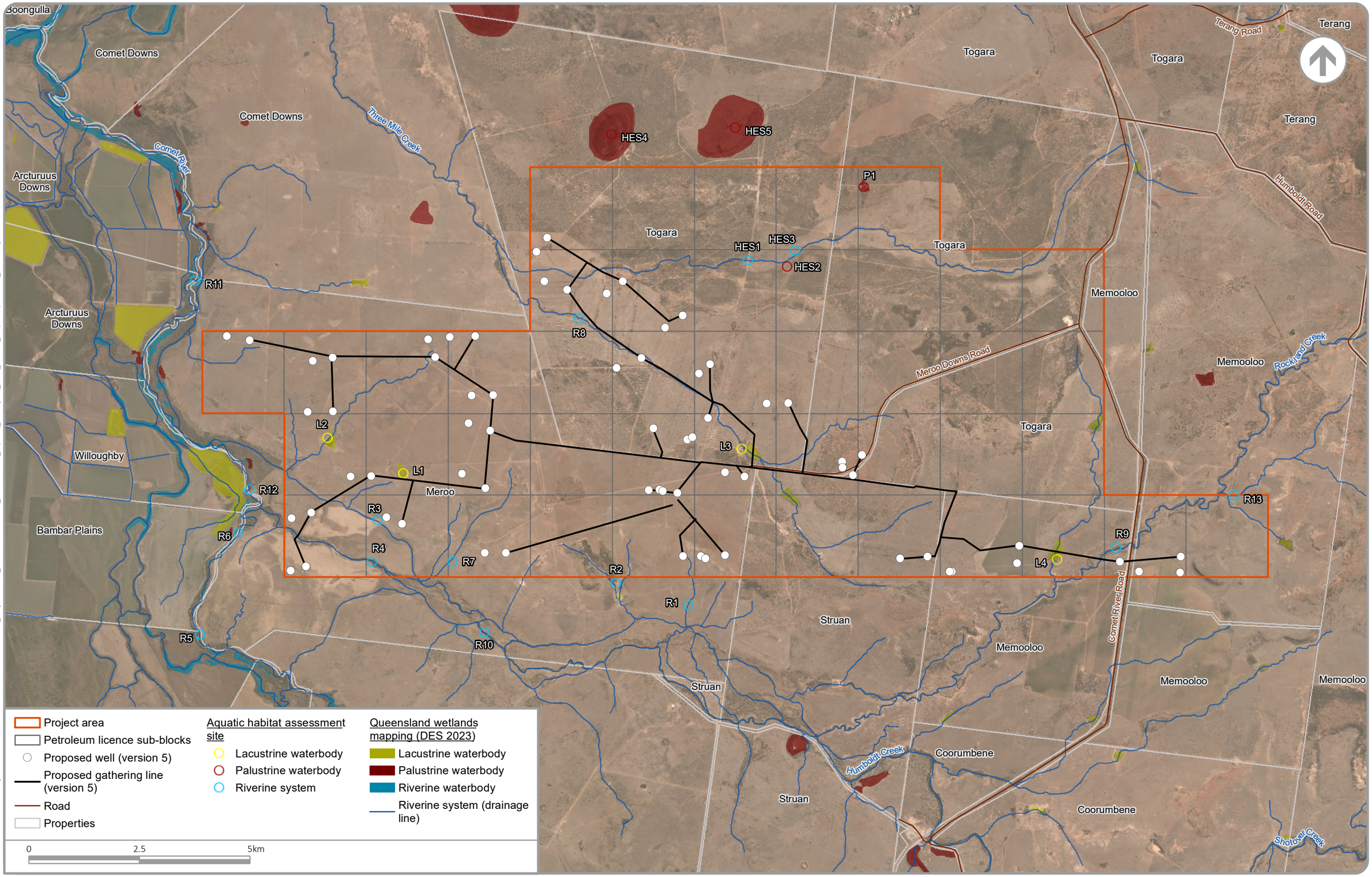

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DPM ENVIROSCIENCES

WATERWAYS AND WETLANDS OF THE STUDY AREA

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

FIGURE 5

Table 2 Aquatic habitat assessment effort across the Project area, 2022-2023

Site ID	Site description	Date	Stream order	Latitude (GDA2020)	Longitude (GDA 2020)	Physico-chem. water quality	Water sample retained for ion analysis	Habitat assess. / aquatic plant survey / photos	Turtle survey effort	
									Fyke nets	Cathedral traps
Riverine drainage system sites										
R1	Unnamed tributary of the Comet River	15/08/2022	1	-24.0874	1487.6333	Dry	Dry	✓	-	-
		15/03/2023				Dry	Dry	✓	-	-
R2	Unnamed tributary of the Comet River	16/08/2022	1	-24.0830	148.6185	Dry	Dry	✓	-	-
		13/03/2023				✓	✓	✓	-	-
R3	Unnamed tributary of the Comet River	16/08/2022	5	-24.0701	148.5701	Dry	Dry	✓	-	-
R4	Humboldt Creek	16/08/2022	6	-24.0787	148.5690	✓	✓	✓	-	-
		15/03/2023				✓	✓	✓	-	-
R5	Comet River	16/08/2022	7	-24.0935	148.5340	✓	✓	✓	-	-
R6	Comet River	16/08/2022	7	-24.0728	148.5418	✓	✓	✓	-	-
R7	Unnamed tributary of the Comet River	16/08/2022	1	-24.0786	148.5853	Dry	Dry	✓	-	-
		15/03/2023				✓	✓	✓	-	-
R8	Unnamed tributary of Three Mile Creek	18/08/2022	2	-24.0294	148.6111	✓	✓	✓	-	-
		16/03/2023				✓	✓	✓	-	-
R9	Rockland Creek	19/08/2022	3	-24.0759	148.7203	✓	✓	✓	-	-
		13/03/2023				✓	✓	✓	-	-
R10	Humboldt Creek	19/08/2022	5	-24.0931	148.5918	✓	✓	✓	-	-
R11	Comet River	14/03/2023	7	-24.0215	148.5330	✓	✓	✓	✓	Not suitable
R12	Comet River	14/03/2023	7	-24.0640	148.5440	✓	✓	✓	✓	Not suitable
R13	Tributary of Rockland Creek / State-mapped surface expression GDE line (mod. Confidence)	16/03/2023	2	-24.0652	148.7442	Dry	Dry	✓	-	-

Site ID	Site description	Date	Stream order	Latitude (GDA2020)	Longitude (GDA 2020)	Physico-chem. water quality	Water sample retained for ion analysis	Habitat assess. / aquatic plant survey / photos	Turtle survey effort	
									Fyke nets	Cathedral traps
Lacustrine wetland sites										
L1	Lacustrine wetland waterbody	16/08/2022	-	-24.0606	148.5751	✓	✓	✓	-	-
		13/03/2023				✓	✓	✓	-	-
L2	Lacustrine wetland waterbody / farm dam	16/08/2022	1	-24.0539	148.5601	✓	✓	✓	-	-
		13/03/2023				✓	✓	✓	-	-
L3	Lacustrine wetland waterbody / farm dam	17/08/2022	2	-24.0557	148.6443	✓	✓	✓	-	-
		13/03/2023				✓	✓	✓	-	-
L4	Lacustrine wetland waterbody / farm dam	19/08/2022	1	-24.0756	148.7085	✓	✓	✓	-	-
		13/03/2023				✓	✓	✓	-	-
Palustrine wetland sites										
HES1	Unnamed tributary of Three Mile Creek within State-mapped HES wetland	17/08/2022	1	-24.0175	148.6452	✓	✓	✓	-	-
		16/03/2023				✓	✓	✓	-	-
HES2	State-mapped HES wetland & State-mapped surface expression GDE area (mod. confidence)	17/08/2022	-	-24.0187	148.6533	Dry	Dry	✓	-	-
HES3	Unnamed tributary of Three Mile Creek within State-mapped HES wetland	17/08/2022	1	-24.0154	148.6550	Dry	Dry	✓	-	-
HES4	State-mapped HES wetland / palustrine wetland waterbody	17/08/2022	-	-23.9919	148.6177	Dry	Dry	✓	-	-
		16/03/2023				✓	✓	✓	-	-
HES5	State-mapped HES wetland / palustrine wetland waterbody	18/08/2022	-	-23.9905	148.6428	✓	✓	✓	-	-
		16/03/2023								
P1	State-mapped palustrine wetland waterbody	18/08/2022	1	-24.0025	148.6689	Dry	Dry	✓	-	-

3.5.2 Aquatic habitats

Aquatic habitats were described in accordance with AusRivAS protocols for Queensland streams (DNRM 2001). This established a general description of the environment of each site and its immediate surrounds. The classifications are based on flow level, depth, velocity, width, canopy cover, substrate types, habitat attributes, local catchment erosion, sediment deposits, water colour, algae, water odour, substrate odour, presence of large woody debris, riparian zone width and cover, and general signs of disturbance.

Variable flow, caused by natural events such as rainfall, runoff and drought/flood cycles influences the aquatic ecosystems of an area. This should be taken into consideration for future studies which may utilise results contained in this report.

Habitat assessment scores (out of 135) were made for each riverine site based on the nine AusRivAS categories (Table 3). Aquatic habitat at each riverine site was classified as Poor, Fair, Good or Excellent based on the overall scores.

A detailed description of the aquatic habitat encountered at each site is included in the site profiles in Appendix B.

Table 3 Aquatic habitat assessment variables and categories

Habitat variable	Poor	Fair	Good	Excellent
Bottom substrate/available cover	0 – 5	6 – 10	11 – 15	16 – 20
Embeddedness	0 – 5	6 – 10	11 – 15	16 – 20
Velocity / depth category	0 – 5	6 – 10	11 – 15	16 – 20
Channel alteration	0 – 3	4 – 7	8 – 11	12 – 15
Bottom scouring and deposition	0 – 3	4 – 7	8 – 11	12 – 15
Pool/riffle, run/bend ratio	0 – 3	4 – 7	8 – 11	12 – 15
Bank stability	0 – 2	3 – 5	6 – 8	9 – 10
Bank vegetative stability	0 – 2	3 – 5	6 – 8	9 – 10
Streamside cover	0 – 2	3 – 5	6 – 8	9 – 10
Total	0 – 38	39 – 74	75 – 110	111 – 135

3.5.3 Surface water quality

In-situ physico-chemical water quality was assessed as a component of the aquatic habitat assessments. The ionic composition of surface water was sampled and assessed to assist in characterising surface waters of the Project site, including their likely interaction with groundwater.

In-situ measurements

In-situ physico-chemical water quality parameters were measured at each wetted survey site using a YSI Professional Plus multi-parameter water quality meter and Hach Turbidimeter 2100Q, each calibrated both prior to and following sampling. Water quality parameters measured included:

- temperature (°C);
- pH;
- electrical conductivity (EC; µS/cm);
- turbidity (NTU); and
- dissolved oxygen (DO) (mg/L and % saturation).

For the purposes of this assessment, salinity descriptors are based on the following EC ranges (DAFF 2012):

- fresh – <800 µS/cm;
- marginal – 800 to 1,600 µS/cm;
- brackish – 1,600 to 4,800 µS/cm;
- slightly saline – 4,800 to 10,000 µS/cm;
- moderately saline – 10,000 to 20,000 µS/cm; and
- saline – >20,000 µS/cm.

Ions

Water samples were obtained from each wetted site in accordance with the *Monitoring and Sampling Manual: Environmental Protection (Water) Policy* (DES 2018). Samples were chilled and delivered to ALS Environmental (a NATA accredited laboratory) and were analysed for the following major ions to assist in characterising surface waters of the Project site:

- major anions (Cl, SO_4 and alkalinity); and
- major cations (Ca, Mg, Na and K).

Data analysis

Physico-chemical water quality measurements were compared against Water Quality Objectives (WQOs) nominated in *Environmental Protection (Water) Policy 2009: Comet River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Comet River Sub-basin* (DEHP 2011) (Tables 5 and 6, Section 4.2.2). This includes WQOs for moderately disturbed aquatic ecosystems of the:

- Comet River Sub-basin waters (applied to riverine sites R1-4, R7-10 and R13);
- Comet River Sub-basin main trunk (applied to riverine sites R5-6 and R11-12);
- Freshwater lakes / reservoirs (applied to lacustrine sites L1-L4); and
- Wetlands (applied to palustrine sites HES1-5 and P1).

3.5.4 Fish

Fish survey was excluded from the scope of work. However, fish bycatch recorded during fyke netting turtle surveys on the Comet River is presented in Section 4.5.1.

Captured native fish were identified and released at the point of capture.

3.5.5 Turtles

The Survey Guidelines for Australia's Threatened Reptiles (DSEWPC 2011) suggest that the Fitzroy River turtle (*Rheodytes leukops*) can be readily observed in riffle zones by diving with a face mask and snorkel, or collected by seine netting, and that the partly carnivorous diet of this species indicates it might be attracted to meat baits in traps. Survey guidelines for the white-throated snapping turtle (*Elseya albagula*) are not identified in DSEWPC 2011, due to the subsequent listing of this species as Critically Endangered (from Least Concern) in November 2014. However, DPM Enviroscienses has successfully captured this species using baited cathedral traps and fyke nets on other projects in the Fitzroy River Basin.

The Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (DES 2022) suggest that freshwater turtle surveys should employ one or more of the following capture techniques:

- visual survey;
- snorkelling;
- spotlighting;

- trapping; or
- seine netting.

Freshwater turtles were surveyed at sites R11 and R12 on the Comet River in March 2023 (Section 3.5.1) by overnight deployment of two baited fyke nets at each site, as well as observations of the bank and water surface for sunning and breaching turtles. Fyke nets (Plate 1) were baited with a mix of meat, fruit and vegetables, including beef, rinsed sardines, apple, banana and spinach, in an attempt to attract omnivorous white-throated snapping turtles. The stream profile and high flows encountered at the time of survey necessitated the positioning of fyke nets in the edge habitat (Plate 1). The falling water levels were also factored into the positioning of nets, ensuring any fish bycatch did not become stranded from the water overnight.

Fyke nets being deployed at site R11

Fyke nets deployed at site R12 the previous night, about to be processed

Plate 1 Fyke nets positioned on the Comet River, 14-15 March 2023

Suitable habitat for the deployment of cathedral traps (i.e. trees or snags overhanging deep, slow to no-flow pools) was not encountered in the March 2023 wet season survey.

Water clarity was too poor to enable snorkelling surveys at any sites (Plate 1).

3.5.6 Mammals

Habitat suitability for platypus (*Ornithorhynchus anatinus*) was assessed at each site. This included targeted searches for burrows along banks.

3.5.7 Aquatic flora

Aquatic plants were surveyed at each site during each seasonal survey. All aquatic plants were identified to species using available literature and taxonomic keys where needed. The abundance of each species was estimated using the AusRivAS (DNRM 2001) categories: extensive (>75% cover), moderate (50-75%), some (10-50%) or little (1-10%).

3.5.8 Overall aquatic values

Aquatic values ratings of Low, Moderate or High have been assigned to each site based on the summation of all available information from the desktop and field assessments (Table 4). When assessing each site the overall aquatic value criteria that fit the situation best is applied. The criteria in Table 4 are listed from highest to least importance.

Table 4 Adopted criteria for assigning aquatic values ratings

Aquatic Values / Sensitivity	Criteria
High	▪ Permanent riverine waterbody or natural wetland
	▪ Wetland of High Ecological Significance
	▪ EVNT species habitat present
	▪ Known presence of platypus breeding place
	▪ Near natural / excellent in-stream habitat
	▪ Excellent habitat bioassessment score (111 – 135)
Moderate	▪ Ephemeral or semi-permanent waterbody
	▪ Wetland of General Ecological Significance
	▪ Priority flora species cover moderate or extensive
	▪ Priority fauna species present
	▪ Platypus foraging habitat present
	▪ Some good quality in-stream habitat
	▪ Regional conduit for fish passage (mapped Major or High)
	▪ Good habitat bioassessment score (75 – 110)
	▪ Dry season riverine refuge for common (Least Concern) species
Low	▪ Ephemeral waterbody
	▪ No EVNT species or platypus habitat
	▪ In-stream habitat highly modified / disturbed
	▪ Poor to Fair habitat bioassessment score (0 – 74)

4 RESULTS – AQUATIC VALUES OF THE PROJECT AREA

4.1 Waterways

Riverine systems, watercourses, waterways, rivers, creeks, streams, drainage lines and drainage features are referred to collectively as waterways in this report.

The Queensland Wetland Map (DES 2023b) identifies riverine system drainage lines (waterways) for the Project area. There are 22 waterways mapped for the Project area, comprising:

- 16 waterways of SO 1;
- three waterways of SO 2;
- one waterway of SO 3, comprising Rockland Creek;
- one waterway of SO 5, comprising Humboldt Creek; and
- one waterway of SO 6, comprising Humboldt Creek.

The waterways of the Project area drain to the Comet River (SO 7) to the west of the Project area, which then runs in a general northern direction. The Comet River was assessed as part of the broader Study area.

The waterways of the Study area are largely ephemeral or episodic, with most flowing only after sustained or intense rainfall and runoff, generally ceasing to flow within days to weeks, and supporting aquatic life whose life cycles are generally adapted to these conditions. Flow in the Comet River is seasonal, alternatively wet and dry most years, according to seasonal changes.

Intermittent and semi-permanent to permanent pools are likely to persist on the Comet River and Humboldt Creek at locations with less permeable clay substrates where standing water may persist for longer periods. These pools would provide important dry season refuge for aquatic fauna.

4.1.1 Watercourses

Water Act 2000

The DoR (2023b) Watercourse Identification Map (Figure 6) identifies Humboldt Creek and an unnamed tributary of the Comet River (on which site R3 is positioned) as a waterway that exhibits the characteristics of a ‘watercourse’ as defined by the *Water Act 2000*. Other waterways within the Project area are identified as ‘unmapped’ on the Watercourse Identification Map (Figure 7).

Site knowledge, available aerial imagery and information collected as part of the 36 site profiles (Appendix B) was used to determine whether DoR would likely consider the ‘unmapped’ waterways to be ‘watercourses’ or ‘drainage features’ under the *Water Act 2000*, with ‘watercourses’ considered to be those waterways with:

- clear channel and bank structure; and
- clear presence of riparian vegetation structure.

Further considerations included:

- stream order: the higher the stream order, the more likely it is a ‘watercourse’; and
- size of upstream catchment: the larger the upstream catchment, the more likely it is a ‘watercourse’.

All other ‘unmapped’ waterways within the Project area are considered to be ‘drainage features’ (Appendix B).

Environmental Protection Act 1994

The watercourse definition applying to petroleum projects is as per Schedule 4 of the EP Act, and means any river, creek or stream in which water flows permanently or intermittently. State watercourse/waterway mapping, such as that of DAF (2023), DES (2023b) and/or DoR (2023b) (Figure 7), can be used for initial Project planning and positioning of infrastructure. However, these mapping datasets are undertaken at a broad scale and are not necessarily accurate in indicating the actual location of watercourse/waterway banks. The actual location of these banks should be used to inform final positioning of planned activities in the vicinity of watercourses/waterways and other wetlands.

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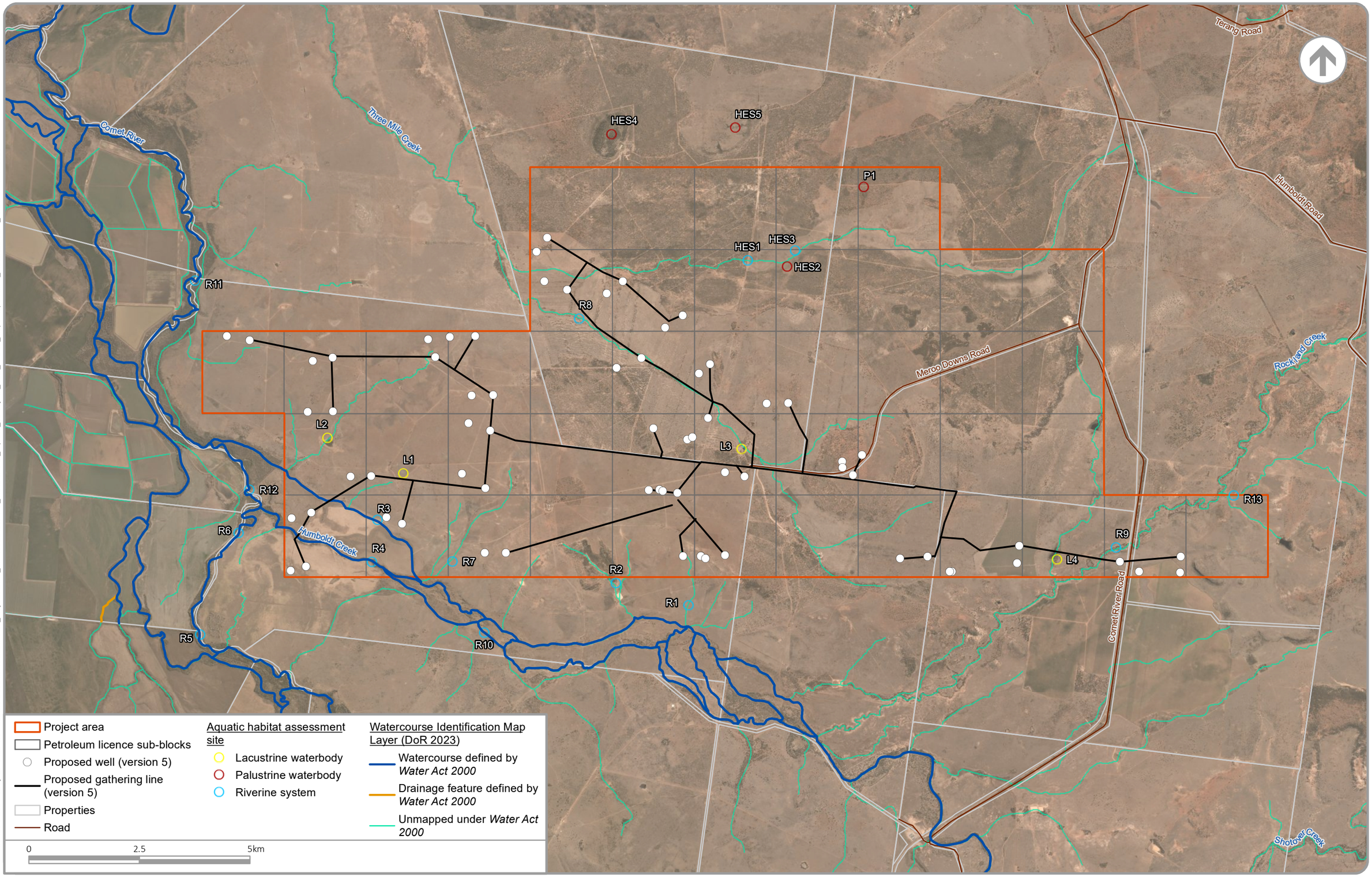

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DPM ENVIROSCIENCES

STATE-MAPPED WATERCOURSES UNDER THE *WATER ACT 2000*

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

FIGURE 6

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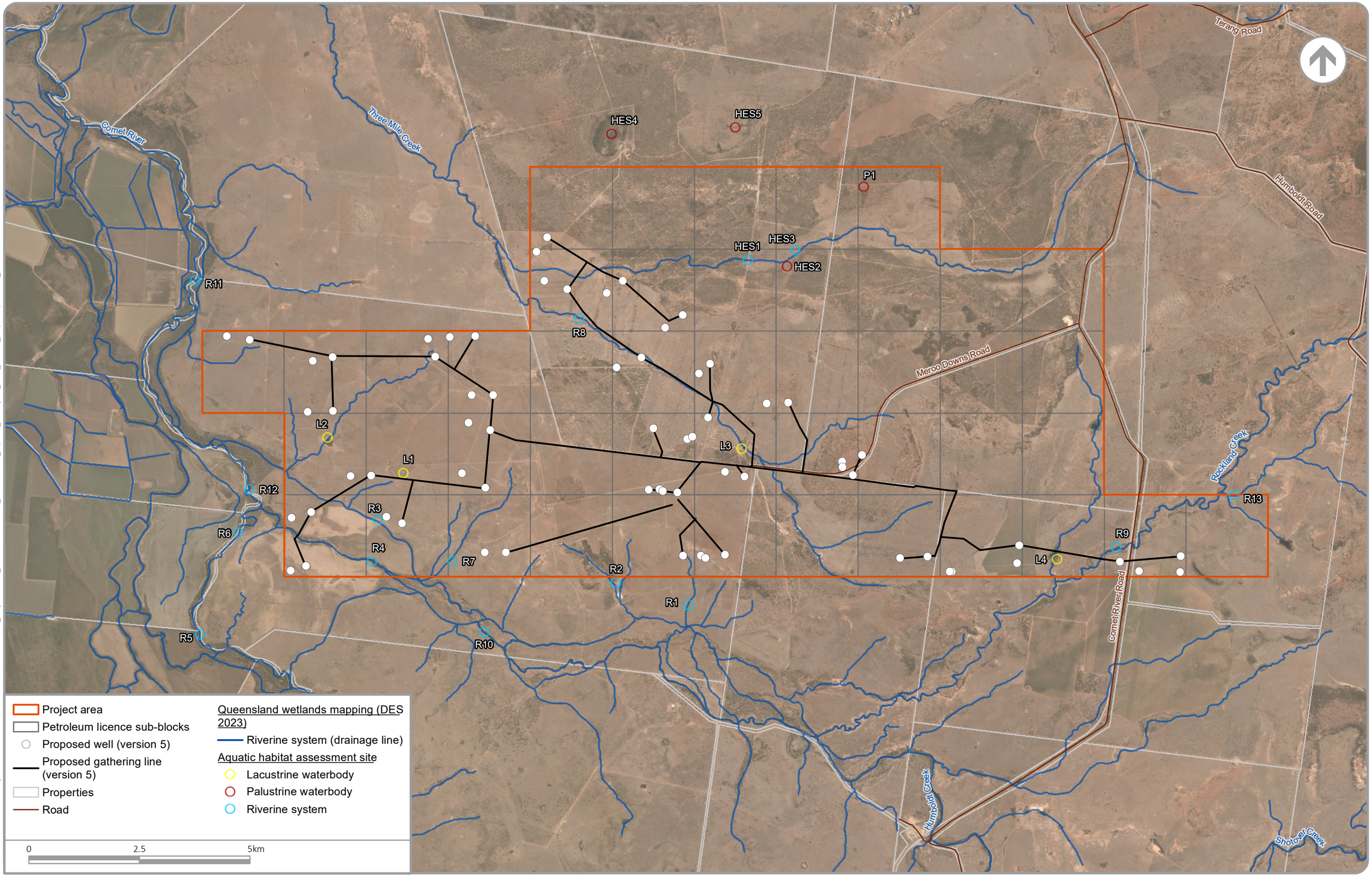

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DPM ENVIROSCIENCES

STATE-MAPPED WATERCOURSES UNDER THE *ENVIRONMENTAL PROTECTION ACT 1994*

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

FIGURE 7

4.1.2 Conservation values

The Aquatic Biodiversity Assessment and Mapping Method (AquaBAMM) (Clayton et al. 2006), was developed to assess conservation values of wetlands and waterways in Queensland. It is a comprehensive method that uses available data (including data resulting from expert opinion), to identify relative non-social, non-economic conservation/ecological values within a specified area. The criteria in AquaBAMM are: naturalness (aquatic); naturalness (catchment); diversity and richness; threatened species and ecosystems; Priority species and ecosystems; special features; connectivity and representativeness. The ACA for the riverine (Inglis and Howell 2009) and non-riverine (Rollason and Howell 2012) wetlands of the Great Barrier Reef catchment (produced by the former Queensland Department of Environment and Resource Management [DERM]) is a product of applying this method. The ACA identifies Humboldt Creek, Rockland Creek and its tributaries to be of High conservation value, the Comet River and some of its tributaries to be Medium conservation value, and some of the upper first order tributaries to be of Very Low conservation value. The ACA identifies each of the mapped palustrine wetland waterbodies and wetlands of the Project area as being of High conservation value. Lacustrine waterbodies (farm dams) identified by ACA are mapped as being of Very Low conservation value. This data is shown in Figure 8.

4.1.3 Waterways providing for fish passage

Waterways, as per the *Fisheries Act 1994*, include rivers, creeks, streams, watercourses or inlets of the sea. The upstream limits of waterways are identified by Peterken et al. (2009) as including features relevant to fisheries resources, such as the following physical and hydrological attributes:

- defined bed and banks – the bed and banks need to be continuous rather than isolated and broken sections of a depression;
- an extended, if non-permanent, period of flow – flow must continue for a reasonable period after rain ceases and have some reliability commensurate with rainfall; and
- flow adequacy – the flow needs to be sufficient to sustain basic ecological processes and to maintain biodiversity within the feature.

The DAF (2023) Queensland Waterways for Waterway Barrier Works mapping (Figure 9) indicates the level of 'risk' associated with undertaking waterway barrier works within Queensland waterways. Waterways with higher stream orders, steeper slopes, higher flow rates, greater numbers of fish present and fish with stronger swimming abilities are allocated a higher level of risk (DAF 2021).

In consideration of these factors, the Comet River main channel, Comet River anabranches and Humboldt Creek are mapped as being at Major risk of adverse impact from waterway barrier works on fish movement (DAF 2023). Rockland Creek main channel (site R9) and Rockland Creek anabranch are indicated as being at High risk of adverse impact. Other mapped waterways within the Project area are indicated as being at Low to Moderate risk of adverse impact from waterway barrier works on fish movement (DAF 2023) (Figure 9).

The types of waterway barriers being proposed (e.g. culverts, bed-level crossings) within these waterways determines the assessment requirements for the activity.

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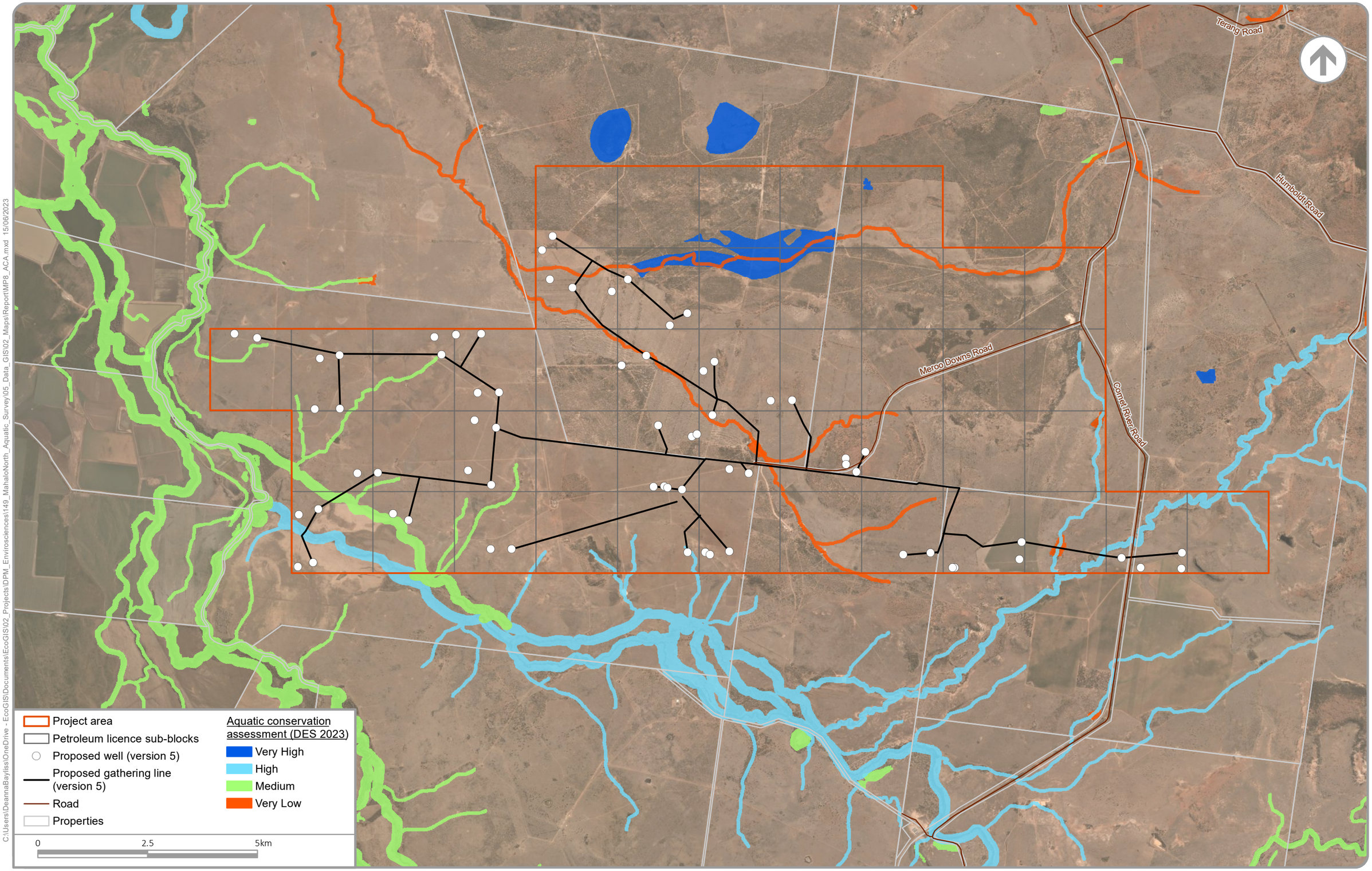

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DPM ENVIROSCIENCES

GREAT BARRIER REEF AQUATIC CONSERVATION ASSESSMENT AREAS

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

FIGURE 8

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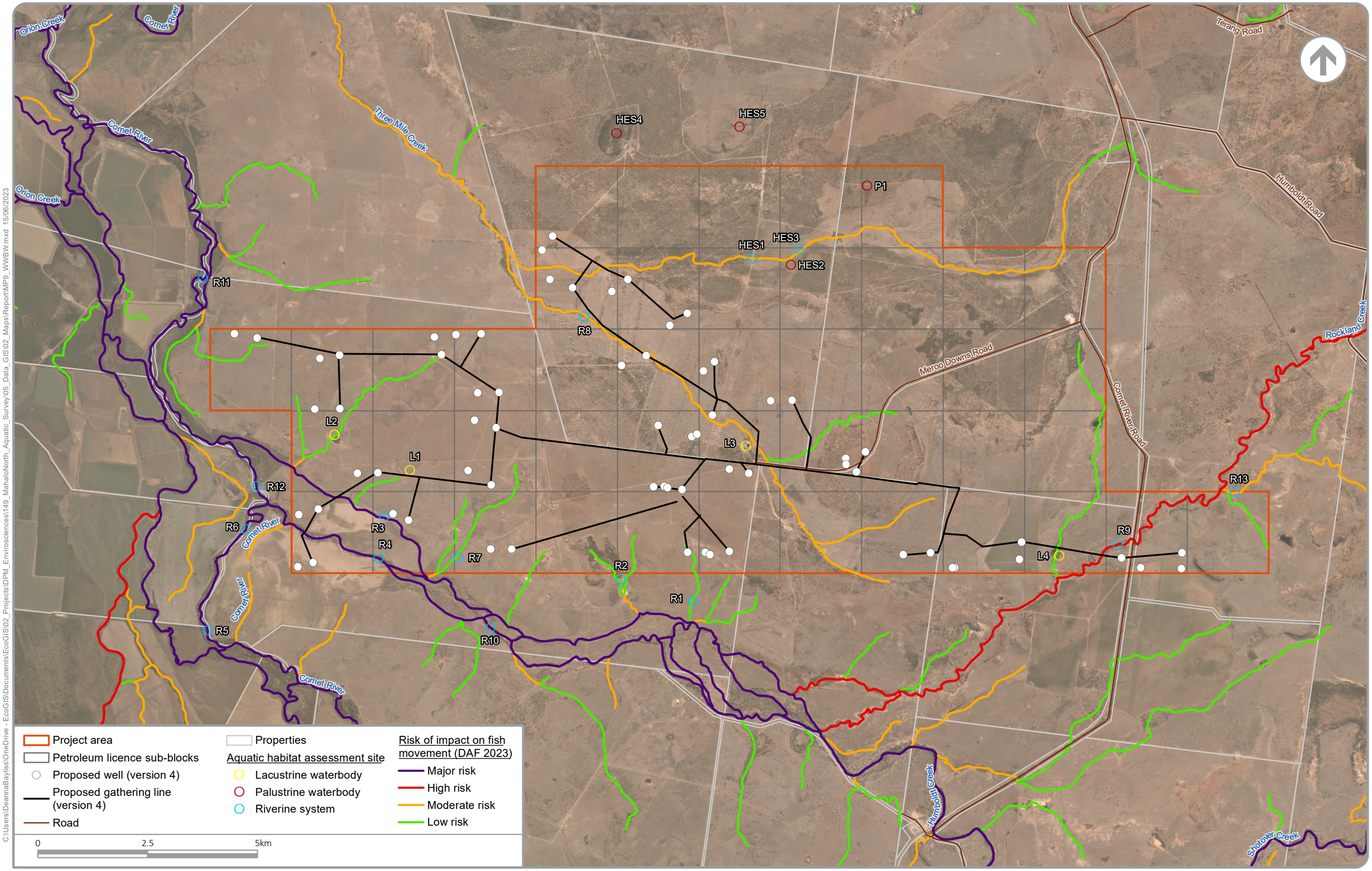

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DPM ENVIROSCIENCES

WATERWAYS FOR WATERWAY BARRIER WORKS MAPPING

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

FIGURE 9

4.2 Aquatic habitat

4.2.1 Waterways

The waterways of the Project area are ephemeral or episodic and expected to experience flow only after sustained or intense rainfall and runoff in the catchment. Stream flows are expected to be highly variable, with most channels drying during winter to early spring when rainfall and runoff is historically low. During these times, aquatic fauna are likely to concentrate in senescing pools. Consequently, physical attributes, water quality, and the composition of aquatic flora and fauna communities are expected to be highly variable over time.

4.2.2 Physico-chemical water quality

Dry season – August 2022

Surface water temperatures at the time of assessment in August 2022 ranged from 10.7°C (cool) to 19.6°C (warm) (Table 5). Water temperatures are influenced by time of day, shading and waterbody depth.

pH levels ranged from 6.7 (neutral) to 8.0 (moderately alkaline) in the riverine sites, from 7.0 (neutral) to 8.0 (moderately alkaline) in the palustrine wetland waterbody sites, and from 6.7 (neutral) to 8.6 (strongly alkaline) in the lacustrine wetland waterbody (farm dam) sites (Table 5). The higher pH levels likely reflect the clay-rich soils of the catchment as well as the high contact time with silt/clay substrates in these receding waterbodies.

Each wetted site exhibited 'fresh' (<800 µS/cm) water, with similar conductivity levels across the riverine, palustrine and lacustrine waterbody sites (Table 5). Conductivity levels at each riverine site were below the WQO baseflow guideline of <375 µS/cm. Conductivity levels in the lacustrine and palustrine wetland waterbody sites were below the WQO of <250 µS/cm for 'freshwater lakes / reservoirs' (Table 5).

Surface water DO levels were variable across the Study area, reflecting a number of factors including time of day, temperature, turbidity (light penetration), organic load, biological activity and rate of transfer from the atmosphere (Appendix B). DO measurements ranged from 37.3% (very low) saturation at farm dam site L3 to 116% (supersaturated) at palustrine wetland waterbody site HES5 (Table 5). The lower DO levels reflect a number of factors, including time of day, likely night-time oxygen consumption by algae, and the breakdown of organic matter in these drying pools. Supersaturated DO levels at site HES5 reflect the time of day and the photosynthetic release of oxygen by algae and submerged macrophytes. Drying pools across the Project area are likely subjected to extreme diurnal fluctuations in DO levels.

Turbidity levels in the riverine sites ranged from 48 NTU (moderate clarity) at site R5 on the Comet River to >1,000 NTU (very poor clarity; opaque) at site R10 on Humboldt Creek, exceeding the WQO of 50 NTU at most wetted sites assessed (Table 5). Turbidity levels in the palustrine wetland waterbody sites ranged from 40 to 55 NTU (moderate clarity). Turbidity levels in the lacustrine wetland waterbody sites ranged from 18 NTU (high clarity) at site L3, from which stock were excluded, to >1000 NTU (very poor clarity; opaque) at site L4, which exhibited extensive pugging by cattle as well as sheet, rill, gully and tunnel erosion from dispersive soils (Appendix B).

Table 5 Surface water quality measurements, dry season – August 2022

Parameter	Units	WQO	Riverine sites						Palustrine sites		Lacustrine sites			
		ANZG	R4#	R5#	R6#	R8#	R9#	R10#	HES1#	HES5^	L1^	L2^	L3^	L4^
Date	DD/M/YY	-	16/08/22	16/08/22	16/08/22	18/08/22	19/08/22	19/08/22	17/08/22	18/08/22	16/08/22	16/08/22	17/08/22	19/08/22
Time	00:00	-	10:43	12:11	13:20	12:56	07:08	10:55	10:12	07:38	08:43	16:06	07:37	08:12
Physico-chemical water quality														
Temperature	°C	-	12.9	15.3	19.6	13.6	10.7	11.5	13.8	13.1	10.9	17.1	14.9	15.9
pH	pH units	6.5-8.5#, 6.5-8.0^	7.2	8.0	7.9	7.0	7.4	6.7	7.0	8.0	7.3	7.9	6.7	**8.6**
Conductivity	µS/cm (@25C°)	<375#base, <210#high, <250^	158	209	212	165	171	160	175	110	205	215	100	221
DO	% saturation	85-110#, 90-110^	**83**	98	90	100	78*	77*	39.8*	**116**	**49.6**	99	**37.3**	**84**
	mg/L	-	8.72	9.55	8.22	10.05	8.68	8.10	3.98	12.22	5.47	9.59	3.72	8.18
Turbidity	NTU	<50#, 1-20^	**916**	48	-	**245**	**498**	**>1,000**	40	**55**	**346**	**>1,000**	18	**37**
Alkalinity (as $CaCO_3$)	mg/L	-	49	94	94	52	60	47	84	59	97	94	45	109
Major cations														
Calcium (Ca^{2+})	mg/L	-	9	18	18	4	11	8	10	9	28	22	2	16
Magnesium (Mg^{2+})	mg/L	-	4	10	10	3	5	4	7	2	3	6	3	8
Sodium (Na^{+})	mg/L	-	16	13	13	28	16	16	17	9	8	8	16	24
Potassium (K^{+})	mg/L	-	6	4	4	5	4	4	5	7	12	16	4	7
Major anions														
Chloride (Cl^{-})	mg/L	-	16	8	8	20	16	16	7	2	4	7	5	6
Sulphate (SO_4^{2-})	mg/L	<5#	4	2	2	<1	4	4	<1	<1	<1	1	<1	<1
Bicarbonate (HCO_3^{-})	mg/L	-	49	94	94	52	60	47	84	59	97	94	45	106

Notes: # WQO applies to Comet River Sub-basin riverine waters. ^ WQO applies to freshwater lakes / reservoirs, and palustrine wetlands in the absence of guidelines specific to wetlands.* DO levels for fresh waters only apply to flowing waters; stagnant pools in intermittent streams naturally experience DO below 50% saturation (DEHP 2011). **Bold text** indicates exceedance of WQO.

Wet season – March 2023

Surface water temperatures at the time of assessment in March 2023 ranged from 25.7 to 37.1°C (hot) (Table 6). Water temperatures were likely influenced by time of day, shading and waterbody depth.

pH levels ranged from 6.1 (slightly acid) to 7.7 (mildly alkaline) in the riverine sites, from 6.2 (slightly acid) to 6.6 (neutral) in the palustrine wetland waterbody sites, and from 6.4 (slightly acid) to 8.6 (strongly alkaline) in the lacustrine wetland waterbody (farm dam) sites (Table 6). The lower pH levels likely reflect recent rainfall. The higher pH level of 8.6 at site L2 likely reflects the clay-rich soils of the catchment as well as the high contact time with silt/clay substrates in this waterbody.

Each wetted site exhibited 'fresh' (<800 µS/cm) water, with similar conductivity levels across the riverine, palustrine and lacustrine waterbody sites (Table 6). Conductivity levels at each riverine site were below the WQO baseflow guideline of <375 µS/cm. Conductivity levels in the lacustrine and palustrine wetland waterbody sites were below the WQO of <250 µS/cm for 'freshwater lakes / reservoirs' (Table 6).

Surface water DO levels were highly variable across the Study area, reflecting a number of factors including time of day, temperature, turbidity (light penetration), organic load, biological activity and rate of transfer from the atmosphere (Appendix B). DO measurements ranged from 4.0% (extremely low) saturation in wetted gilgai at lacustrine wetland site L1, to 130% (supersaturated) at farm dam site L2 (Table 6). The lower DO levels reflect a number of factors, including the likely breakdown of recently inundated terrestrial grasses and other organic matter in these drying pools. Supersaturated DO levels reflect time of day and the photosynthetic release of oxygen by algae and to a lesser extent submerged macrophytes. Isolated pools and waterbodies across the Study area are likely subjected to extreme diurnal fluctuations. This includes most of the farm dams and other wetlands which are typically subjected to high nutrient load from cattle with direct access, resulting in proliferation of algae and subsequent extreme diurnal fluctuations in DO.

Turbidity levels in the riverine sites ranged from 110 NTU (poor clarity) in a small isolated pool at first order tributary site R7 to >1,000 NTU (very poor clarity; opaque) at sites R2, R4 (Humboldt Creek), R9 (Rockland Creek), R11 (Comet River) and R12 (Comet River), exceeding the WQO of 50 NTU at each wetted site (Table 6). Turbidity levels in the palustrine wetland waterbody sites ranged from 45 NTU (moderate clarity) to >1,000 (very poor clarity; opaque). Turbidity levels in the lacustrine wetland waterbody sites ranged from 27 NTU (high clarity) at site L3, from which stock was excluded, to 464 NTU (poor clarity) at site L1, which exhibited pugging by cattle (Appendix B).

Table 6 Surface water quality measurements, wet season – March 2023

Parameter	Units	WQO	Riverine sites							Palustrine sites			Lacustrine sites			
		ANZG	R2#	R4#	R7#	R8#	R9#	R11#	R12#	HES1#	HES4^	HES5^	L1^	L2^	L3^	L4^
Date	DD/M/YY	-	13/03/23	15/03/23	15/03/23	16/03/23	13/03/23	14/03/23	14/03/23	16/03/23	16/03/23	16/03/23	13/03/23	13/03/23	13/03/23	13/03/23
Time	00:00	-	15:34	12:38	13:38	13:53	07:51	09:37	13:32	09:08	11:53	10:37	12:49	14:18	11:07	08:55
Physico-chemical water quality																
Temperature	°C	-	29.6	30.7	37.1	27.0	25.7	26.2	26.8	26.7	31.0	27.2	27.6	30.1	31.4	27.8
pH	pH units	6.5-8.5#, 6.5-8.0^	**6.1**	6.8	7.7	**6.4**	6.8	7.1	6.7	6.6	6.5	**6.2**	**6.4**	**8.6**	6.5	7.7
Conductivity	µS/cm (@25C°)	<375#base, <210#high, <250^	161	121	202	190	89	135	161	131	121	126	159	141	117	170
DO	% saturation	85-110#, 90-110^	53*	**19.1**	92	9.1*	**67**	**75**	**75**	15.9*	**51**	**23.4**	**4.0**	**130**	92	**74**
	mg/L	-	3.9	1.41	6.25	0.71	5.47	6.10	6.04	1.33	3.71	1.90	0.40	9.60	6.77	5.81
Turbidity	NTU	<50#, 1-20^	**>1,000**	**>1,000**	**110**	**655**	**>1,000**	**>1,000**	**>1,000**	**268**	**>1,000**	**45.4**	**464**	**42.5**	**26.9**	**31.3**
Alkalinity (as $CaCO_3$)	mg/L	-	42	72	78	52	31	50	62	51	51	61	46	64	48	85
Major cations																
Calcium (Ca^{2+})	mg/L	-	5	11	14	3	3	9	11	5	9	12	10	11	3	13
Magnesium (Mg^{2+})	mg/L	-	4	4	5	2	1	5	6	4	3	4	2	4	2	7
Sodium (Na^{+})	mg/L	-	22	13	16	35	13	11	13	14	8	10	2	5	18	14
Potassium (K^{+})	mg/L	-	4	8	7	5	4	5	5	6	8	4	11	16	5	6
Major anions																
Chloride (Cl^{-})	mg/L	-	23	9	8	28	10	6	6	8	4	4	3	5	8	4
Sulphate (SO_4^{2-})	mg/L	<5#	4	1	1	6	2	5	4	1	<1	<1	<1	<1	<1	<1
Bicarbonate (HCO_3^{-})	mg/L	-	42	72	78	52	31	50	62	51	51	61	46	64	48	85

Notes: # WQO applies to Comet River Sub-basin riverine waters. ^ WQO applies to freshwater lakes / reservoirs, and palustrine wetlands in the absence of guidelines specific to wetlands.* DO levels for fresh waters only apply to flowing waters; stagnant pools in intermittent streams naturally experience DO below 50% saturation (DEHP 2011). **Bold text** indicates exceedance of WQO.

4.2.3 Ionic composition of surface waters

The concentration and proportion of ions in surface waters depends on the location of the waterway (geology, land-use and topography), climate and the proportionate contributions of groundwater flow, interflow and overland flow (Boulton and Brock 2001). These proportionate contributions will vary depending on seasonal and climatic patterns and so the source of ions will also vary. During periods of low to no rainfall or runoff, groundwater contributions can become more evident. During periods of high rainfall and runoff, catchment and atmospheric sources typically dominate.

The concentrations of major anions and cations in surface water samples collected from across the Study area are provided in Appendix C. The relative proportions of these major cations and anions are presented in a Piper plot as Figure 10. The Piper plot indicates that the surface waters exhibited either mixed or sodium-dominated cations and mostly bicarbonate-dominated anions, except for wet season samples collected from unnamed tributary sites R2 and R8 which were chloride-dominated.

Bicarbonate-dominated waters are typical of many inland waterways, or the upland reaches of coastal draining waterways where weak carbonic acid, formed from atmospheric carbon dioxide dissolved in rainwater and from rainwater infiltrating carbon dioxide-rich soil, reacts with sodium, calcium and magnesium prevalent in soil, rock or other deposits to form mixed bicarbonate waters.

The wet season surface waters collected from sites R2 and R8 were sodium chloride type waters; however, the dry season sample collected from site R8 (site R2 was dry) was a mixed type water dominated by bicarbonate anions (Figure 9). Chlorides are typically dissolved from rocks and soils derived from evaporites, minerals or igneous rock, although are also concentrated in animal excretions.

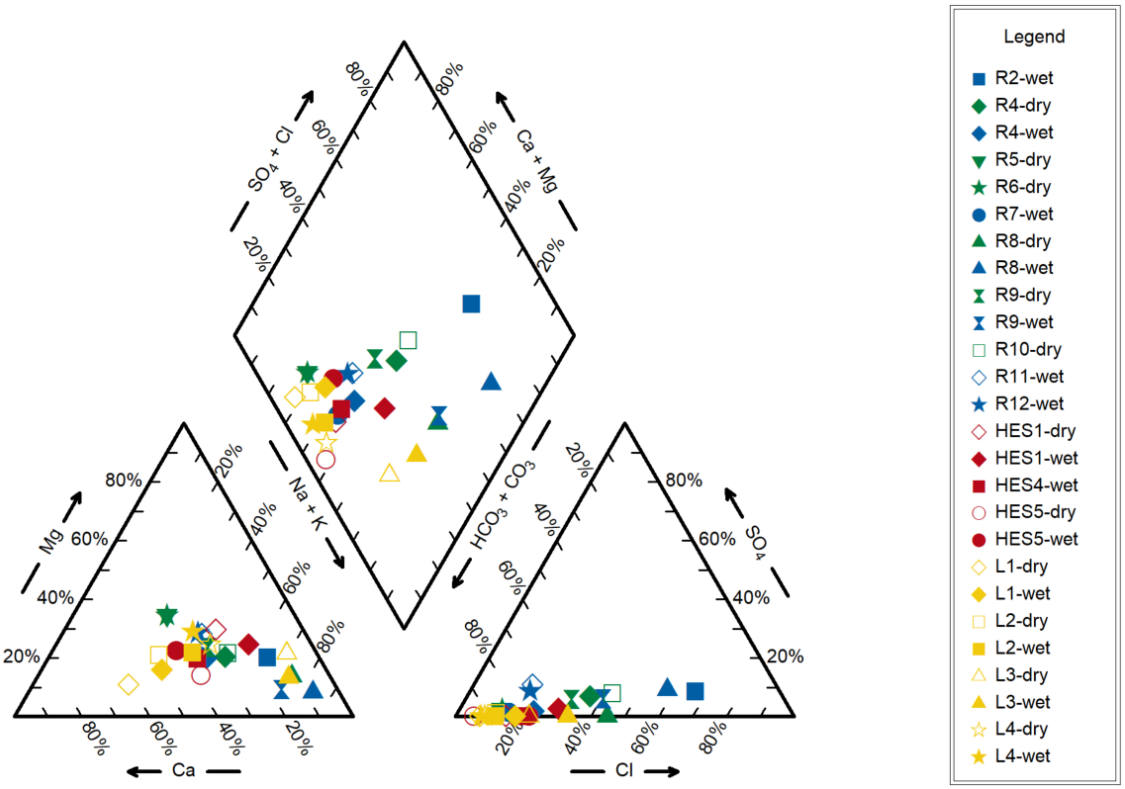


Figure 10 Piper plot showing relative abundance of major cations and anions in surface waters collected from the Study area

Figure 11 compares the major anionic and cationic compositions of surface waters of the Study area against the Gibbs (1970) model for world geochemistry of surface waters.

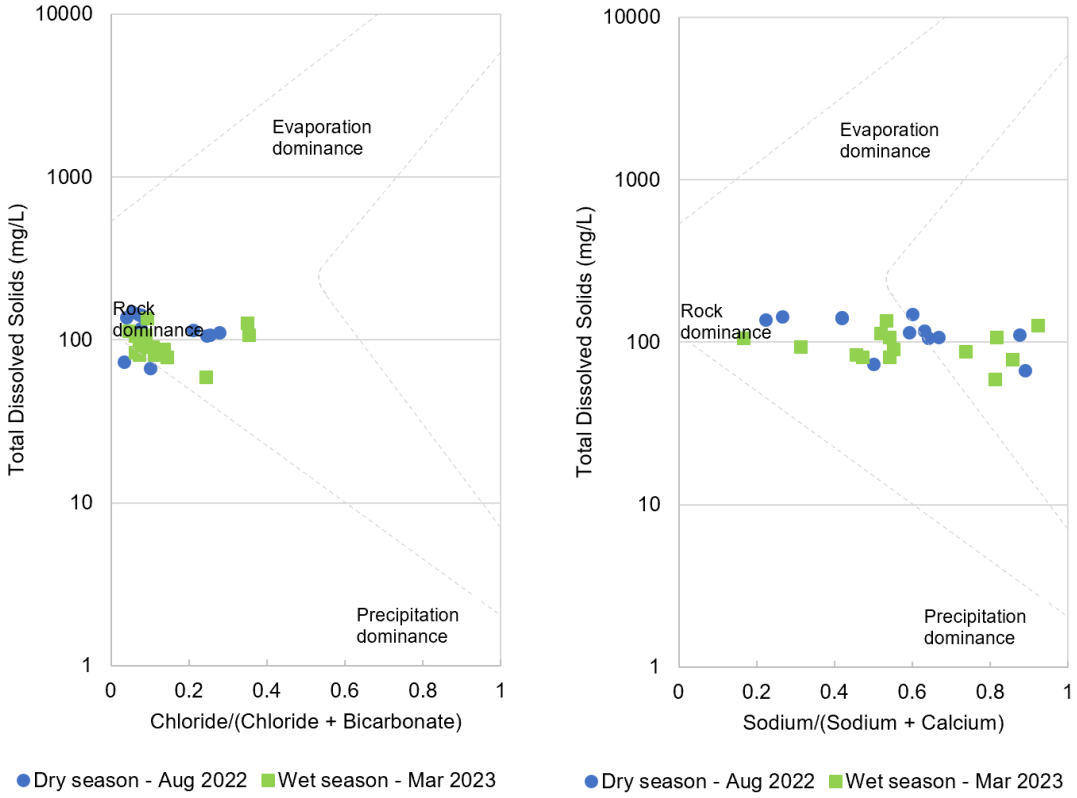


Figure 11 Gibbs (1970) diagrams and ionic balance of surface water samples collected from the Study area

The anion samples cluster closer to the centre-left in the 'rock dominance' zone in the Gibbs (1970) model (Figure 11), resembling the ionic composition of waters found in soil and rock dominated geochemistry rather than atmospheric precipitation or evaporation-crystallisation processes. The relatively low concentration (based on the logarithmic scale of Gibbs [1970] of total dissolved salts (approximately 60 to 165 mg/L, inferred from conductivity levels of 89 to 111 µS/cm) (Figure 11) support the notion that surface waters are rainfall derived, with no obvious indicators of groundwater contribution. The associated lack of on-ground evidence of surface expression GDEs is discussed in Section 4.8.1.

4.2.4 Instream habitat

Instream (aquatic) habitat assessment scores ranged from Poor to Good (Section 3.5.2) for the riverine survey sites across the Study area (Table 7), with most sites scoring Fair. The bottom substrate / available cover and embeddedness categories rated Poor at most sites, owing to the dominance of fine sediments (silt/clay and sand) and general lack of the larger pebble, cobble and boulder substrates at most sites. Bottom substrate / available cover and embeddedness rated Good at site R9 on Rockland Creek, owing to the presence of larger substrates in the form of cobbles, pebbles and gravel, and other habitat attributes including branches, logs and bank overhangs (Appendix B).

The velocity/depth category rated Poor at most sites due to either dry conditions or shallow, isolated pools being encountered at most sites. Velocity/depth categories were rated Fair at sites R4 (Humboldt Creek) and R5 (Comet River) in both the wet and dry season surveys owing to slow (<0.3 m/s) shallow (<0.5 m) and slow deep wetted habitat being encountered, Fair at site R9 (Rockland Creek) in the wet season owing to slow shallow and fast shallow wetted habitat being encountered, Good at site R12 (Comet River) in the wet season owing to slow shallow, slow deep

and fast deep wetted habitat being encountered, and Excellent at site R11 (Comet River) in the wet season owing to slow shallow, slow deep, fast shallow and fast deep wetted habitats being encountered (Appendix B).

4.2.5 Bank stability/erosion

Bank vegetative stability ranged from Fair to Excellent across most riverine sites, indicating that at least 50% of the stream banks were covered by vegetation at the time of assessment. Bank vegetative stability at site R2 (unnamed first order tributary) rated Poor in both the dry and wet season surveys (Appendix B).

Banks were moderately stable at most sites, with only small, infrequent areas of erosion that are mostly healed over. However, there remains some potential for erosion in extreme flooding at each site. Bank stability was rated Poor at site R13 (unnamed first order tributary) due to the prevalence of bank slumping, gully, rill and tunnel erosion (Appendix B).

4.2.6 Adjacent land use

Land use across the Study area is dominated by cattle grazing of varying intensity, with small areas showing some evidence of opportunistic cropping. The land has been largely cleared through past agricultural practices; however, large patches of remnant vegetation remain (or have regrown) in the central and northern portions of the Project area (Figure 2).

The width of the riparian zones in representative stream reaches assessed as part of this aquatic ecology assessment ranged from 30 to 100 m (single bank measurements) on the Comet River sites to an almost complete lack of riparian vegetation at sites R1 (unnamed first order tributary), R3 (fifth order flood channel of the Comet River) and R7 (unnamed first order tributary), due to being subjected to past complete clearing of riparian vegetation (Appendix B). Trees commonly encountered in riparian zones across the Study area included Queensland blue gum (*Eucalyptus tereticornis*), coolabah (*E. coolabah*), poplar box (*E. populnea*), Dawson gum (*E. cambageana*), carbeen (*Corymbia tessellaris*), yellowwood (*Terminalia oblongata*), river she-oak (*Casuarina cunninghamiana*), sally wattle (*Acacia salicina*), brigalow (*A. harpophylla*), white bauhinia (*Lysiphyllum hookeri*) and snow-in-summer (*Melaleuca linariifolia*). The shrub layer and groundcover was variable across the Study area (Appendix B).

Table 7 Aquatic habitat assessment scores for riverine survey sites across the Study area, August 2022 (dry season) and March 2023 (wet season)*

Habitat variable	R1		R2		R3	R4		R5	R6	R7		R8		R9		R10	R11	R12	R13	HES1Dry	
	Dry	Wet	Dry	Wet	Dry	Dry	Wet	Dry	Dry	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Wet	Wet	Dry	Wet
	2022	2023	2022	2023	2022	2022	2023	2022	2022	2022	2023	2022	2023	2022	2023	2022	2023	2023	2023	2022	2023
Bottom substrate/available cover	P (1)	P (1)	P (1)	P (1)	P (1)	P (5)	P (5)	P (3)	P (5)	P (1)	P (1)	P (1)	P (1)	G (15)	G (15)	F (6)	P (3)	P (3)	P (2)	P (3)	P (3)
Embeddedness	P (1)	P (1)	P (1)	P (1)	P (1)	P (5)	P (5)	P (2)	P (5)	P (1)	P (1)	P (1)	P (1)	G (15)	G (15)	P (5)	P (3)	P (3)	P (2)	P (3)	P (3)
Velocity/depth category	P (0)	P (0)	P (0)	P (1)	P (0)	F (6)	F (6)	F (6)	F (6)	P (0)	P (1)	P (4)	P (3)	P (1)	F (10)	P (5)	E (16)	G (12)	P (0)	P (2)	P (2)
Channel alteration	E (12)	E (12)	P (3)	P (3)	E (12)	P (2)	P (2)	F (5)	F (6)	P (3)	P (3)	P (3)	P (3)	G (10)	G (10)	F (7)	F (5)	F (5)	F (5)	F (5)	F (5)
Bottom scouring and deposition	G (10)	G (10)	P (3)	P (3)	G (11)	P (3)	P (3)	P (3)	P (3)	P (3)	P (3)	P (3)	P (3)	F (7)	F (7)	F (5)	P (3)	P (3)	P (3)	F (5)	F (5)
Pool/riffle, run/bend ratio	P (3)	P (3)	F (4)	F (4)	P (1)	F (5)	F (5)	F (6)	F (6)	P (0)	P (1)	F (4)	F (4)	F (5)	F (5)	F (4)	F (6)	F (6)	F (4)	F (4)	F (4)
Bank stability	E (9)	E (9)	F (5)	F (5)	E (9)	G (8)	G (8)	G (6)	G (8)	G (8)	G (8)	G (7)	G (7)	F (5)	F (5)	E (9)	G (8)	G (8)	P (2)	F (5)	F (5)
Bank vegetative stability	E (9)	E (9)	P (2)	P (2)	E (9)	F (4)	F (2)	E (9)	G (8)	E (9)	E (9)	G (6)	G (8)	G (7)	G (7)	G (8)	E (10)	E (10)	F (5)	F (4)	F (4)
Streamside cover	F (4)	F (4)	E (9)	E (9)	F (3)	E (9)	E (9)	E (9)	E (9)	F (3)	F (3)	F (5)	F (5)	E (9)	E (9)	E (9)	E (10)	E (10)	E (9)	E (9)	E (9)
Total (out of 135)	**49**	**49**	**28**	**29**	**47**	**47**	**45**	**49**	**56**	**28**	**30**	**34**	**35**	**74**	**83**	**58**	**64**	**60**	**32**	**40**	**40**
Rating	**Fair**	**Fair**	**Poor**	**Poor**	**Fair**	**Fair**	**Fair**	**Fair**	**Fair**	**Poor**	**Poor**	**Poor**	**Poor**	**Good**	**Good**	**Fair**	**Fair**	**Fair**	**Poor**	**Fair**	**Fair**

* Notes: P – Poor, F – Fair, G – Good, E – Excellent, followed by (score)

4.2.7 Overall aquatic values

Aquatic values for each site are presented in the site profiles in Appendix B. Ratings for aquatic values were determined for each site based on the criteria in Section 3.5.8 and are presented in Table 8. The sites on the Comet River were rated as having High aquatic values, due to providing known or likely habitat for the Critically Endangered (EBPC Act and NC Act) white-throated snapping turtle (*Elseya albagula*). The sites on Humboldt Creek and Rockland Creek were rated as having Moderate aquatic value, due to their importance as regional conduits for fish passage (Section 4.1.3). The smaller, unnamed tributaries were rated as having Low aquatic value. Site R3 (flood channel of the Comet River) was also rated Low as, although this site is State-mapped as a regional (Major risk) conduit for fish passage, there were no on-ground indicators of this drainage swale being a waterway (Appendix B).

The State-mapped HES wetlands were rated High aquatic value due to their State-mapping status. Although only sites HES4 and HES5 exhibited on-ground indicators of being actual wetlands, the accuracy of the State HES wetland mapping (DES 2023d and DSDILGP 2023) is not being challenged by the Proponent.

The lacustrine wetland waterbodies (mostly farm dams) were rated Low aquatic value, although still provide important watering and foraging habitat for terrestrial fauna and some dry season refuge for LC fish and turtle species.

Table 8 Aquatic values ratings for the Study area

Site	Waterway/wetland	Stream order	Key aquatic values / criteria	Aquatic values rating
R1	Unnamed tributary of the Comet River	1	▪ Waterway with ephemeral flow ▪ Fair habitat bioassessment score ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	Low
R2	Unnamed tributary of the Comet River	1	▪ Waterway with ephemeral flow ▪ Poor habitat bioassessment score ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	Low
R3	Flood channel of the Comet River	5	▪ Drainage swale with ephemeral flow ▪ Poor habitat bioassessment score ▪ No EVNT or SLC species detected ▪ No Priority flora species detected ▪ Mapped regional conduit for fish passage (Major); however, no on-ground indicators of being a waterway.	Low
R4	Humboldt Creek	6	▪ Waterway with episodic flow ▪ Fair habitat bioassessment score ▪ No EVNT or SLC species detected ▪ No Priority flora species detected ▪ Regional conduit for fish passage (Major)	Moderate
R5	Comet River	7	▪ Waterway with seasonal flow ▪ Mapped wetland of General Ecological Significance (GES) ▪ Fair habitat bioassessment score ▪ Likely habitat for the Critically Endangered (EPBC Act and NC Act) white-throated snapping turtle (*Elseya albagula*) ▪ No Priority flora species detected ▪ Regional conduit for fish passage (Major)	High

Site	Waterway/wetland	Stream order	Key aquatic values / criteria	Aquatic values rating
R6	Comet River	7	▪ Waterway with seasonal flow ▪ Mapped GES wetland ▪ Fair habitat bioassessment score ▪ Likely habitat for the Critically Endangered (EPBC Act and NC Act) white-throated snapping turtle (*Elseya albagula*) ▪ No Priority flora species detected ▪ Regional conduit for fish passage (Major)	High
R7	Unnamed tributary of the Comet River	1	▪ Waterway with ephemeral flow ▪ Poor habitat bioassessment score ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	Low
R8	Unnamed tributary of the Comet River	2	▪ Waterway with episodic flow ▪ Poor habitat bioassessment score ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	Low
R9	Rockland Creek	3	▪ Waterway with episodic flow ▪ Good habitat bioassessment score ▪ No EVNT or SLC species detected ▪ No Priority flora species detected ▪ Regional conduit for fish passage (High)	Moderate
R10	Humboldt Creek	5	▪ Waterway with episodic to seasonal flow ▪ Fair habitat bioassessment score ▪ No EVNT or SLC species detected ▪ Little cover of Priority flora species ▪ Regional conduit for fish passage (Major)	Moderate
R11	Comet River	7	▪ Waterway with seasonal flow ▪ Mapped GES wetland ▪ Fair habitat bioassessment score ▪ Likely habitat for the Critically Endangered (EPBC Act and NC Act) white-throated snapping turtle (*Elseya albagula*) ▪ No Priority flora species detected ▪ Regional conduit for fish passage (Major)	High
R12	Comet River	7	▪ Waterway with seasonal flow ▪ Mapped GES wetland ▪ Fair habitat bioassessment score ▪ Known habitat for the Critically Endangered (EPBC Act and NC Act) white-throated snapping turtle (*Elseya albagula*) ▪ No Priority flora species detected ▪ Regional conduit for fish passage (Major)	High
R13	Unnamed tributary of Rockland Creek	2	▪ Waterway with ephemeral flow ▪ Poor habitat bioassessment score ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	Low

Site	Waterway/wetland	Stream order	Key aquatic values / criteria	Aquatic values rating
HES1	Mapped HES wetland	1	▪ State-mapped HES wetland ▪ Intersected by waterway with ephemeral flow ▪ Appears in State RE mapping (DoR 2023a) as wetland RE 11.5.16 ▪ Appears in Queensland Wetlands Mapping (DES 2023b) as wetland RE 11.5.16 ▪ Appears in project's ground-truthed RE mapping as wetland RE 11.5.16 ▪ Field verified by DPM as RE 11.5.3 (not a wetland RE); however, State mapping not being challenged by proponent ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	High
HES2	Mapped HES wetland	-	▪ State-mapped HES wetland ▪ Appears in State RE mapping (DoR 2023a) as non-remnant ▪ Appears in Queensland Wetlands Mapping (DES 2023b) as not a wetland ▪ Appears in project's ground-truthed RE mapping as non-remnant ▪ Field verified by DPM as non-remnant and not a wetland; however, State mapping not being challenged by proponent ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	High
HES3	Mapped HES wetland	1	▪ State-mapped HES wetland ▪ Intersected by waterway with ephemeral flow ▪ Appears in State RE mapping (DoR 2023a) as non-remnant ▪ Appears in Queensland Wetlands Mapping (DES 2023b) as not a wetland ▪ Appears in project's ground-truthed RE mapping as non-remnant ▪ Field verified by DPM as a non-remnant palustrine wetland; State mapping not being challenged by proponent ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	High
HES4	Mapped HES wetland	-	▪ State-mapped HES wetland ▪ Appears in State RE mapping (DoR 2023a) as non-remnant ▪ Appears in Queensland Wetlands Mapping (DES 2023b) as wetland waterbody RE 11.5.17 ▪ Not covered by project's ground-truthed RE mapping ▪ Field verified by DPM as wetland waterbody RE 11.5.16; however, State mapping not being challenged by proponent ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	High

Site	Waterway/wetland	Stream order	Key aquatic values / criteria	Aquatic values rating
HES5	Mapped HES wetland	-	▪ State-mapped HES wetland ▪ Appears in State RE mapping (DoR 2023a) as non-remnant ▪ Appears in Queensland Wetlands Mapping (DES 2023b) as wetland waterbody RE 11.5.17 ▪ Not covered by project's ground-truthed RE mapping ▪ Field verified by DPM as a non-remnant palustrine wetland; State mapping not being challenged by proponent ▪ No EVNT or SLC species detected ▪ Extensive cover of Priority flora species	High
P1	Mapped palustrine wetland waterbody	-	▪ Appears in State RE mapping (DES 2023x) as RE 11.5.3. ▪ Appears in Queensland Wetlands Mapping (DES 2023b) as palustrine wetland waterbody RE 11.5.3b. ▪ Field verified by DPM as RE 11.5.3 (not a wetland waterbody or wetland RE). ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	Low
L1	Lacustrine wetland waterbody	-	▪ Modified (dammed) wetland ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	Low
L2	Lacustrine wetland waterbody (farm dam)	1	▪ Modified (dammed) wetland ▪ No EVNT or SLC species detected ▪ Little cover of Priority flora species	Low
L3	Lacustrine wetland waterbody (farm dam)	2	▪ Modified (dammed) wetland ▪ No EVNT or SLC species detected ▪ No Priority flora species detected	Low
L4	Lacustrine wetland waterbody (farm dam)	1	▪ Modified (dammed) wetland ▪ No EVNT or SLC species detected ▪ Little cover of Priority flora species	Low

4.3 Wetlands

4.3.1 Wetlands of International Importance

There are no wetlands of International Importance identified within the Project area or broader desktop Search area in the EPBC Act Protected Matters Report (DCCEEW 2023a). Wetlands of International Importance nearest to the Project area include those of the Shoalwater and Corio Bays Area, approximately 230 km (direct line) to the north-east.

4.3.2 Wetlands of National Importance

One Nationally Important wetland, Lake Nuga Nuga, is recorded by Wetland*Info* for the Comet River sub-basin (DES 2023a). Lake Nuga Nuga is located approximately 100 km south of the Project area. Lake Nuga Nuga is positioned well upstream of the Project area and is unlikely to be of relevance to the Project.

4.3.3 Referrable wetlands

Wetland Protection Areas

The Map of Great Barrier Reef Wetland Protection Areas (DES 2023d) shows the location of WPAs, comprising HES wetlands and their trigger area buffers. These wetlands have been assessed as containing high ecological values by a bioregional aquatic conservation assessment, the AquaBAMM (Rollason and Howell 2012).

One WPA is mapped as occurring within the Project area (DES 2023d; Figure 12). This WPA has been established around a HES wetland mapped in an earlier version of the Queensland RE mapping. A larger area of palustrine wetland RE 11.5.16 had been mapped in an earlier version of the Queensland RE mapping, which formed the basis for the extent of the State-mapped HES wetland. The latest version of RE mapping (version 12.02, DoR 2023a) has removed the cleared component of this RE polygon comprising the eastern half of the State-mapped HES wetland. Sites HES2 and HES3 (Plate 2 and Figure 12) were positioned within this cleared component. The remaining half of this HES wetland is mapped as RE 11.5.16 (palustrine wetland dominated by *Acacia harpophylla* and/or *Casuarina cristata* open forest) but was field verified at site HES1 as being RE 11.5.3 (*Eucalyptus populnea* on Cainozoic sand plains; not a wetland) (Plate 2 and Figure 12). Notwithstanding, the Proponent does not intend to challenge the accuracy of the HES wetland mapping and will instead avoid the mapped HES wetland with a separation of at least 200 m (Section 5.1.2).

Site HES3 – State-mapped HES wetland comprising State-mapped (DoR 2023a) non-remnant vegetation

Site HES1 – State-mapped HES wetland comprising State-mapped palustrine RE 11.5.16, field verified as RE 11.5.3 (not a wetland)

Plate 2 State-mapped wetland of High Ecological Significance

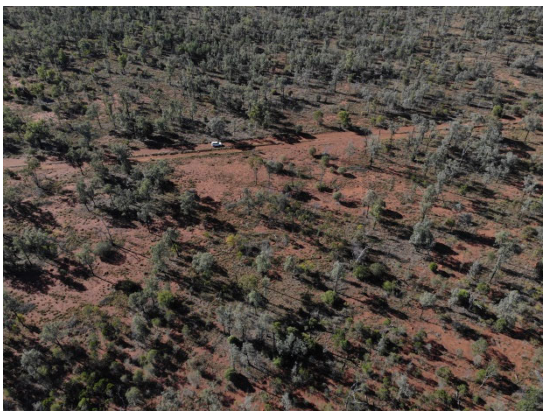
Queensland Wetland Environmental Values

The Map of Queensland Wetland Environmental Values (MQWEV) identifies the location and ecological significance of wetlands using the environmental values for wetlands in Section 7 of the *Environmental Protection (Wetland and Water Biodiversity) Policy 2019* (EPP 2019). Wetlands are considered either HES or of GES for the purposes of allocating EVs. The MQWEV also shows High Ecological Value (HEV) waters management intent under the EPP 2019.

One HES wetland is mapped within the Project area, as identified in the previous paragraph 'Wetland Protection Areas' and in Figure 12. One State-mapped GES wetland is mapped as occurring within the Project area (DES 2019; Figure 12). This mapped GES wetland aligns with State-mapped RE 11.5.3 (DoR 2023a) but is mapped as palustrine wetland waterbody RE 11.5.3b in the Queensland Wetland Mapping (DES 2023b). Site P1 (Plate 3 and Figure 12) was positioned within this polygon, which was field verified as being RE 11.5.3 (*Eucalyptus populnea* on Cainozoic sand plains; not a wetland) (Plate 3 and Figure 12). Notwithstanding, the Proponent does not intend to challenge the GES wetland mapping and will avoid the State-mapped GES wetland polygon.

No HEV waters are identified for the Project area in the MQWEV.

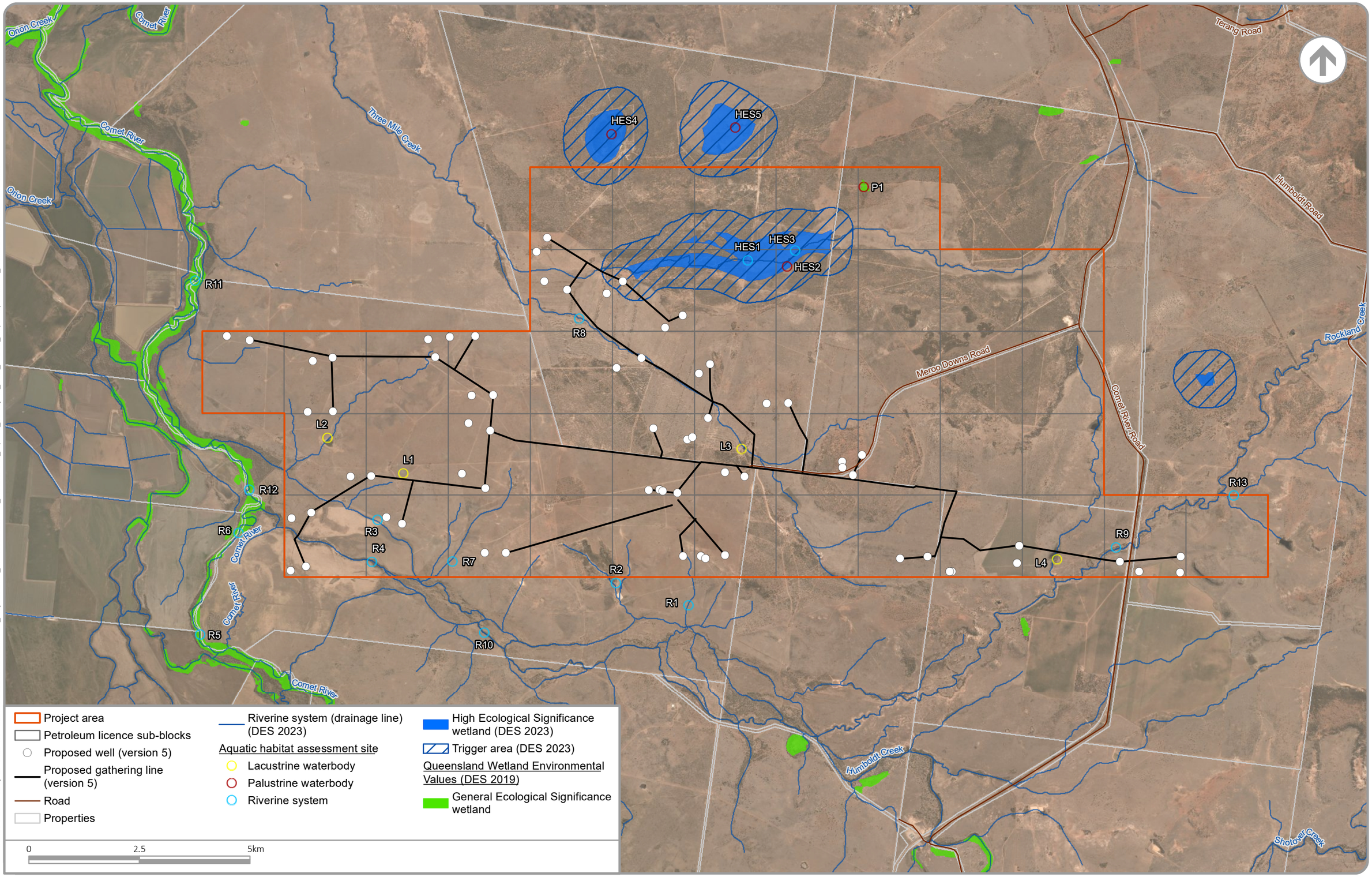
Site P1 – State-mapped GES wetland mapped as palustrine wetland RE 11.5.3b, field verified as RE 11.5.3 (not a wetland)



Site P1 aerial photo – State-mapped GES wetland, mapped as palustrine wetland RE 11.5.3b, field verified as RE 11.5.3 (not a wetland)

Plate 3 State-mapped wetland of General Ecological Significance

Data sources: Queensland Government 2023, DPM Enviros ciences 2023. Includes material © Planet Labs Netherlands B.V. 2019-2020, reproduced under licence from Planet and Geoplex, all rights reserved..
DPM Enviros ciences does not warrant the accuracy or completeness of information displayed in this map and any person using it does so at their own risk. DPM Envios ciences shall bear no responsibility or liability for any errors, faults, defects, or omissions in the information.



C:\Users\DeannaBayliss\OneDrive - EcoGIS\Documents\EcoGIS\02_Projects\DPM_Enviros ciences\149_MahaloNorth_Aquatic_Survey\05_Data_GIS\02_Maps\Report\MP12_WetlandValue.mxd 15/06/2023

DPM ENVIROSCIENCES

QUEENSLAND WETLAND ENVIRONMENTAL VALUES

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

FIGURE 12

4.4 Aquatic flora

A total of 28 species of aquatic or semi-aquatic plants were recorded from the Study area during the seasonal surveys (Table 9).

Most aquatic flora species detected are considered LC under the NC Act. Four are listed as SLC under the NC Act. Schedule 2 of the Nature Conservation (Plants) Regulation 2020 identifies SLC species as those plants belonging to a number of families and genera. SLC plants are not considered rare or threatened but are managed under the NC Act to protect these plants from harvest and commercial trade. During the surveys, the following SLC aquatic flora species were recorded:

- *Caldesia oligococca*;
- starfruit (*Demasonium minus*);
- water nymph (*Najas tenuifolia*);
- swamp lily (*Ottelia ovalifolia*); and
- curly pondweed (*Potamogeton crispus*).

Three Priority aquatic flora species (defined in Section 3.2) were detected (Table 11), comprising:

- tall flatsedge (*Cyperus exaltatus*) – riverine sites R8, R10 and HES1, lacustrine wetland sites L3 and L4, and palustrine wetland site HES5;
- native water hyacinth (*Monochoria cyanea*) – lacustrine wetland sites L3 and L4; and
- water nymph (*Najas tenuifolia*) – palustrine wetland site HES5.

Most aquatic flora species encountered are semi-aquatic species including grasses, sedges and rushes. The greatest diversity of aquatic flora was recorded from the lacustrine wetland waterbodies.

The lack of both diversity and abundance of aquatic plants at some sites reflects the harsh physical conditions, cattle grazing and trampling, or a combination of these factors.

Table 9 Aquatic flora recorded from the Study area, August (dry season) 2022

Scientific name	Common name	Riverine sites										Wetland sites									
		R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	HES1	HES2	HES3	HES4	HES5	P1	L1	L2	L3	L4
Cyperus concinnus	-								L					L	L			L			
Cyperus difformis	Rice sedge								L												L
Cyperus exaltatus	Tall flatsedge								L		L					S				S	L
Cyperus sp.	-				L													L			
Diplachne fusca var. *fusca*	Beetle grass								L					L		L				L	
Duma florulenta	Lignum										L				L	L					
*Echinochloa colona**	Awnless barnyard grass*							L	L					L				L		L	L
*Eclipta prostrata**	White eclipta*																			L	
Eleocharis plana	Ribbed spikerush																			L	L
Eleocharis sp.	-																	L			
Juncus usitatus	Common rush															L					L
Leptochloa digitata	Umbrella canegrass								L									L		L	L
Ludwigia octovalvis	Willow primrose											L				L					
Ludwigia peploides	Water primrose														L					L	L
Marsilea drummondii	Common nardoo															S				L	L
Marsilea hirsuta	Hairy nardoo																	L			
Marsilea sp.	Nardoo														L						
Ottelia ovalifolia	Swamp lily															L				S	L
Persicaria attenuata	Hairy knotweed																			S	L
Persicaria decipiens	Slender knotweed																				L
Potamogeton crispus	Curly pondweed																			L	
Species richness		**0**	**0**	**0**	**1**	**0**	**0**	**1**	**6**	**0**	**2**	**1**	**0**	**3**	**4**	**8**	**0**	**6**	**0**	**11**	**11**

Notes: * denotes introduced species; L = 1-10% (little); S = 10-50% (some); M = 50-75% (moderate); E = >75% (extensive), as per AusRivAS categories (DNRM 2001).

Table 10 Aquatic flora recorded from the Study area, March (wet season) 2023

Scientific name	Common name	Riverine sites									Wetland sites						
		R1	R2	R4	R7	R8	R9	R11	R12	R13	HES1	HES4	HES5	L1	L2	L3	L4
*Azolla filiculoides**	Red azola*												E				
Caldesia oligococca	-																L
Cyperus betchei	-					L							L			L	
Cyperus concinnus	-											L	L	L			
Cyperus difformis	Rice sedge			L							L		L	L		L	L
Cyperus exaltatus	Tall flatsedge										L		M			M	L
Damasonium minus	Starfruit															L	
Diplachne fusca var. *fusca*	Beetle grass											L	L	L		L	L
Duma florulenta	Lignum											L	L				
*Echinochloa colona**	Awnless barnyard grass*				L	L					L			L		L	L
*Eclipta prostrata**	White eclipta*															L	L
Eleocharis philippinensis	-															L	
Eleocharis pallens	Pale spikerush																L
Eleocharis plana	Ribbed spikerush															E	L
Juncus usitatus	Common rush													L			L
Leptochloa digitata	Umbrella canegrass			L		L								S		L	S
Ludwigia octovalvis	Willow primrose										L		L	L			L
Ludwigia peploides	Water primrose															E	E
Marsilea drummondii	Common nardoo												S			E	S
Marsilea hirsuta	Hairy nardoo													L			L
Marsilea sp.	Nardoo											L					
Monochoria cyanea	Native hyacinth												L			L	L
Najas tenuifolia	Water nymph												E				
Ottelia ovalifolia	Swamp lily												E				L
Persicaria attenuata	Hairy knotweed																S
Persicaria decipiens	Slender knotweed																L
Persicaria orientalis	Princes feathers															L	
Philydrum lanuginosum	Woolly frogsmouth												L				
Potamogeton crispus	Curly pondweed															S	

Scientific name	Common name	Riverine sites									Wetland sites						
		R1	R2	R4	R7	R8	R9	R11	R12	R13	HES1	HES4	HES5	L1	L2	L3	L4
Walwhalleya subxerophila	Gilgai grass												L				
Species richness		**0**	**0**	**2**	**1**	**3**	**0**	**0**	**0**	**0**	**4**	**4**	**14**	**8**	**0**	**15**	**18**

Notes: * denotes introduced species; L = 1-10% (little); S = 10-50% (some); M = 50-75% (moderate); E = >75% (extensive), as per AusRivAS categories (DNRM 2001).

4.5 Aquatic fauna

4.5.1 Fishes

A total of 22 native fish species have been recorded from the broader Comet River drainage sub-basin (DES 2023a), many of which may occur in the Study area on occasion. Fish surveys were excluded from the scope of work. However, fish bycatch was recorded as part of the turtle survey effort on the Comet River (Section 3.5.5).

Seven common (Least Concern) native fish species were opportunistically recorded from 101 fishes captured from two sites (R11 and R12) on the Comet River 14-15 March 2023. This comprised Agassiz's glassfish (*Ambassis agassizii*), spangled perch (*Leiopotherapon unicolor*), eastern rainbowfish (*Melanotaenia splendida splendida*), bony bream (*Nematalosa erebi*), Hyrtl's catfish (*Neosilurus hyrtlii*), sleepy cod (*Oxyeleotris lineolata*) and freshwater catfish (*Tandanus tandanus*). The mesh size (20 mm stretched) was too large to capture smaller species such as gudgeon species *(Hypseleotris* spp.).

Each of the above species had previously been recorded in Wetland*info* (DES 2023a) for the Comet River drainage sub-basin. All fishes captured appeared healthy, with little sign of stress and no obvious sign of disease. Captured fishes (all native) were released at the point of capture. The seven native fish species opportunistically recorded from the Study area in March 2023 are widespread species commonly encountered in ephemeral (and permanent) waterways of Central Queensland.

4.5.2 Turtles

The Critically Endangered (EPBC Act and NC Act) white-throated snapping turtle (*Elseya albagula*) was recorded at site R12 on 14-15 March 2023, comprising two males of approximately 25 cm and 27 cm curved carapace length. Species identification has been confirmed by Principal Aquatic Ecologist Chris Pietsch (Blue Earth Environmental) who has extensive experience in the capture, tagging and tracking of this species; and the Queensland Museum.

Desktop searches and habitat assessments in August 2022 identified potential for the occurrence of white-throated snapping turtle in the Comet River adjoining the Project area. This species is known to utilise productive but often ephemeral riffle zones but falls back to less productive large slow-moving pools or isolated waterholes during the drier months (Cann and Saddler 2017). Turtle survey effort was conducted at the same time as wet season aquatic habitat assessments in March 2023 and confirmed the presence of this species. Although the location of important dry season refuge pools on the Comet River in the Study area is not currently known, review of aerial imagery and on-ground features (including water offtake infrastructure) at site R12 suggests that important dry season refuge pools may persist at this location.

Plate 4 White-throated snapping turtle (*Elseya albagula*) recorded from the Study area

4.5.3 Platypus

The platypus (*Ornithorhynchus anatinus*) is listed as SLC under the NC Act for cultural reasons. The Wetland*Info* database (DES 2023a) identifies the platypus as having previously been recorded from the Comet River drainage sub-basin. ALA (2023) identifies these records as being from the Carnarvon Gorge area.

The seasonal nature of the waterways and palustrine wetlands of the Project area are not conducive to sustaining a population of platypus. Similarly, the lacustrine waterbodies (i.e. farm dams) of the Project area are unlikely to sustain a population of platypus as, despite relative permanence of wetted habitat, these artificial/modified waterbodies lack the banks and habitat features necessary for platypus burrow construction.

No platypus burrows were encountered during the surveys, despite targeted searches at each aquatic habitat assessment site. It is considered unlikely that platypus occupy the Project area.

4.6 Conservation-significant species

4.6.1 Aquatic flora

No EVNT aquatic (wetland indicator) flora species listed under the EPBC Act and/or NC Act were recorded during the surveys. The Wetland*Info* database identifies 306 wetland indicator flora species, subspecies and varieties that have previously been recorded from the Fitzroy Basin (DES 2023a). Of these, the following are listed as EVNT (Table 11):

- salt pipewort/button grass (*Eriocaulon carsonii*) – Endangered (NC Act);
- salt pipewort/button grass (*Eriocaulon carsonii* subsp. *orientale*) – Endangered (EPBC Act and NC Act);
- *Maundia triglochinoides* – Vulnerable (NC Act);
- Lesser swamp orchid (*Phaius australi*s) – Endangered (EPBC Act and NC Act); and
- Swamp fern (*Thelypteris confluens*) – Vulnerable (NC Act).

It is unlikely that any of these EVNT aquatic flora species occur within the Project area (Table 11).

Table 11 EVNT and Priority aquatic flora recorded from the Fitzroy Basin and desktop Search area

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
EVNT species													
Eriocaulon carsonii (including subsp. *orientale*)	salt pipewort / button grass	E	E	H/ H		Restricted to saturated soil adjacent to flowing mound springs (Sainty and Jacobs 2003).	**Unlikely**. Mound springs not known to occur within the Study area. Preferred habitat is unlikely to occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.				✓	✓
Maundia triglochinoides	-		V			Grows in coastal freshwater swamps and streams (Sainty and Jacobs 2003), in waters up to 0.5 m deep, or shallow waters that may dry up seasonally.	**Unlikely**. Current distribution (ALA 2023) is not in proximity to the Study area.	**Unlikely**. Species not detected during field surveys.					✓
Phaius australis	lesser swamp-orchid	E	E	C/ C	R& T	Grows in sandy areas where soils are almost always damp, but not flooded for lengthy periods; occurring in southern Queensland and northern NSW (DES 2023f).	**Unlikely**. Preferred habitat not known to occur within the Study area. Current known distribution (ALA 2023) is not in proximity to the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.		✓		✓	✓
Thelypteris confluens	swamp fern		V		R& T	Found in permanently swampy areas and mound springs (DES 2023g). Occurs in the Queensland pastoral districts on Leichhardt, Moreton and Wide Bay (DES 2023g).	**Unlikely**. Preferred habitat not known to occur within the Study area. Current known distribution (ALA 2023) is not in proximity to the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.		✓			✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Priority species													
Machaerina articulata (*previously Baumea articulata*)	jointed twigrush		LC		P	Grows in standing water <1 m deep. Inhabits coastal lagoons, deeper swamps and slow-moving streams. Scattered occurrence in inland wetlands (Fielder *et al.* 2011).	**Unlikely**. Preferred habitat not known to occur within the Study area. Current known distribution (ALA 2023) is not in proximity to the Study area.	**Unlikely**. Not detected during seasonal field surveys.		✓			
Machaerina rubiginosa (*previously Baumea rubiginosa*)	soft twigrush		LC		P	Grows in damp environments such as ephemeral swamps, lagoons and creek banks (Sainty and Jacobs 2003).	**Potential**. Preferred habitat occurs within the Study area. There are no records within 10 km of the Study Area, although there are records within 50 km of the Study Area (ALA 2023).	**Unlikely**. Not detected during seasonal field surveys.		✓			
Cyperus exaltatus	tall flatsedge		LC		P	Forms extensive stands along inland rivers and creeks, in areas which are often flooded. Grows in swamps and wetland margins (Sainty and Jacobs 2003).	**Likely**. Preferred habitat occurs within the Study area and there are records within 10 km of the Study area (ALA 2023; EMM/DPM 2020).	**Known**. Widespread across the Study area. Detected at riverine sites R8, R10 and HES1, lacustrine wetland sites L3 and L4, and palustrine wetland site HES5.		✓			✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Eleocharis blakeana	-		LC	H/ M	R	Occurs on plains and low undulating country on poorly drained, clayey soils; commonly in ephemeral wet habitats in gilgai country and in small depressions along drainage lines in open forest and woodland communities (Halford 1996; and Wilson 2006, cited in DES 2023h).	**Unlikely**. The species habitat is known from the broader Fitzroy Basin, but not from the Comet River sub-basin (DES 2023a).	**Unlikely**. Not detected during seasonal field surveys.	✓			✓	✓
Eleocharis dulcis	water chestnut		LC		P	Grows in shallow lagoons and floodplains, on heavy soils (Sainty and Jacobs 2003).	**Potential**. Preferred habitat is known to occur within the Study area. Recorded from Rolleston (ALA 2023).	**Unlikely**. Not detected during seasonal field surveys.		✓			✓
Eleocharis sphacelata	tall spikerush		LC		P	Grows in stationary or slow-moving water bodies of the coast and inland; occurring in shallow water up to 2 m depth (Sainty and Jacobs 2003).	**Potential**. Preferred habitat is known to occur within the Study area. Recorded from Rolleston (ALA 2023).	**Unlikely**. Not detected during seasonal field surveys.		✓			✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Gahnia sieberiana	sword grass		LC		P	Swamps and wet heaths (Melzer and Plumb 2011).	**Potential**. Swamps occur within the Study area. There are no records within 10 km of the Study area, although there are records within 50 km of the Study area (ALA 2023).	**Unlikely**. Not detected during seasonal field surveys.		✓			✓
Leersia hexandra	swamp rice grass		LC		P	Edges of billabongs, in swamps and constructed wetlands. Forms dense stands, often excluding other plant species (Sainty and Jacobs 2003).	**Potential**. Preferred habitat is known to occur within the Study area. There are no records within 10 km of the Study area, although there are records within 50 km of the Study area (ALA 2023).	**Unlikely**. Not detected during seasonal field surveys.		✓			✓
Monochoria cyanea	native water hyacinth		LC		P	Generally rooted in the mud; preferring stationary or slow-flowing nutrient-rich water, but will survive for short periods on drying mud (Sainty and Jacobs 2003).	**Likely**. Preferred habitat occurs within the Study area and there are records within 10 km of the Study area (ALA 2023; EMM/DPM 2020).	**Known**. Detected at lacustrine wetland sites L3 and L4, and palustrine wetland site HES5.		✓			✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Myriophyllum artesium	-		LC	H/ H	R& T	Wetlands and creek lines associated with springs emanating from the Great Artesian Basin and associated basins (DES 2023i). Recently delisted from Endangered (NC Act) to Least Concern.	**Unlikely**. Current known distribution (ALA 2021) is not in proximity to the study are. Spring fed wetlands and creeks not known to occur within the Study area. Preferred habitat is unlikely to occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.		✓		✓	✓
Myriophyllum simulans	Amphibious water-milfoil		LC		P	Grows in still water, or more frequently, fully emergent on mud (Harden 2002).	**Potential**. Preferred habitat is known to occur within the Study area. There are no records within 10 km of the Study area, although there are records within 50 km of the Study area (ALA 2023).	**Unlikely**. Not detected during seasonal field surveys.	✓				✓
Myriophyllum verrucosum	water milfoil		LC		P	Various habitats, from deep water to exposed mud (Harden 2002).	**Likely**. Preferred habitat occurs within the Study area and there are records within 10 km of the Study area (ALA 2023; EMM/DPM 2020).	**Potential**. Not detected during seasonal field surveys, but potential remains for species occurrence in the broader Study area.	✓				✓
Najas tenuifolia	water nymph		LC		P	Fresh water less than 3 m deep, widespread; submerged aquatic species (Fielder et al. 2011).	**Likely**. Preferred habitat occurs within the Study area and there are records within 10 km of the Study area (ALA 2023; EMM/DPM 2020).	**Known**. Detected at palustrine wetland site HES5.	✓	✓			✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Nelumbo nucifera	pink waterlily		LC		P	Deep lagoons and deep slow-moving streams (Fielder et al. 2011).	**Unlikely**. Preferred habitat does not occur within Project area.	**Unlikely**. Not detected during seasonal field surveys.	✓	✓			✓
Nymphaea gigantea	giant waterlily		LC		P	Permanent deep water with muddy substrates (Sainty and Jacobs 2003).	**Potential**. Preferred habitat is known to occur within the Study area. There are no records within 10 km of the Study area, although there are records within 50 km of the Study area (ALA 2023).	**Unlikely**. Not detected during seasonal field surveys.	✓	✓			✓
Nymphoides exiliflora	-		LC		P	Saturated soils or clear shallow (to 5 cm) fresh water; low heath and edge swamps on sandy soils (Stanley and Ross 1983).	**Unlikely**. The species habitat is known from the broader Fitzroy Basin, but not from the Comet River sub-basin (DES 2023a).	**Unlikely**. Not detected during seasonal field surveys.	✓	✓			
Nymphoides indica	water snowflake		LC		P	Stationary and slow-moving water bodies (Sainty and Jacobs 2003).	**Likely**. Preferred habitat occurs within the Study area and there are records within 10 km of the Study area (ALA 2023; EMM/DPM 2020).	**Potential**. Not detected during seasonal field surveys, but potential remains for species occurrence in the broader Study area.	✓	✓			✓
Ottelia alismoides	-		LC		P	Margins of lakes, ponds and backwaters; usually submerged, but may be partly emergent in shallow water (Sainty and Jacobs 2003).	**Unlikely**. Preferred habitat is known to occur within the Study area, but there are no known records within 50 km of the Study area (ALA 2023).	**Unlikely**. Not detected during seasonal field surveys.	✓	✓			✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				J & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Paspalum distichum	water couch		LC		P	Damp areas and margins of waterbodies, creeks, streams, channels and drains on the coast and inland (Sainty and Jacobs 2003).	**Unlikely**. Preferred habitat is known to occur within the Study area, but there are no known records within 50 km of the Study area (ALA 2023).	**Unlikely**. Not detected during seasonal field surveys.	✓	✓			✓
Phragmites australis	common reed		LC		P	Stationary or slow-moving waterbodies, margins of creeks, streams, channels and drains, swamps, areas with high water or that are seasonally inundated; tolerant of slightly brackish water (Sainty and Jacobs 2003). May grow in deep and permanent waters, or shallow, seasonally inundated lowlands, or where there is a permanently high water table not far below the surface (Romanowski 1998).	**Unlikely**. Preferred habitat is known to occur within the Project area, but there are no known records from within 50 km of the Study area.	**Unlikely**. Not detected during seasonal field surveys.	✓	✓			✓
Schoenoplectiella mucronata	schoenoplectus		LC		P	Creek and river banks, periodically inundated floodplains and in billabongs. Banks of stationary or slow-moving waterbodies and floodplains (Sainty and Jacobs 2003).	**Potential**. Preferred habitat is known to occur within the Study area. There are no records within 10 km of the Study area, although there are records within 50 km of the Study area (ALA 2023).	**Unlikely**. Not detected during seasonal field surveys.		✓			✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Typha orientalis	broad-leaved cumbungi		LC		P	Stationary or slow-moving waterbodies, margins of creeks and rivers of the inland and coast; fresh or brackish water up to 2 m deep (Sainty and Jacobs 2003).	**Unlikely**. Preferred habitat is known to occur within the Study area, but there are no known records within 50 km of the Study area.	**Unlikely**. Not detected during seasonal field surveys.	✓	✓			✓
Vallisneria nana	ribbonweed		LC		P	Still to fast-flowing waters of streams, lakes, ponds and irrigation channels (Stephens and Dowling 2002).	**Likely**. Preferred habitat occurs within the Study area and there are records of Vallisneria sp. (likely *V. nana*) within 10 km of the Study area (ALA 2023; EMM/DPM 2020).	**Potential**. Not detected during seasonal field surveys, but potential remains for species occurrence in the broader Study area.	✓	✓			✓

Notes:

E = Endangered, V = Vulnerable, LC = Least Concern, C = Critical Priority, H = High Priority, M = Medium Priority, P = Priority, R&T = Rare and Threatened.

1. EPBC Act = status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
2. NC Act = status under the Queensland *Nature Conservation Act 1992*.
3. Back on Track = status under the DERM (2010) Fitzroy Natural Resource Management Region – Back on Track Actions for Biodiversity.
4. ACA = status under the Aquatic Conservation Assessments using AquaBAMM for riverine and non-riverine wetlands of the Great Barrier Reef catchments (Inglis and Howell 2009; Rollason and Howell 2012).

4.6.2 Fishes

No fish species listed under the EPBC Act and/or NC Act were recorded during opportunistic fish surveys. The Wetland*Info* database identifies 52 native fish species that have previously been recorded from the broader Fitzroy Basin (DES 2023x). Of these, two are listed as EVNT:

- silver perch (*Bidyanus bidyanus*) – Critically Endangered (EPBC Act); and
- Murray cod (*Maccullochella peelii*) – Vulnerable (EPBC Act).

It is unlikely these EVNT species occur within waterbodies of the Study area as either resident or transient occurrences as suitable habitat is not present, and the Study area is outside the known range of these species (Table 12).

An additional EVNT fish species, the Endangered (NC Act) and Vulnerable (EPBC Act) honey blue-eye (*Pseudomugil mellis*), is identified in the ACA Expert Panel Report for non-riverine wetlands in the Fitzroy section of the GBR catchment (Rollason and Howell 2012). However, this species is not listed by Wetland*Info* as having been recorded from the Fitzroy Basin (DES 2023a) and is also unlikely to occur in the Study area.

The BoT Actions for Biodiversity for the Fitzroy NRM region report (DERM 2010) lists the ornate rainbowfish (*Rhadinocentrus ornatus*) as a Priority species (Table 12). An additional 11 Priority fish species are recorded by the ACA Expert Panel Reports for the Fitzroy section of the GBR catchment (Inglis and Howell 2009; Rollason and Howell 2012) (Table 12).

4.6.3 Freshwater turtles

The Wetland*Info* database identifies seven freshwater turtle species as having previously been recorded from the Fitzroy Basin (DES 2023a). Of these, two are listed as EVNT:

- white-throated snapping turtle (*Elseya albagula*) – Critically Endangered (EPBC Act and NC Act); and
- Fitzroy River turtle (*Rheodytes leukops*) – Vulnerable (EPBC Act and NC Act).

The EPBC Act Protected Matters Report (DCCEEW 2023a) identifies both the white-throated snapping turtle and Fitzroy River turtle, or their habitat, as 'likely' to occur within the Search area (Appendix A). There are no Priority aquatic reptile species identified in the BoT Actions for Biodiversity for the Fitzroy NRM region (DERM 2010) or ACA Expert Panel Reports for the Fitzroy section of the GBR catchment (Inglis and Howell 2009; Rollason and Howell 2012) that are not also listed under the EPBC Act or NC Act (Table 13).

The white-throated snapping turtle is known from stream reaches with permanent water in the Fitzroy, Mary and Burnett catchments (DAWE 2020). In the Fitzroy River catchment it uses the productive but often ephemeral riffle zones but falls back to less productive large, slow-moving pools or isolated waterholes during the dry season (Cann and Saddler 2017). The white-throated snapping turtle was recorded at site R12 in March 2023 (Section 4.5.2). Species identification has been confirmed by Principal Aquatic Ecologist Chris Pietsch (Blue Earth Environmental) who has extensive experience in the capture, tagging and tracking of this species. Specifically, the taxonomic attributes that led to the identification include: an intergular shield that is narrower than the gular shields (Plate 4, Section 4.5.2), distinguishing it from the similar saw-shelled turtle (*Wollumbinia latisternum*); an iris colour that is a dull brownish olive, lacking the bright/light coloured ring in the inner iris surrounding the pupil that is characteristic of the saw-shelled turtle; and the lack of enlarged and pointed tubercles on top of the neck that is characteristic of the saw-shelled turtle in central Queensland (pers. comm. Chris Pietsch, 24 April 2023).

The Fitzroy River turtle (*R. leukops*) is believed to prefer fast-flowing water of the Fitzroy River and its tributaries (Cogger 2014), including rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles (DCCEEW 2023b), areas of higher water clarity, and is commonly associated with ribbonweed (*Vallisneria* spp.) beds (DCEEW 2023b). Preferred

habitat is unlikely to occur within the Study area but may occur downstream near the confluence of the Comet and Nogoa rivers, which form the Mackenzie River.

4.6.4 Freshwater invertebrates

No aquatic invertebrates are identified in the EPBC Act Protected Matters Report (Appendix A), or in the BoT Actions for Biodiversity for the Fitzroy NRM region (DERM 2010).

The Wetland*Info* database for the Fitzroy Basin (DES 2023a) identifies four macro-crustaceans and 25 wetland indicator insects as having previously been recorded from the Fitzroy Basin, none of which are listed in the EPBC Act or NC Act.

The ACA Expert Panel Report (riverine wetlands) for the Fitzroy sub-catchment of the GBR catchment (Rollason and Howell 2012) lists two Priority aquatic invertebrates: the spiny crayfish (*Euastacus monteithorum*) and the Eungella spiny crayfish (*E. eungella*). Due to their distributional range and high-altitude requirements, it is unlikely these species occur in the Study area (Table 14).

Table 12 EVNT and Priority fish species recorded from the desktop Search area

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
EVNT species													
Bidyanus bidyanus	Silver perch	CE	LC			Faster-flowing water, including rapids and races, and more open sections of river, throughout the Murray-Darling Basin (MDB) (Clunie and Koehn 2001, cited in DotE 2013).	**Unlikely**. Distributional range is naturally in the MDB, although translocated to coastal streams in south-east Queensland (and other states). Preferred habitat does not occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.					✓
Maccullochella peelii	Murray cod	V	LC			Deep water with in-stream habitat such as boulders, logs, and overhanging vegetation (Allen et al. 2002). From fast-moving clear upland streams to slow-flowing, turbid lowland waters. Most individuals stay within 10 km reach of the river (Pusey et al. 2004; Allen et al. 2002).	**Unlikely**. Outside of natural area of distribution (ALA 2023). Preferred habitat does not occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.					✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Pseudomugil mellis	Honey blue-eye	V	E		R& T	Found in coastal lowland wallum, inhabiting flowing and still waterbodies. Generally found in areas with little or no flow, and where emergent and submerged aquatic plants are abundant (Pusey et al. 2004).	**Unlikely**. Outside of natural area of distribution (ALA 2023). Preferred habitat does not occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.		✓			
Priority species													
Hephaestus fuliginosus	Sooty grunter		LC		✓	Found across a range of stream types from small tributaries to large lowland rivers, preferring flowing water of moderate depth, with juveniles most abundant in riffles and runs. Structural woody habitat, submerged root masses and bank undercuts are important habitat features (Pusey et al. 2004). Translocated populations in Fitzroy catchment are widely distributed (Pusey et al. 2004).	**Potential**. Previously recorded from the Comet River drainage sub-basin (DES 2023a). The Study area is outside of the natural distribution, although has been translocated into area encompassing the Study area. Preferred habitat does not occur within the Project area.	**Unlikely**. Species or species habitat not detected during field surveys.	✓	✓			✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Kuhlia rupestris	Jungle perch		LC		✓	Patchily distributed in fast-flowing streams and rivers; however, also known to occur within floodplain lagoons. Usually occurs in coastal rainforest drainages from the tip of the Cape York Peninsula south to Fraser Island (Allen et al. 2002).	**Unlikely**. Outside of natural area of distribution (ALA 2023). Preferred habitat does not occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.	✓				
Lates calcarifer	Barramundi		LC		✓	Young live in freshwater upper reaches of rivers, favouring undercut banks, submerged logs and overhanging vegetation. Adults typically found in or near estuaries, often around mangroves in clear or turbid water (Allen et al. 2002).	**Unlikely**. Outside of natural area of distribution (ALA 2023). Preferred habitat does not occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.	✓	✓			✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Macquaria ambigua	Golden perch		LC		✓	Predominantly found in lowland warmer, turbid, slow-flowing rivers, often in association with structural woody habitat and other cover. A wide-ranging species with a natural distribution throughout the Murray-Darling, Fitzroy, Lake Eyre and Bullaroo River basins (Pusey et al. 2004).	**Potential**. Natural distribution encompasses the Study area. Preferred habitat may occur within the Study area.	**Potential**. Natural distribution encompasses the Study area. Suitable habitat occurs within the Study area. Comprehensive fish surveys not undertaken.	✓				✓
Megalops cyprinoides	Oxeye herring		LC		✓	Juveniles and small adults occasionally occur within the freshwater reaches of coastal streams of Queensland; however, most commonly occurs in estuarine and marine waters (Allen et al. 2002).	**Unlikely**. Outside of normal area of distribution (ALA 2023). Preferred habitat does not occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.	✓	✓			✓
Mugil cephalus	Sea mullet		LC		✓	Found around the entire mainland coast of Australia, primarily occurring in brackish waters, although known to enter lower reaches of freshwater rivers (Allen et al. 2002).	**Unlikely**. Preferred habitat does not occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.	✓	✓			✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Ophiocara porocephala	Spangled gudgeon		LC		✓	Distributed in brackish estuaries and river mouths; however, also found in freshwater bodies at low elevations around the northern and eastern coasts of Australia (Allen et al. 2002).	**Unlikely**. Preferred habitat does not occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.	✓	✓			
Rhadinocentrus ornatus	Ornate rainbowfish		LC	H/H	✓	Coastal lowland wallum and rainforest ecosystems; often in association with dense emergent and submerged vegetation / woody debris, leaf litter and undercut banks (Allen et al. 2002).	**Unlikely**. Preferred habitat does not occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.				✓	✓
Scleropages leichardti	Southern saratoga		LC		✓	Billabongs or large pools in slow-flowing streams, usually in turbid conditions. Often associated with abundant large in-stream wood, undercut banks and overhanging vegetation. Endemic to the Fitzroy River basin (Allen et al. 2002).	**Potential**. Natural distribution encompasses the Study area. Preferred habitat may occur within the Study area.	**Potential**. Natural distribution encompasses the Study area. Suitable habitat occurs within the Study area. Comprehensive fish surveys not undertaken.	✓	✓			✓

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Scortum hillii	Leathery grunter		LC		✓	Endemic to the Fitzroy River where it occurs in flowing freshwater streams and still pools. Most common in lower reaches of larger rivers and estuaries (Allen et al. 2002).	**Potential**. Natural distribution encompasses the Study area. Preferred habitat may occur within the Study area.	**Potential**. Natural distribution encompasses the Study area. Suitable habitat occurs within the Study area. Comprehensive fish surveys not undertaken.	✓	✓			✓
Strongylura krefftii	Freshwater longtom		LC		✓	Variety of habitats, including floodplain lagoons, main channels of rivers, sandy bed creeks and perennial escarpment streams (Pusey et al. 2004).	**Potential**. Natural distribution encompasses the Study area. Preferred habitat may occur within the Study area.	**Potential**. Natural distribution encompasses the Study area. Suitable habitat occurs within the Study area. Comprehensive fish surveys not undertaken.	✓	✓			✓
Trachystoma petardi	Pinkeye mullet		LC		✓	Deep, gently flowing rivers; as well as estuaries and coastal seas on the east coast of Australia (Allen et al. 2002).	**Unlikely**. Preferred habitat does not occur within the Study area.	**Unlikely**. Species or species habitat not detected during field surveys.	✓	✓			✓

Notes:

E = Endangered, V = Vulnerable, LC = Least Concern, C = Critical priority, H = High Priority, M = Medium Priority, P = Priority, R&T = Rare and Threatened.

1. EPBC Act = status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
2. NC Act = status under the Queensland *Nature Conservation Act 1992*.
3. Back on Track = status under the DERM (2010) Fitzroy Natural Resource Management Region – Back on Track Actions for Biodiversity.
4. ACA = status under the Aquatic Conservation Assessments using AquaBAMM for riverine and non-riverine wetlands of the Great Barrier Reef catchments (Inglis and Howell 2009; Rollason and Howell 2012).

Table 13 EVNT and Priority freshwater turtles recorded from the desktop Search area

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Rheodytes leukops	Fitzroy River turtle	V	V	H/ H	R& T	Fast-flowing water of the Fitzroy River and its tributaries (Cogger 2014). Rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles (DCCEEW 2023b). Preferred areas have high water clarity and are often associated with ribbonweed (*Vallisneria* spp.) beds (DCCEEW 2023b).	**Unlikely**. Species or species habitat 'likely' to occur within broader Search area (DCCEEW 2023a). Preferred habitat unlikely to occur within the Study area. ALA (2023) indicates the nearest record being in the vicinity of the Comet and Mackenzie rivers near Comet (although with 10 km coordinate uncertainty).	**Unlikely**. Species or species habitat not detected during field surveys.	✓		✓	✓	✓
Elseya albagula	White-throated snapping turtle (also known as the southern snapping turtle)	CE	CR	H/ H	P	Stream reaches with permanent water in the Fitzroy, Mary and Burnett catchments (DAWE 2020). In the Fitzroy River catchment it uses the productive but often ephemeral riffle zones, but falls back to less productive large slow moving pools or isolated waterholes during the dry season (Cann and Saddler 2017).	**Potential**. Species or species habitat 'likely' to occur within the broader Search area (DCCEEW 2023a). Preferred habitat likely occurs within the Study area. ALA (2023) indicates records well upstream (Carnarvon Creek up in the gorge country) and well downstream of the Study area (Mackenzie River near Comet), with a lack of records in-between.	**Known**. Two males captured from site R12 in March 2023.	✓			✓	✓

Notes:
CE/CR = Critically Endangered, E = Endangered, V = Vulnerable, LC = Least Concern, C = Critical Priority, H = High Priority, M = Medium Priority, P = Priority, R&T = Rare and Threatened, Mi = Migratory.

1. EPBC Act = status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
2. NC Act = status under the Queensland *Nature Conservation Act 1992*.
3. Back on Track = status under the DERM (2010) Fitzroy Natural Resource Management Region – Back on Track Actions for Biodiversity.
4. ACA = status under the Aquatic Conservation Assessments using AquaBAMM for riverine and non-riverine wetlands of the Great Barrier Reef catchments (Inglis and Howell 2009; Rollason and Howell 2012).

Table 14 Priority invertebrate species recorded from the desktop Search area

Scientific name	Common name	Status				Preferred habitat	Likelihood of occurrence within the Study area based on desktop	Likelihood of occurrence within the Study area post seasonal field surveys	Data Source				
		EPBC Act[1]	NC Act[2]	Back on Track[3]	ACA[4]				I & H 2009	R & H 2012	DCCEEW 2023a	DERM 2010	DES 2023a
Euastacus eungella	Eungella spiny crayfish		LC		P	Only a small population restricted to localities >740 m above sea level in tropical rainforest headwaters and seepages in the Clarke Range, 65km west of Mackay (Coughran and Furse 2010).	**Unlikely**. Outside of known distributional range.	**Unlikely**. Species or species habitat not detected during field surveys.		✓			
Euastacus monteithorum	Monteith's spiny crayfish		LC		P	Cool, clear, fast-flowing headwaters in rainforest areas at >800 m above sea level. Prefers heavily shaded, well oxygenated waters where it can burrow under logs and rocks. Known from only one location: Kroombit Tops National Park, 62 km south-west of Gladstone (Coughran and Furse 2010).	**Unlikely**. Outside of known distributional range.	**Unlikely**. Species or species habitat not detected during field surveys.		✓			

Notes:

CE/CR = Critically Endangered, E = Endangered, V = Vulnerable, LC = Least Concern, C = Critical Priority, H = High Priority, M = Medium Priority, P = Priority, R&T = Rare and Threatened, Mi = Migratory.

1. EPBC Act = status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
2. NC Act = status under the Queensland *Nature Conservation Act 1992*.
3. Back on Track = status under the DERM (2010) Fitzroy Natural Resource Management Region – Back on Track Actions for Biodiversity.
4. ACA = status under the Aquatic Conservation Assessments using AquaBAMM for riverine and non-riverine wetlands of the Great Barrier Reef catchments (Inglis and Howell 2009; Rollason and Howell 2012).

4.7 Introduced species

4.7.1 Introduced aquatic flora

There are 23 introduced wetland indicator plant species known from the Fitzroy Basin (DES 2023a). Of these, only two were recorded in the Project area: awnless barnyard grass (*Echinochloa colona*) and white eclipta (*Eclipta prostrata*). Those invasive species considered to pose a particular threat to aquatic biodiversity, and that could potentially occur within the Project area, are identified as either Weeds of National Significance (WoNS) (Weeds Australia 2021) or a Restricted matter category 3 under the Queensland *Biosecurity Act 2014* (Table 15). No WoNS or restricted weeds were detected in the Project area.

Table 15 Introduced wetland indicator plants known to occur from the broader Fitzroy Basin, and potentially in the Project area

Scientific name	Common name	National status^	Biosecurity Act status*
Arundo donax	-		
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**		
Eichhornia crassipes	water hyacinth	WoNS	Restricted 3
Eleocharis minuta	-		
Hymenachne amplexicaulis 'Olive'	Olive hymenachne	WoNS	Restricted 3
Juncus bufonius	Toad rush		
Nymphaea caerulea	Cape waterlily		
Paspalum distichum	Water couch		
Paspalum vaginatum	Saltwater couch		
Pistia stratiotes	Water lettuce		Restricted 3
Polypogon monspeliensis	annual beardgrass		
Rorippa nasturtium-aquaticum	Watercress		
Salix babylonica	Weeping willow		
Salvinia molesta	Salvinia	WoNS	Restricted 3
Sparganium erect68ubsp.bsp. *stoloniferum*	Erect bur-reed		
Stenotaphrum secundatum	Buffalo grass		
Urochloa mutica	Para grass		

Notes: ^ Species listed as WoNS; * species listed under the Queensland *Biosecurity Act 2014*; * **Bold text** indicates species detected during field surveys.

4.7.2 Pest fish species

Six introduced fish species have been recorded from the Fitzroy Basin: mosquitofish (*Gambusia holbrooki*), guppy (*Poecilia reticulata*), goldfish (*Carassius auratus*), European carp (*Cyprinus carpio*), Mozambique mouthbrooder / tilapia (*Oreochromis mossambicus*) and platy (*Xiphophorus maculatus*) (DES 2023a). None of these are known from the Comet River drainage sub-basin (DES 2023a).

4.7.3 Introduced aquatic reptiles

No introduced aquatic reptile species were recorded during the surveys and none were identified from the desktop review as having potential to occur in the Study area.

4.8 Groundwater-dependent ecosystems

The EPBC Act lists 'a water resource, in relation to coal seam gas development and large coal mining development', as an MNES. A water resource is defined under the Commonwealth *Water Act 2007* and incorporates ecosystems that contribute to the physical state and environmental value of the water resource. As such, environmental assessments for CSG development are required to identify potential GDEs and assess and manage potential impacts to GDEs (Independent Expert Scientific Committee [IESC] 2018).

GDEs are ecosystems that rely on groundwater for their continued existence. They may be 100% dependent on groundwater, such as aquifer GDEs, or may access groundwater intermittently to supplement their water requirements, such as riparian tree species in arid and semi-arid areas (IESC 2018).

GDEs can be classified into three broad types:

- aquifer and cave ecosystems (subterranean GDEs);
- ecosystems dependent on the surface expression of groundwater (surface expression GDEs, including river baseflow systems, springs and swamps); and
- ecosystems dependent on the subsurface presence of groundwater (terrestrial GDEs, including some riparian vegetation communities).

Consideration of subterranean and terrestrial GDEs was excluded from the scope of work. Surface expression GDEs are discussed further below.

4.8.1 Surface expression GDEs

Desktop mapping of potential GDEs throughout Queensland (DES 2023c) shows no 'known' surface expression GDEs within the Study area. A number of 'derived' surface expression GDEs of moderate confidence level are identified for the Study area in the State mapping (DES 2023c), based on expert knowledge of the landscape and available spatial datasets, but without field verification. State-mapped surface expression GDEs for the Study area includes (Figure 13):

- 'Moderate confidence' derived surface expression GDE areas (site HES2, Plate 5) – being a State-mapped palustrine wetland waterbody 'within 50 m of the edge of basalt plains and hills (100 ha or more) with fresh, intermittent flow' (DES 2023c), but field verified as non-remnant and unlikely to have previously been a wetland RE or wetland waterbody; and
- 'Moderate confidence' derived surface expression GDE lines (sites R1, R2, R7 and R13, Plate 5) – being State-mapped first and second order streams comprising 'channels on or within 100 m of basalt plains and hills (100 ha or more) with fresh, intermittent flow' (DES 2023c).

Although surface water was encountered in both the August 2022 and March 2023 field surveys, water sampling (for measurement of conductivity and analysis of ionic compositions) and aquatic flora inventory assisted in differentiating between those aquatic ecosystems dependent on surface water runoff and those potentially dependent on the surface expression of groundwater.

Field verification at sites HES2, R1, R2, R7 and R13 (Plate 5) found no evidence of groundwater expressions, salt seeps, hydrophytes or other on-ground indicators of being a GDE (Appendix B). The health, apparent moisture levels and extent of riparian vegetation was consistent with other waterways of the Study area not mapped as potential surface expression GDEs.

No surface GDEs were encountered within the Project area, nor are they considered likely to occur. A field verified surface expression GDE figure is presented as Figure 14.

Site HES2 – looking west/downstream,17/08/2022

Site HES2 – aerial/drone photo from 120 mAGL

Site R1 – looking downstream, 15/08/2022

Site R2 – looking upstream, 16/08/2022

Site R7 – looking upstream, 16/08/2022

Site R13 – looking upstream, 16/03/2023

Plate 5 State-mapped moderate confidence surface expression GDEs in the Study area

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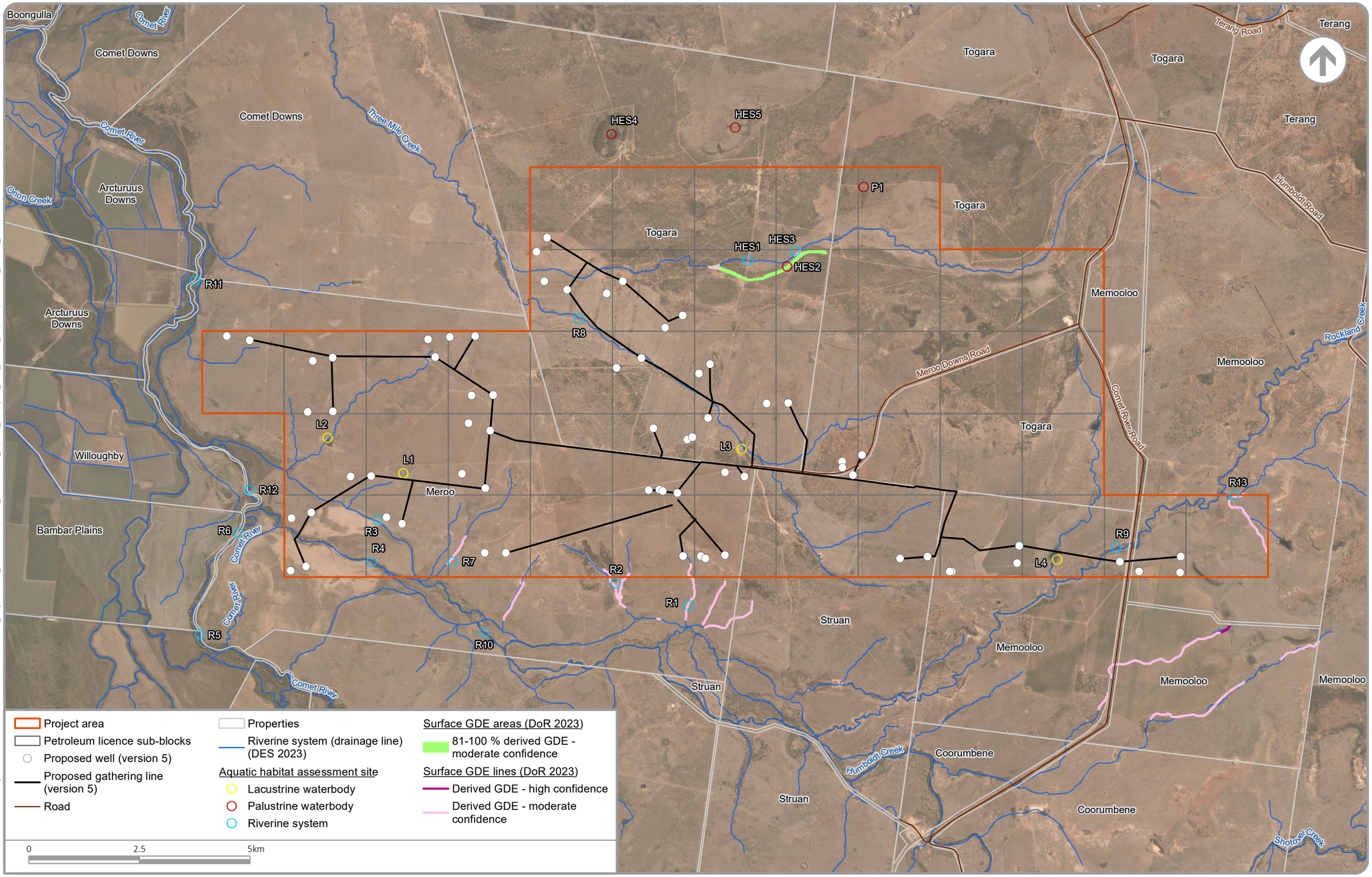

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STATE-MAPPED SURFACE EXPRESSION GROUNDWATER-DEPENDENT ECOSYSTEMS

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

FIGURE 13

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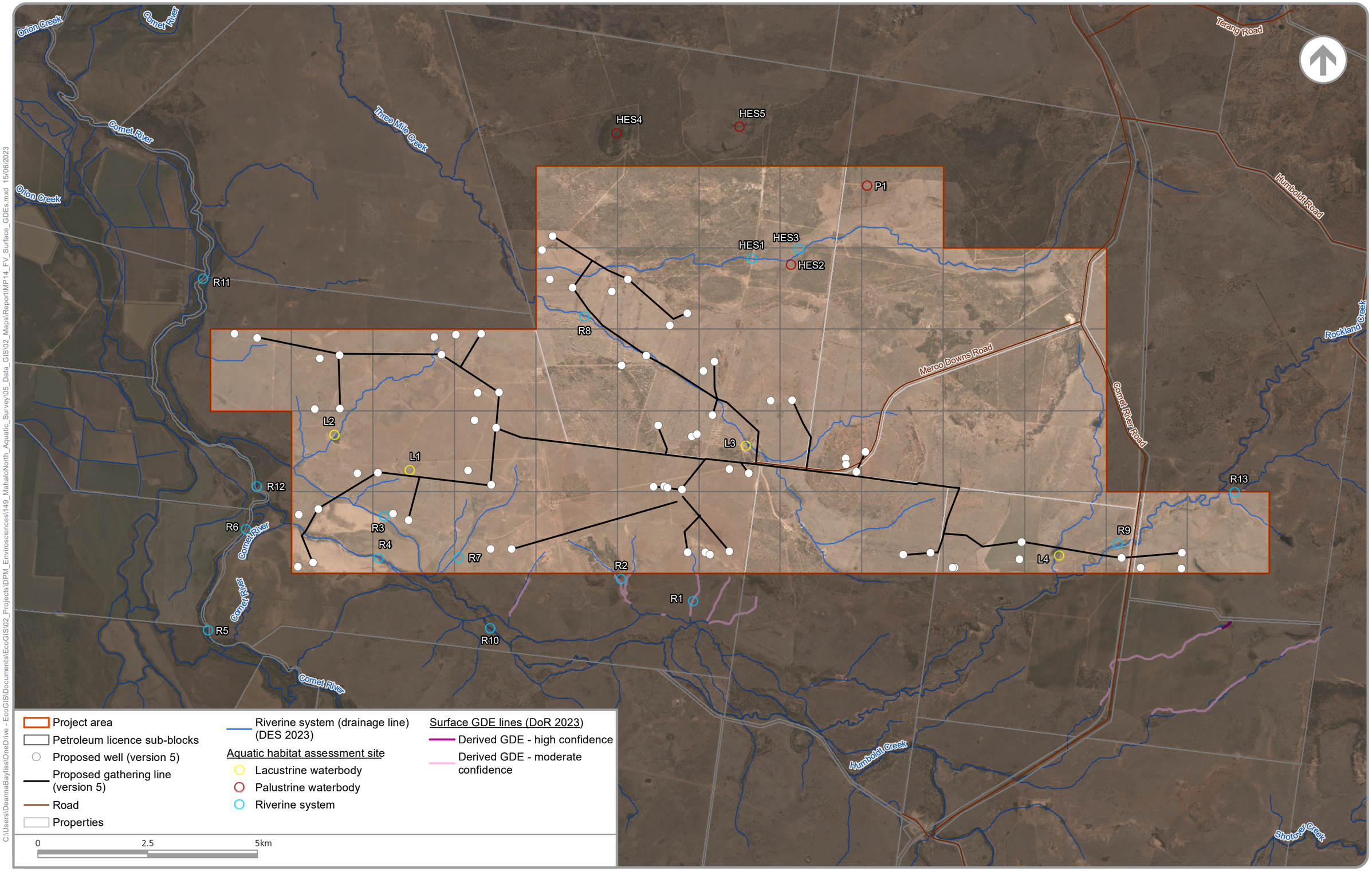

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DPM ENVIROSCIENCES

VERIFIED SURFACE EXPRESSION GROUNDWATER-DEPENDENT ECOSYSTEMS

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

FIGURE 14

4.9 Matters of National Environmental Significance

4.9.1 World and National Heritage properties

No World Heritage Properties or National Heritage Places are identified for the Search area in the EPBC Act Protected Matters Report (DCCEEW 2023a, Appendix A).

4.9.2 Wetlands of International Importance

No wetlands of International Importance are identified within the Search area in the EPBC Act Protected Matters Report (DCCEEW 2023a). Wetlands of International Importance nearest to the Project area include those of the Shoalwater and Corio Bays Area, approximately 230 km (direct line) to the north-east. These wetlands are well removed from the Project area and are hydraulically connected only by the Coral Sea.

4.9.3 Threatened Ecological Communities

No EPBC Act listed Threatened Ecological Communities (TECs), relevant to aquatic ecology, are identified from the Search area (DCCEEW 2023a). No aquatic TECs are expected to occur within the Project area.

4.9.4 Threatened species

No MNES aquatic flora species are likely to occur within the Project area. No MNES aquatic flora species were detected during seasonal field surveys.

Two aquatic fauna species that are MNES are identified as 'likely' to occur in the broader desktop Search area encompassing the Study area (DCCEEW 2023a). This includes the Critically Endangered white-throated snapping turtle (*Elseya albagula*) and the Vulnerable Fitzroy River turtle (*Rheodytes leukops*), each listed under the EPBC Act.

The white-throated snapping turtle was identified from the Study area at site R12 on the Comet River. The Project area itself is unlikely to provide suitable habitat for the white-throated snapping turtle. However, the occurrence of this species in nearby downstream receiving waters highlights the importance of protecting downstream habitats from the potential for sedimentation and water quality impacts associated with the Project. Potential impacts are discussed in Section 5 and corresponding impact mitigation measures are presented in Section 6. By implementing the impact mitigation measures presented in Section 6, Project impacts on downstream habitats, including habitat of the white-throated snapping turtle, are unlikely.

Due to habitat requirements, it is unlikely that the Fitzroy River turtle occurs within the Study area as either resident or transient occurrences. Suitable habitat for the Fitzroy River turtle was not encountered within the Study area.

4.9.5 Migratory species

No aquatic migratory species (i.e. migratory species that live in water for most or all their lives) are identified from the Search area.

4.9.6 Commonwealth Marine Areas

The Project area is located approximately 270 km west (direct line) of any marine area and is separated hydraulically by at least two sub-catchments (Mackenzie River and Fitzroy River) with varying land use and water quality.

4.9.7 Nuclear actions (including uranium mines)

The Project does not involve any nuclear actions.

4.9.8 Water resource

A water resource, in relation to CSG development and large coal mining development, is expected to be indicated as a controlling provision in the referral decision notice for the Project.

Seasonal field surveys demonstrate that it is unlikely that any surface expression GDEs occur within or adjoining the Project area. Consequently, the assessment and management of potential impacts on surface expression GDEs is not triggered by this assessment.

Consideration of subterranean and terrestrial GDEs is excluded from the scope of work.

4.10 Matters of State Environmental Significance

The environmental offsets framework in Queensland includes the *Environmental Offsets Act 2014* (EO Act), the Environmental Offsets Regulation 2014 (EO Regulation) and the Queensland Environmental Offsets Policy (EO Policy).

A number of MSES were identified during the desktop review as occurring within the Project area. Potential MSES of relevance to this aquatic ecology assessment comprise State-mapped 'wetlands of High Ecological Significance' (HES wetlands) and 'waterways providing for fish passage' (Table 16).

One State-mapped HES wetland occurs within the Project area. Although the State mapping is inaccurate (the surveyed portion of the wetland polygon is not a wetland; Section 4.3.3), the Proponent does not intend to challenge the State mapping; instead opting to avoid the State-mapped HES wetland polygon altogether. High impact petroleum activities would not occur within 200 m of the mapped HES wetland, consistent with Condition 'water 3' of the Streamlined model conditions for petroleum activities (DES 2016). Consequently, impacts on HES wetlands are not anticipated.

A 'waterway providing for fish passage' is only an MSES if a waterway barrier work is proposed that would limit the passage of fish along a waterway (Section 4.1.3).

Figure 15 presents the potential aquatic MSES mapping for the Project area.

Table 16 Matters of State Environmental Significance located in the Project area

Prescribed Environmental Matter	Present in the Project area	Detail
Regulated vegetation	-	Refer to terrestrial ecology assessment for the Project.
Connectivity areas	-	Refer to terrestrial ecology assessment for the Project.
Wetlands and watercourses	Yes	No High Ecological Value waters or High Ecological Value watercourses occur within the Project area. The Project area contains one State-mapped HES wetland, although the Proponent would avoid the HES wetland (Section 5.1.2).
Protected Wildlife Habitat	-	Refer to terrestrial ecology assessment for the Project.
Koala Habitat in South-East Queensland	-	The Project area is not located in South-east Queensland.
Protected Areas	-	No Protected Areas occur within the Project area.
Fish Habitat Areas and Highly Protected Zones of State Marine Parks	-	The Project area is not located in a State Marine Park.
Waterway providing for fish passage	Yes	Waterways within the Project area provide for fish passage (Figure 15; Section 5.7.3).
Marine Plants	-	The Project area is not located in a marine environment.
Secured Offset Area	-	Refer to terrestrial ecology assessment for the Project.

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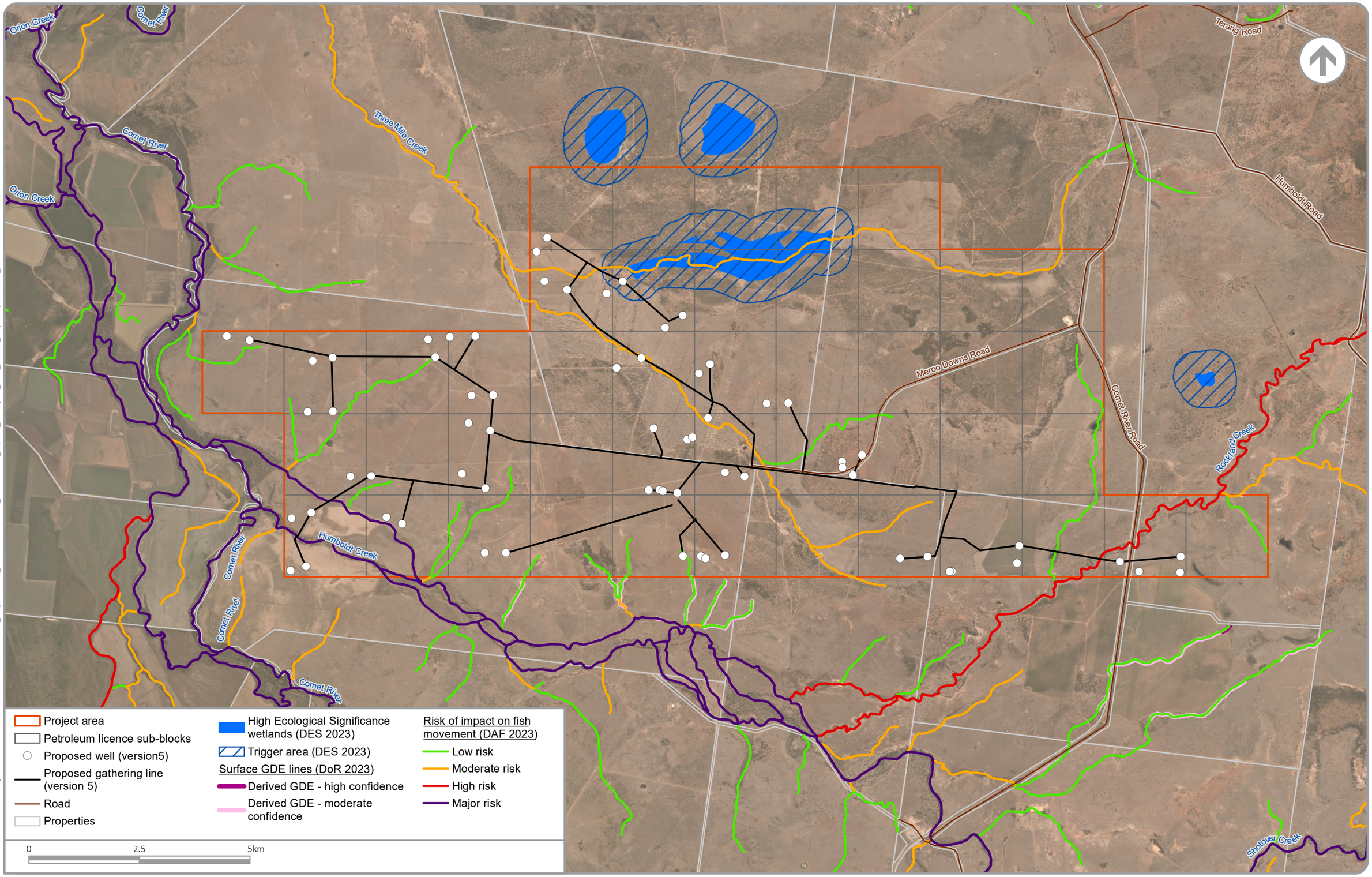

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DPM ENVIROSCIENCES

AQUATIC MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE

Mahalo North Coal Seam Gas Project – Aquatic Values Assessment

FIGURE 15

5 POTENTIAL IMPACTS

5.1 Aquatic habitat

5.1.1 General description

The proposed construction of gathering lines and associated access tracks for the Project would result in minor modification of aquatic habitat at the location of proposed crossings. These habitats comprise waterways with ephemeral to episodic flow, and one semi-permanent lacustrine wetland waterbody (farm dam). Aquatic habitats of the Project area are not expected to support aquatic species of conservation-significance listed under the NC Act or EPBC Act, given the lack of suitable habitat features (Section 4.6).

5.1.2 HES wetland buffer

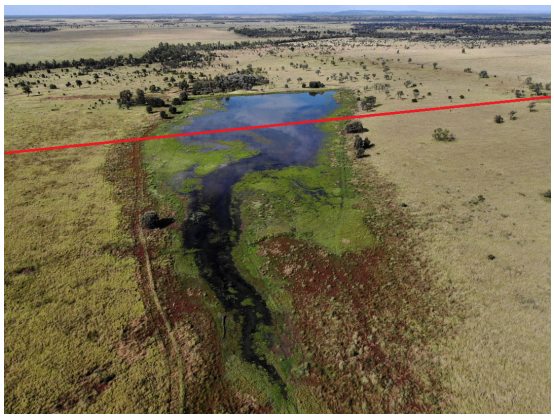
One State-mapped HES wetland occurs within the Project area. Although the State mapping is inaccurate (the surveyed portion of the wetland polygon is not a wetland; Section 4.3.3), the Proponent does not intend to challenge the State mapping; instead opting to avoid the State-mapped HES wetland polygon altogether.

High impact petroleum activities would not occur within 200 m of the mapped HES wetland, consistent with Condition 'water 3' of the Streamlined model conditions for petroleum activities (DES 2016). Consequently, impacts on HES wetlands are not anticipated.

5.1.3 Crossings of waterways and other wetlands

No wells (or infrastructure other than linear infrastructure) would be positioned within any wetland or waterway. A number of waterways would be intersected by linear infrastructure, including gathering lines and access tracks (Figure 15). One lacustrine wetland waterbody (farm dam, site L4) is intersected by a proposed gathering line and access track (Plate 6; Figure 15). This waterbody is allocated a Low aquatic value in accordance with the adopted criteria (Section 3.5.8) and there are no strict regulatory constraints that would inhibit the placement of linear infrastructure through this waterbody. However, the Proponent will relocate both the gas gathering and access track to avoid this waterbody during the detailed design phase.

Site L4 – looking downstream



Site L4 – looking downstream, showing V4 access track/gathering line alignment (red line)

Plate 6 Lacustrine wetland waterbody (farm dam) site L4, 13 March 2023

The construction of gathering lines and associated access tracks would result in the removal of aquatic habitat and riparian vegetation from the bed and banks of waterways. The waterway

crossings would comprise bed level or culvert crossings for vehicles. Gathering lines would be trenched and the pipes placed beneath the stream bed. The construction right-of-way would be up to 18 m wide and reduced to 6 m wide through waterways.

The placement of gathering lines through waterways would utilise either under-boring techniques, or open trench and backfill during times of no/low flow. The Proponent will consider cost, geotechnical and other environmental (including forecast weather) considerations in deciding which technique to employ at each crossing. The construction of each waterway crossing is expected to take in the order of one week.

Under-boring utilises trench-less techniques, such as horizontal directional drilling, which involves the use of a self-propelled drilling machine, excavator, drilling mud plant, and extraction of a small amount of water from the stream or a water tank. Catch pits are excavated on either side of the waterway at the beginning and end of the borehole to capture drilling mud returns. Open trench crossings require clearing of vegetation, soil, rock and any large woody debris, the installation of temporary coffer dams if required, the use of a flume pipe or diesel pump and hoses to convey water through the construction area where necessary, as well as excavation and reinstatement of the bed and bank. The soil or sediment removed from the trench would be stockpiled and either used for backfilling or disposed of.

Construction activities that involve disturbance of the stream bed and banks have the potential to impact:

- channel morphology, hydraulic characteristics, and aquatic habitat within, upstream of, and downstream of, the construction area;
- water quality, due to erosion and sedimentation leading to locally increased dissolved and suspended solids, turbidity, nutrients and contaminants, and reduced dissolved oxygen levels;
- water quality, due to accidental release of drilling fluids from under-boring;
- aquatic and riparian ecological health and community assemblages, associated with the modification of habitat and changes in water quality;
- fish passage, albeit temporary and with impacts likely limited to resilient species well adapted to highly ephemeral systems; and
- the behaviour of aquatic biota (including avoidance response, and reduced foraging) and physiology (including gill damage to fish) associated with increased suspended sediment concentrations and deposition.

These impacts would be localised, transient, and avoid areas of High aquatic value. Further, species inhabiting the waterways of the Project area are already subject to high sediment loads periodically during flow events as evidenced by high washloads (fine sediments held in suspension) observed during both the wet and dry season surveys (Section 4.2.2). Impact mitigation measures are discussed in Section 6.

5.2 Aquatic flora

LC and SLC aquatic flora would be impacted by a loss of habitat required for the construction of gathering lines and access tracks. No conservation significant (EPBC Act or NC Act) aquatic flora species are likely to be impacted.

5.3 Aquatic fauna

Aquatic fauna present within the Project area would be impacted by a loss of habitat as discussed in Section 5.1. In the absence of suitable mitigation measures, the Project has potential to impact on water quality and sedimentation of downstream environments including the Comet River and associated habitat for EVNT species such as the white-throated snapping turtle. However, with

implementation of suitable sediment and erosion controls (Sections 6.2 and 6.3) and water management (Sections 6.2 and 6.3) within the Project area, impacts on downstream environments are unlikely. Consequently, significant impacts on the white-throated snapping turtle are unlikely.

5.3.1 Fish passage

Poorly designed waterway crossings can create a barrier to fish passage, restricting and/or isolating fish communities and preventing access to fish habitats otherwise available to them. Poorly designed structures can kill or otherwise injure fish moving over or around them or can cause fish to become stranded and subjected to poor water quality, lack of food, increased predation, crowding or other conditions can that impact on their health, wellbeing, and productivity.

The Project requires a number of crossings of waterways, which each create the potential for barriers to fish passage. However, the Project is unlikely to have a significant impact on Waterways Providing for Fish Passage given any crossing on a mapped waterway will be undertaken either via under-boring, or open trench and backfill during times of no/low flow, and that waterway crossings would be constructed in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF 2018).

The detailed design and construction of each waterway crossing should entail an assessment against DAF (2018), which is beyond the scope of this aquatic ecology assessment.

5.4 Surface water

Surface water flows and quality are relevant to the health and productivity of aquatic ecosystems. A CSG Water Management Plan will be prepared for the Project and that plan will allow for all produced water to be used for stock watering, irrigation, drilling or rehabilitation. No produced water will be released offsite to surface water.

5.4.1 Erosion and sedimentation

Construction of waterway crossings for gathering lines and access tracks temporarily elevates the risk of mobilising soils and sediments. Trench excavation for the placement of gathering lines requires soils/sediments to be temporarily excavated, with the generally more productive topsoils and less productive and more erodible subsoils segregated and stockpiled separately. Following pipe placement, a portion of the subsoil is reinstated, excess subsoil is disposed of, and all topsoil is reinstated. Areas of exposed soils, including open trenches and temporary soil stockpiles/windrows, are at higher risk of being mobilised by air or water.

A ’best practice’ Erosion and Sediment Control Plan would be developed and implemented throughout Project construction, consistent with the International Erosion Control Association (IECA) recommendations (Section 6). If implemented effectively, environmental risks to water quality from disturbed area runoff are expected to be low.

5.4.2 Leaks and spills

Leaks or spills of hydrocarbon-based fluids from construction equipment represents a potential risk to aquatic habitat downstream of the Project. However, there is a low risk of leaks and spills occurring given the implementation of suitable management measures, including implementation of a spill response and appropriate water management system (Section 6). As such, the Project is unlikely to result in leaks/spills that would eventuate in serious environmental harm to aquatic species or their habitats.

5.5 Cumulative impacts

The Project is located within the Comet River sub-catchment of the greater Fitzroy Basin. The major rivers and tributaries of the Fitzroy catchment include the Fitzroy, Dawson, Nogoa, Comet, Isaac and Mackenzie Rivers.

Humboldt Creek is the main waterway intercepting the Project area and flows in a west-north-west direction and into the Comet River approximately 800 m downstream of the Project area. The Humboldt Creek catchment includes the southern extent of the Blackwater Coal Mine. The Rolleston Coal Mine and the township of Rolleston occur in the broader Comet River catchment upstream of the Study area.

The site water management system would be designed such that the risk of off-site uncontrolled release of Project affected water during both construction and operation is very low and sediment inputs can be controlled through drainage, and erosion and sediment control measures. On this basis, the Project is not expected to make any significant contribution to water quality degradation or cumulative sediment loads in the Fitzroy River Basin.

The Project will not be releasing any CSG produced water into the receiving environment and any overland flows affected by construction would be managed in accordance with best practice erosion and sediment control. Consequently, the Project is expected to have negligible cumulative impact on surface water quality and associated aquatic habitat values.

The Project is unlikely to result in a significant cumulative impact to the aquatic ecosystems of the Comet River system, given the limited potential impacts associated with the Project and the implementation of mitigation and management measures described in Section 6.

5.6 Summary of impacts on MNES

5.6.1 Fauna species

There were no MNES related to aquatic ecology recorded within the Project area. The Critically Endangered white-throated snapping turtle (*Elseya albagula*) was recorded downstream in the Comet River (at site R12) adjoining the Project area. Potential impacts of the Project on the white-throated snapping turtle relate to impacts on water flows, water quality and sedimentation.

The Project is not proposing to contain any surface water flows and will maintain as far as possible all overland flow paths. There will be no/negligible impact on flows in the Comet River. In terms of water quality, the project will not be releasing any CSG produced water into the receiving environment and any overland flows affected by construction will be managed in accordance with best practice erosion and sediment control. Consequently, the Project is unlikely to have a significant impact on downstream receiving waters, including habitat for the MNES white-throated snapping turtle.

5.6.2 Groundwater-dependent ecosystems

The EPBC Act lists ‘a water resource, in relation to coal seam gas development and large coal mining development’, as an MNES. A water resource is defined under the Commonwealth *Water Act 2007* and incorporates ecosystems that contribute to the physical state and environmental value of the water resource. As such, GDEs form part of the water resource.

Surface expression GDEs were considered as part of this assessment. Consideration of subterranean and terrestrial GDEs was excluded from the scope of work.

Seasonal field surveys were undertaken to field verify State-mapped ‘derived’ surface expression GDEs of moderate confidence (DES 2023c). No surface GDEs were encountered within the Project area, nor are they considered likely to occur. The Project is unlikely to result in significant

impacts on surface expression GDEs as no surface expression GDEs are likely to occur within the Project area or broader Study area.

5.7 Summary of impacts on MSES

The *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (DEHP 2014) is used to determine if a prescribed activity would have a significant residual impact on MSES. A significant residual impact is defined as an adverse impact, whether direct or indirect, of a prescribed activity on all or part of a prescribed environmental matter that:

a) remains, or will or is likely to remain (whether temporarily or permanently), despite on-site avoidance and mitigation measures for the prescribed activity; and

b) is, or will or is likely to be significant.

There are two MSES relevant to aquatic ecology that are known to occur in the Project area that may be subject to impacts from the Project, comprising:

- HES Wetlands; and
- Waterways Providing for Fish Passage.

Potential impacts on these MSES are discussed below.

5.7.2 HES wetlands

One State-mapped HES wetland occurs within the Project area. High impact petroleum activities would not occur within 200 m of the mapped HES wetland, consistent with Condition 'water 3' of the Streamlined model conditions for petroleum activities (DES 2016).

5.7.3 Waterways providing for fish passage

As described in Section 5.3.1, pipeline crossings on a mapped waterway would be undertaken either via under-boring, or open trench and backfill during times of no/low flow. Vehicle crossings of waterways would be constructed in accordance with the *Accepted Development Requirements for Operational Work that is Constructing or Raising Waterway Barrier Works* (DAF 2018) using bed level or culvert crossings to facilitate crossing during low flow events, enabling fish passage to be maintained within/through the Project area. In the unlikely instance that waterway crossings cannot meet the DAF (2018) design criteria, alternative waterway crossings would be designed in consultation and agreement with DAF. Any culvert crossings would be designed to be inundated during moderate to high flow events, allowing for fish passage above and around the structure.

An assessment of the potential impacts on this MSES, in accordance with the *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (DEHP 2014) is provided in Table 17.

In summary, it is concluded that the Project is unlikely to have a significant impact on Waterways Providing for Fish Passage given waterway crossings would either be constructed in accordance with the *Accepted Development Requirements for Operational Work that is Constructing or Raising Waterway Barrier Works* (DAF 2018), or otherwise in consultation and agreement with DAF, so as not to create a barrier to fish movement.

Table 17 Waterways Providing for Fish Passage Significant Residual Impact Assessment

Criteria	Assessment / consideration
An action is likely to have a significant impact on a waterway providing fish passage if there is a real possibility that the action will:	
Result in the mortality or injury of fish	The Project is unlikely to result in barriers that cause the mortality or injury of native fish because waterway crossings would be constructed in accordance with the *Accepted Development Requirements for Operational Work that is Constructing or Raising Waterway Barrier Works* (DAF 2018), or in consultation and agreement with DAF, so as not to create a barrier to fish movement.
Result in conditions that substantially increase risks to the health, wellbeing and productivity of fish seeking passage such as through the depletion of fishes energy reserves, stranding, increased predation risks, entrapment or confined schooling behaviour in fish.	The Project is unlikely to result in conditions that would substantially increase risks to the health, wellbeing and productivity of fish seeking passage because waterway crossings would be constructed so as not to create a barrier to fish movement.
Reduce the extent, frequency or duration of fish passage previously found at a site.	The Project is not proposing to contain any surface flows and will maintain as far as possible all overland flow paths. The Project will only increase the area of hardstand by a minimal fraction of the total petroleum lease area (<0.1% increase). Therefore the project is anticipated to have a negligible measurable impact on the extent, frequency and duration of flows encountered in waterways within and surrounding the Project area. Further, the Project is unlikely to reduce the extent, frequency or duration of fish passage previously found within the Project area because waterway crossings would be constructed in accordance with the *Accepted Development Requirements for Operational Work that is Constructing or Raising Waterway Barrier Works* (DAF 2018), or in consultation and agreement with DAF, to maintain the extent, frequency and duration of fish movement.
Substantially modify, destroy or fragment areas of fish habitat (including, but not limited to in-stream vegetation, snags and woody debris, substrate, bank or riffle formations) necessary for the breeding and/or survival of fish.	The waterways of the Project area are not known to constitute any rare, unique, or particularly important habitats or features essential for the breeding and/or survival of the native fish species known to utilise this area. Several waterways mapped as being at Low or Moderate risk of adverse impact on fish movement would be temporarily impacted by the construction of vehicle access tracks and/or gathering lines (Section 5.1.3; Figure 15). However, these waterways are of low stream order (1 or 2), are highly ephemeral, and are not considered to constitute, nor provide a conduit to, fish habitat areas essential for the breeding and/or survival of native fish. Vehicle access tracks and/or gathering lines are proposed to cross at one location on Rockland Creek (mapped High risk), one location on Humboldt Creek (mapped Major risk), and one location on the Humboldt Creek flood channel (mapped Major risk, but field verified as Low to no risk). The standard 18 m wide right-of-way

Criteria	Assessment / consideration
	would be reduced to 6 m wide at all waterways crossings. These minor impact footprints are unlikely to be considered substantial modification, destruction or fragmentation of fish habitats.
Result in a substantial and measurable change in the hydrological regime of the waterway, for example, a substantial change to the volume, depth, timing, duration and frequency of flows.	Any crossing on a mapped waterway will be undertaken via under-boring (i.e. horizontal directional drilling) or open trench and backfill (during times of no/low flow). Either construction method will not result in a measurable change to the hydrological regime of the waterways within and surrounding the Project area. The volume, depth, timing, duration and frequency of flows would continue to reflect the ephemeral and variable flow nature of the waterways of the Project area. The Project is considered unlikely to result in a substantial and measurable change in the hydrological regime of these waterways, and the seasonality of fish movements is unlikely to be affected.
Lead to significant changes in water quality parameters such as temperature, dissolved oxygen, pH and conductivity that provide cues to movement in local fish species.	The Project is unlikely to lead to an abrupt or otherwise significant change in water quality parameters that would be expected to cue local fish movement. The Project will not be releasing any CSG produced water into the receiving environment and any overland flows affected by construction would be managed in accordance with best practice erosion and sediment control. The risk of deteriorating water quality would be mitigated by monitoring and maintaining receiving environment water quality in accordance with the EA Conditions (once granted).

6 MITIGATION MEASURES

Consistent with the management hierarchy applied by DES, the mitigation strategy for the Project has focused on a hierarchy of:

1. avoidance;
2. minimisation;
3. mitigation; then
4. offset residual impacts.

The avoidance or minimisation of adverse impacts is most relevant to the design phase of the Project, where information collected through desktop analysis and field surveys can be incorporated into the planning and preliminary engineering work (Section 6.1). Mitigation of impacts and the implementation of monitoring and management plans are most relevant to the construction and operational phases of the Project. Table 18 provides a summary of the mitigation measures for the Project, with a brief description of potential impacts and measures that can be implemented for the Project.

Residual impacts, after the implementation of mitigation measures, may be required to be offset. However, no offset requirements relevant to aquatic ecology are anticipated.

6.1 Measures to avoid and minimise impacts

The following measures would be implemented to avoid and/or minimise impacts on aquatic ecology:

- Schedule the construction of waterway crossings to coincide with periods of no to low flow.
- Gathering lines – Gathering lines typically require an 18 m wide right-of-way, allowing sufficient room for trenching, topsoil and subsoil segregation, and movement of vehicles, pipe-laying equipment and other plant. This would be reduced to a 6 m wide right-of-way at all waterway crossings, minimising the removal of aquatic habitat and riparian vegetation to the smallest practicable width.
- Vehicle access tracks – Access tracks from the public road network to the well sites and other infrastructure would utilise existing property access tracks where available. Access tracks would be co-located with gathering lines, to reduce the impact footprint. Other small sections of new access track are also required in areas not co-located with gathering lines, but these do no intersect waterways or wetlands.

6.2 Impact mitigation

Mitigation measures proposed to be implemented for the Project are detailed in Table 18.

Table 18 Mitigation measures

Potential impact	Mitigation measures
1. Aquatic habitat clearing at waterways and wetlands	▪ Implement 200 m buffer from HES wetlands to any well pads or other high impact earthworks. ▪ Design and construct waterway crossings consistent with the *Accepted Development Requirements for Operational Work that is Constructing or Raising Waterway Barrier Works* (DAF 2018). ▪ Design and construct waterway crossings consistent with the *Riverine Protection Permit Exemption Requirements* (DRDMW 2023). ▪ Implement the Erosion and Sediment Control Plan (Section 6.3) prepared in accordance with best practice.
2. Creating a barrier to fish passage	▪ Where possible, construct waterway crossings in the drier months of the year when surface water flows (and aquatic fauna) are less likely to be encountered. ▪ Design and construct waterway crossings consistent with the *Accepted Development Requirements for Operational Work that is Constructing or Raising Waterway Barrier Works* (DAF 2018).
3. Alteration to surface water quality and/or quantity	▪ Where possible, construct waterway crossings in the drier months of the year when surface water flow (and associated risk of impacting water quality) is less likely to be encountered. ▪ If using open cut trenching for placement of gathering lines at waterway crossings, utilise an excavator or backhoe to enable trench spoil to be stockpiled away from the streambed. Place prefabricated pipe across the waterway, lower in and backfill the trench and apply erosion control rip rap (rock size to withstand predicted flow rates) immediately, minimising the risk of encountering flow events whilst sediments/soils are exposed. ▪ Any necessary release of water from sediment dams (designed in accordance with the Best Practice Erosion and Sediment Control [IECA 2008]) to the downstream environment would only occur in accordance with the EA conditions, which is unlikely to have a measurable impact on receiving water quality. ▪ Design and construct waterways crossings consistent with the *Riverine protection permit exemption requirements* (DRDMW 2023). ▪ Implement the Water Management Plan (Section 6.3).

6.3 Management and monitoring plans

The following management and monitoring plans should be implemented for the Project:

1. CSG Water Management Plan, including:
   - details of the potential sources of contaminants that could impact on water quality;
   - a description of the water management system for the Project;
   - corrective actions and contingency procedures for emergencies; and
   - a program for monitoring and review of the effectiveness of the CSG Water Management Plan.
2. Erosion and Sediment Control Plan, including:
   - design and installation in accordance with the *Best Practice Erosion and Sediment Control* (IECA 2008) and *Soil Erosion and Sediment Control Engineering Guidelines for Queensland Construction Sites* (Witheridge and Walker 1996);
   - minimise the area of disturbance;
   - where possible, apply local temporary erosion control measures;
   - intercept runoff from undisturbed areas and divert around disturbed areas; and
   - where temporary measures are likely to be ineffective, divert runoff from disturbed areas to sedimentation basins prior to release from the site.

7 CONCLUSION

The waterways of the Project area are likely ephemeral or episodic, experiencing flow only after sustained or intense rainfall and runoff in the catchment. Stream flows are highly variable, with most channels expected to dry up during winter to early spring when rainfall and runoff is historically low. Consequently, physical attributes, water quality, and the composition of aquatic flora and fauna communities are expected to be highly variable over time.

Overall aquatic values within the Project area range from Low to High. The sites on Humboldt Creek and Rockland Creek are of Moderate aquatic value, due to their importance as conduits for fish passage. The smaller, unnamed tributaries are of Low aquatic value. The State-mapped HES wetlands are of High aquatic value, due to their mapped HES status. The lacustrine wetland waterbodies (mostly farm dams) are of Low aquatic value, although still provide important watering and foraging resources for terrestrial fauna and some dry season refuge for LC fish and turtle species. The sites on the adjoining Comet River are of High aquatic value as they provide both likely and known habitat for the Critically Endangered (EBPC Act and NC Act) white-throated snapping turtle.

Although the white-throated snapping turtle was recorded from Comet River adjoining the Project area, no conservation-significant aquatic flora or fauna species listed under the NC Act and/or EPBC Act were recorded from the Project area itself. Due to habitat requirements and distributional range, it is unlikely that any conservation-significant aquatic flora or fauna species occur within the waterways or wetlands of the Project area as either resident or transient occurrences.

There are no wetlands of National or International Importance within the Project area. The nearest wetlands of National and International Importance are well removed from the Project area and are unlikely to be of relevance to the Project.

One State-mapped HES wetland occurs within the Project area. Although the State mapping is inaccurate (the surveyed portion of the wetland polygon is not a wetland), the Proponent does not intend to challenge the State mapping; instead opting to avoid the State-mapped HES wetland polygon altogether. High impact petroleum activities would not occur within 200 m of this mapped HES wetland, consistent with Condition ‘water 3’ of the Streamlined model conditions for petroleum activities (DES 2016).

The proposed construction of gathering lines and associated access tracks for the Project would result in minor modification of aquatic habitat at the location of proposed waterway crossings. These habitats comprise waterways with ephemeral to episodic flow, and one semi-permanent lacustrine wetland waterbody (farm dam). The Project requires several waterway crossings, which each create the potential for barriers to fish passage. However, the Project is unlikely to have a significant impact on Waterways Providing for Fish Passage given any crossing on a mapped waterway will be undertaken either via under-boring, or open trench and backfill during times of no/low flow, and that waterway crossings would be constructed in accordance with the *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (Department of Agriculture and Fisheries [DAF] 2018).

The aquatic habitats of the Project area are unlikely to support aquatic species of conservation-significance listed under the NC Act and/or EPBC Act, given the lack of suitable habitat features. The Comet River, downstream of the Project area, supports aquatic species of conservation-significance. However, with suitably implemented water quality management and erosion and sediment controls in place, the Project is expected to be able to negate downstream indirect impacts.

The Project is unlikely to result in significant impacts on surface expression GDEs as no surface expression GDEs are likely to occur within the Project area or surrounds.

Indirect impacts that have been considered in this assessment include potential impacts associated with changes in water quality, hydrological changes, and potential cumulative impacts. It is concluded that the Project is unlikely to have a significant impact on aquatic ecology as a result of these potential indirect impacts.

To mitigate unavoidable adverse impacts on aquatic ecology values associated with the Project, the following mitigation and management measures are proposed, including:

- maintaining a minimum 200 m buffer between HES wetlands and well pads or other high impact earthworks;
- designing and constructing waterway crossings consistent with the *Accepted Development Requirements for Operational Work that is Constructing or Raising Waterway Barrier Works* (DAF 2018);
- designing and constructing waterway crossings consistent with the *Riverine Protection Permit Exemption Requirements* (Department of Regional Development, Manufacturing and Water [DRDMW] 2023);
- avoiding the release of produced water; and
- implementing a CSG Water Management Plan and Erosion and Sediment Control Plan.

With effective implementation of the above mitigation and management measures, the Project is unlikely to result in significant impacts on aquatic Matters of State and National Environmental Significance.

8 REFERENCES

Allen GR, Midgley SH and Allen M 2002, *Field guide to the freshwater fishes of Australia*, Western Australia Museum.

Atlas of Living Australia (ALA) 2023, *Australia's species*, http://bie.ala.org.au, accessed 6 March 2023.

Boulton AJ and Brock MA 1999, *Australian Freshwater Ecology: Processes and Management*. Gleneagles Publishing. Glen Osmond, South Australia.

Bureau of Meteorology (The Bureau) 2023, Rolleston Airport station 35129 monthly rainfall data, http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=122&p_display_type=dailyDataFile&p_startYear=&p_c=&p_stn_num=035129, accessed 7 April 2023.

Bureau of Meteorology (The Bureau) 2023b, Somerby station 35063 monthly rainfall data, http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=&p_c=&p_stn_num=035063, accessed 7 April 2023.

Cann J and Sadlier R 2017, *Freshwater Turtles of Australia*. CSIRO Publishing.

Clayton PD, Fielder DP, Howell S and Hill CJ 2006, Aquatic Biodiversity Assessment and Mapping Method (AquaBAMM): a conservation values assessment tool for wetlands with trial application in the Burnett River catchment. Environmental Protection Agency, Brisbane.

Cogger HG 2014, Reptiles and Amphibians of Australia (Seventh Edition). CSIRO Publishing, Collingwood.

Coughran J and Furse JM 2010, *An assessment of genus Eustacus (49 species) versus IUCN Red List criteria*. International Association of Astacology, USA.

Department of Agriculture and Fisheries (DAF) 2023, Mapping data – *Queensland Waterways for Waterway Barrier Works*, Queensland Government, Brisbane.

Department of Agriculture and Fisheries (DAF) 2018, *Accepted Development Requirements for Operational Work that is Constructing or Raising Waterway Barrier Works.* Queensland Government, Brisbane.

Department of Agriculture, Fisheries and Forestry (DAFF) 2012, *Interpretation of water analysis for irrigation*. Queensland Government, Brisbane.

Department of Agriculture and Fisheries (DAF) 2021, *Queensland waterways for waterway barrier works spatial data layer: Guide to determining waterways*. Queensland Government, Brisbane.Department of Agriculture, Water and the Environment (DAWE) 2020, National Recovery Plan for the White-throated Snapping Turtle (*Elseya albagula*), Commonwealth of Australia.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2023a, EPBC Act Protected Matters Report, created 6 March 2023, http://environment.gov.au/epbc/protected-matters-search-tool

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2023b, Species Profile and Threats Database, accessed 8 April 2023, https://environment.gov.au/sprat-public/action/report

Department of Environment and Heritage Protection (DEHP) 2011, *Environmental Protection (Water) Policy 2009: Comet River Sub-basin Environmental Values and Water Quality Objectives Basin No. 130 (part), including all waters of the Comet River Sub-basin*. Queensland Government, Brisbane.

Department of Environment and Heritage Protection (DEHP) 2014, *Queensland Environmental Offsets Policy: Significant Residual Impact Guideline*. Queensland Government, Brisbane.

Department of Environment and Resource Management (DERM) 2010, *Fitzroy Natural Resource Management Bioregion Back on Track Actions for Biodiversity*. Queensland Government, Brisbane.

Department of Environment and Science (DES) 2016, *Guideline – Environmental Protection Act 1994* – Streamlined model conditions for petroleum activities, available: https://environment.des.qld.gov.au/__data/assets/pdf_file/0036/89964/rs-gl-streamlined-model-conditions-petroleum.pdf

Department of Environment and Science (DES) 2018, *Monitoring and Sampling Manual: Environmental Protection (Water) Policy*. Brisbane: Department of Environment and Science Government.

Department of Environment and Science (DES) 2019, Mapping data – *Queensland Wetland Environmental Values*. Queensland Government, Brisbane.

Department of Environment and Science (DES) 2022, *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland*. Queensland Government, Brisbane.

Department of Environment and Science (DES) 2023a, Wetland*Info* – *Fitzroy Basin*, viewed 7 April 2023, available: https://wetlandinfo.des.qld.gov.au/wetlands/facts-maps/basin-fitzroy/

Department of Environment and Science (DES) 2023b, Mapping data – *Queensland Wetland Data Version 5 – Queensland Wetlands Map*. Queensland Government, Brisbane.

Department of Environment and Science (DES) 2023c, Mapping data – *Queensland Groundwater Dependent Ecosystems and Potential GDE Aquifer Mapping 2018 Version 1.5.1*. Queensland Government, Brisbane.

Department of Environment and Science (DES) 2023d, Mapping data – *Great Barrier Reef Wetland Protection Areas*. Queensland Government, Brisbane.

Department of Environment and Science (DES) 2023e, Mapping data – Aquatic Conservation Assessment series. Queensland Government, Brisbane.

Department of Environment and Science (DES) 2023f, *Phaius australis, WetlandInfo*, viewed 7 April 2023, available: https://apps.des.qld.gov.au/species-search/details/?id=12722

Department of Environment and Science (DES) 2023g, *Thelypteris confluens, WetlandInfo*, viewed 7 April 2023, available: https://apps.des.qld.gov.au/species-search/details/?id=16042

Department of Environment and Science (DES) 2023h, *Eleocharis blakeana, WetlandInfo*, viewed 7 April 2023, available: https://apps.des.qld.gov.au/species-search/details/?id=11468

Department of Environment and Science (DES) 2023i, *Myriophyllum artesium, WetlandInfo*, viewed 8 April 2023, available: https://apps.des.qld.gov.au/species-search/details/?id=27450

Department of Natural Resources and Mines (DNRM) 2001, Queensland Australian River Assessment System (AusRivAS) Sampling and Processing Manual. Queensland Government, Rocklea.

Department of Regional Development, Manufacturing and Water (DRDMW) 2023, *Riverine protection permit exemption requirements*, WSS/2013/726, Version 2.02. Queensland Government, Brisbane.

Department of Resources (DoR) 2023a, *Vegetation management regional ecosystem map, Version 12.02*. DoR, Brisbane.

Department of Resources (DoR) 2023b, *Watercourse Identification Map (WIM) under the Water Act 2000*. Queensland Government, Brisbane.

Department of State Development, Infrastructure, Local Government and Planning (DSDILGP) 2023. State Planning Policy Interactive Mapping System – Matters of State Environmental Significance. Queensland Government, Brisbane.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) 2011, *Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Australian Government, Canberra.

Department of the Environment (DotE) 2013, *Conservation Advice Bidyanus bidyanus (silver perch)*. Canberra, DoE, available: https://www.environment.gov.au/biodiversity/threatened/species/pubs/76155-conservation-advice.pdf

EMM Consulting Pty Ltd (EMM Consulting) and DPM Enviros ciences Pty Ltd (DPM Enviros ciences) 2020, *BHP Blackwater Mine Southern Lease – Aquatic Ecology Baseline Surveys*.

Fielder D, Davidson W and Barratt P 2011, Aquatic Conservation Assessments (ACA), using AquaBAMM, for the wetlands of the Queensland Murray–Darling Basin. Department of Environment and Resource Management, Brisbane.

Gibbs RJ 1970, Mechanisms controlling world water chemistry, *Science*, 170, 1088:1090.

Golder Associates Pty Ltd (Golder) 2018 and DPM Enviros ciences Pty Ltd (DPM Enviros ciences), *Comet Ridge Mahalo (South) Project – Aquatic Habitat Assessments*.

Harden GJ 2002, *Flora of New South Wales – Volume 2*, University of New South Wales, Sydney.

Independent Expert Scientific Committee (IESC) 2018, *Assessing Groundwater-Dependent Ecosystems: IESC Information Guidelines Explanatory Note*.

Inglis SN and Howell S 2009, Aquatic Conservation Assessments for the riverine wetlands of the Great Barrier Reef Catchment: Fitzroy region. Department of Environment and Resource Management, Queensland Government.

International Erosion Control Association (Australasia) (IECA) 2008, *Best Practice Erosion and Sediment Control*. IECA, Picton NSW.

Melzer R and Plumb J 2011, *Plants of Capricornia*. Belgamba, Rockhampton.

Peterken C, Ringwood G and Sarac Z 2009, *Waterway barrier works development approvals*, Queensland Primary Industries and Fisheries Fish Habitat Management Operational Policy FHMOP 008.

Pusey BJ, Kennard MJ and Arthington AH 2004, *Freshwater fishes of north-eastern Australia*, CSIRO Publishing, Collingwood, Victoria.

Rollason SN and Howell S 2012, Aquatic Conservation Assessments (ACA), using AquaBAMM, for the non-riverine wetlands of the Great Barrier Reef catchment*, Version 1.3*. Published by the Department of Environment and Resource Management, Brisbane.

Romanowski N 1998, *Aquatic and wetland plants: a field guide for non-tropical Australia*. University of New South Wales Press Ltd, Sydney.

Sainty GR and Jacobs SWL 2003, *Waterplants in Australia*, Sainty and Associates Pty Ltd, NSW.

Stanley TD and Ross EM 1983, *Flora of south-eastern Queensland*. Queensland Department of Primary Industries, Brisbane.

Stephens KM and Dowling RM 2002, *Wetland plants of Queensland*. CSIRO, Collingswood, Victoria.

Strahler AN 1952, Hypsometric (Area-altitude) Analysis of Erosional Topology, *Geological Society of America Bulletin*, **63** (11), 1117-1142.

Weeds Australia 2021, Weeds of National Significance, accessed 20 April 2023, https://weeds.org.au/

Witheridge G and Walker R 1996, Soil Erosion and Sediment Control, Engineering Guidelines for Queensland Construction Sites, Institute of Engineers Australia, Queensland Division.

Appendix A: EPBC Act Protected Matters Report

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 06-Mar-2023

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	26
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	9
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area	In feature area
Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin	Endangered	Community likely to occur within area	In feature area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area	In feature area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area	In buffer area only
Weeping Myall Woodlands	Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area	In feature area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area	In feature area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat may occur within area	In buffer area only
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
MAMMAL			
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area	In feature area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat may occur within area	In feature area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area	In feature area
Petauroides volans Greater Glider (southern and central) [254]	Endangered	Species or species habitat likely to occur within area	In feature area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat likely to occur within area	In feature area
PLANT			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Aristida annua [17906]	Vulnerable	Species or species habitat known to occur within area	In feature area
Bertya opponens [13792]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat may occur within area	In feature area
Dichanthium queenslandicum King Blue-grass [5481]	Endangered	Species or species habitat likely to occur within area	In feature area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat may occur within area	In feature area
Leichhardtia brevifolia listed as Marsdenia brevifolia [91893]	Vulnerable	Species or species habitat may occur within area	In feature area
Solanum dissectum [75720]	Endangered	Species or species habitat may occur within area	In buffer area only
REPTILE			
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area	In feature area
Denisonia maculata Ornamental Snake [1193]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Elseya albagula Southern Snapping Turtle, White-throated Snapping Turtle [81648]	Critically Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hemiaspis damelii Grey Snake [1179]	Endangered	Species or species habitat may occur within area	In feature area
Rheodytes leukops Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Extra Information

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Blackwater Mine South Coking Coal Project	2022/09279		Assessment	In feature area
rail track to link the proposed MIM Rolleston coal mine to existing rail network	2002/637		Post-Approval	In feature area
Controlled action				
Arcturus Coal Project; A combined open cut and underground longwall coal mine	2010/5783	Controlled Action	Completed	In buffer area only
Coal Seam Gas Field Development for Natural Gas Liquefaction Park, Curtis Island	2008/4059	Controlled Action	Completed	In feature area
Springsure Creek Coal Project	2010/5782	Controlled Action	Post-Approval	In feature area
ZeroGen Integrated Gasification Combined Cycle Power Plant and CO2 Capture, Transport and Storage	2009/5195	Controlled Action	Completed	In feature area
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Mahalo Development Area CSG Project	2019/8534	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
Blackwater to Rolleston 132 kV transmission line	2002/880	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

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

Threatened, migratory and marine species

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

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

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

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

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

Please feel free to provide feedback via the Contact us page.

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Appendix B: Aquatic Survey Site Profiles

Site code: R1	**Location:** unnamed tributary of Comet River, Meroo Downs
Date: 15/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0874; 148.6333 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
Stream order (Strahler): 1	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, low risk of impact	
Water quality	
Time (EST): 14:15	**Water temperature:** NA/dry
Sp. Conductivity: NA/dry	**pH:** NA/dry
Dissolved oxygen: NA/dry	**Dissolved oxygen:** NA/dry
Turbidity: NA/dry	**Ion sample collected:** no
Observations within 2 m of sampling point	
Shading: NA/dry	**Water colour:** NA/dry
Water odour: NA/dry	**Water surface:** NA/dry
Algae on substrate: NA/dry	**Algae in water column:**
Emergent macrophytes: NA	**Submerged macrophytes:** NA
Floating macrophytes: NA/dry	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 10 m
Maximum depth: 0 m	**Bankfull height:** 1 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat:	
Habitat attributes:	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 91% silt/clay (<0.05 mm), 2% sand (0.05-2 mm), 5% gravel (2-4 mm), 2% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 91% silt/clay (<0.05 mm), 2% sand (0.05-2 mm), 5% gravel (2-4 mm), 2% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: gravelly clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:**
Local catchment erosion: cattle pugging (S)	

Upstream

Left bank

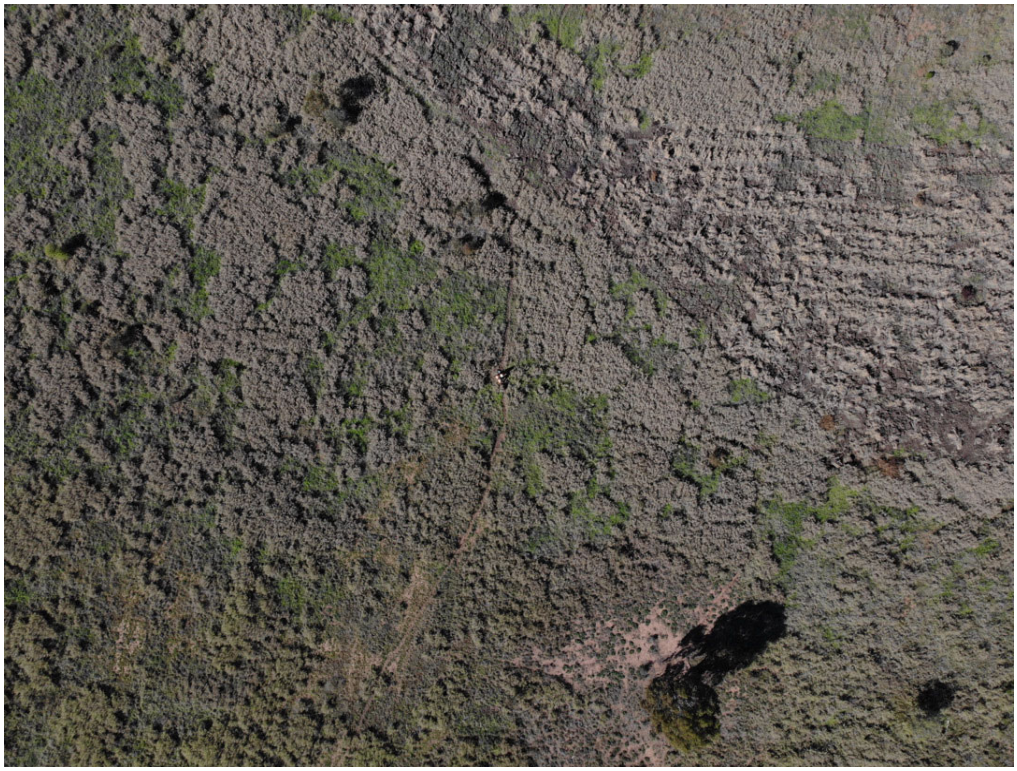
Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 1 m	**Width of riparian zone on right bank:** 1 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: exotic	**Dominant stratum:** grassland
Health: degraded	**Dieback:** not detected
EDL height: 1 m	**EDL cover:** 90%
Canopy species: *Eucalyptus populnea* (R), *Eucalyptus cambageana* (R)	
Sub-canopy species:	
Shrub species: *Acacia harpophylla* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Atalaya hemiglauca* (O)	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** *(A), Dichanthium sericeum* (O), *Senecio brigalowensis* (F)	
Macrophytes	
Submerged macrophytes: NA	
Floating macrophytes: NA	
Emergent macrophytes: None detected	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	1 (Poor)
2. Embeddedness	1 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	12 (Excellent)
5. Bottom scouring and deposition	10 (Good)
6. Pool/riffle, run/bend ratio	3 (Poor)
7. Bank stability	9 (Excellent)
8. Bank vegetative stability	9 (Excellent)
9. Streamside cover	4 (Fair)
Overall score	**49 (Fair)**
Notes:	
Overall aquatic value: Low	



Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R2	**Location:** unnamed tributary of Comet River, Meroo Downs
Date: 16/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.083; 148.6185 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
Stream order (Strahler): 1	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, low risk of impact	
Water quality	
Time (EST): 07:37	**Water temperature:** NA/dry
Sp. Conductivity: NA/dry	**pH:** NA/dry
Dissolved oxygen: NA/dry	**Dissolved oxygen:** NA/dry
Turbidity: NA/dry	**Ion sample collected:** no
Observations within 2 m of sampling point	
Shading: NA/dry	**Water colour:** NA/dry
Water odour: NA/dry	**Water surface:** NA/dry
Algae on substrate: NA/dry	**Algae in water column:**
Emergent macrophytes: NA	**Submerged macrophytes:** NA
Floating macrophytes: NA/dry	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 20 m
Maximum depth: 0 m	**Bankfull height:** 1.7 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat:	
Habitat attributes: detritus (L), sticks (L), branches (L), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 40% silt/clay (<0.05 mm), 54% sand (0.05-2 mm), 5% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 60% silt/clay (<0.05 mm), 34% sand (0.05-2 mm), 5% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay	**Bank stability:** unstable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (S)
Local catchment erosion: gully (E), rill (S), tunnel (L), sheet (L), bank slumping (L), cattle pugging (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: M	**Grasses/forbs:** S
Shrubs: S	**Trees <10 m:** S
Trees >10m: N	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: regrowth	**Dominant stratum:** tree
Health: poor	**Dieback:** 1-10
EDL height: 6 m	**EDL cover:** 20%
Canopy species: *Acacia harpophylla* (D), *Eucalyptus populnea* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Geijera parviflora* (O)	
Sub-canopy species:	
Shrub species: *Acacia harpophylla* (D), *Santalum lanceolatum* (O), *Carissa ovata* (O)	
Ground species: *Cenchrus ciliaris** (D), *Urochloa mosambicensis** (F), *Bothriochloa bladhii* (F), *Heteropogon contortus* (O), *Parthenium hysterophorus** (O)	
Macrophytes	
Submerged macrophytes: NA	
Floating macrophytes: NA	
Emergent macrophytes: None detected	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	1 (Poor)
2. Embeddedness	1 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	3 (Poor)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	5 (Fair)
8. Bank vegetative stability	2 (Poor)
9. Streamside cover	9 (Excellent)
Overall score	**28 (Poor)**
Notes:	
Overall aquatic value: Low	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R3	**Location:** Unnamed tributary of Comet River, Meroo Downs
Date: 16/08/2022	**Season:** Dry
Assessor: DM	**Coordinates:** -24.0701; 148.5701 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
Stream order (Strahler): 5	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, major risk of impact	
Water quality	
Time (EST): 09:57	**Water temperature:** NA/dry
Sp. Conductivity: NA/dry	**pH:** NA/dry
Dissolved oxygen: NA/dry	**Dissolved oxygen:** NA/dry
Turbidity: NA/dry	**Ion sample collected:** no
Observations within 2 m of sampling point	
Shading: NA/dry	**Water colour:** NA/dry
Water odour: NA/dry	**Water surface:** NA/dry
Algae on substrate: NA/dry	**Algae in water column:**
Emergent macrophytes: NA	**Submerged macrophytes:** NA
Floating macrophytes: NA/dry	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 3 m
Maximum depth: 0 m	**Bankfull height:** 0.1 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool 100% dry	
Variety of habitat:	
Habitat attributes: detritus (N), sticks (N), branches (N), logs (N), periphyton (N), moss (N), filamentous algae (N), macrophytes (N), bank overhang (N), trailing bank vegetation (N), blanketing silt (N), substrate anoxia (N)	
Upstream landuse: moderate grazing,non-irrigated cropping	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): non-irrigated cropping	
Bed, edge and bank characteristics	
Bed substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: gully (N), rill (N),tunnel (N), sheet (N), bank slumping (N), cattle pugging (N)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 0 m	**Width of riparian zone on right bank:** 0 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: N	**Trees <10 m:** N
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: exotic	**Dominant stratum:** grassland
Health: completely degraded	**Dieback:** not detected
EDL height: 0.5 m	**EDL cover:** 95%
Canopy species:	
Sub-canopy species:	
Shrub species: *Melaleuca linariifolia* (O), *Eucalyptus coolabah* (O)	
Ground species: *Parthenium hysterophorus** (D), *Cenchrus ciliaris** (D), *Atriplex muelleri* (O), *Portulaca oleracea** (O), *Urochloa mosambicensis** (O)	
Macrophytes	
Submerged macrophytes:	
Floating macrophytes:	
Emergent macrophytes:	

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes:

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	1 (Poor)
2. Embeddedness	1 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	12 (Excellent)
5. Bottom scouring and deposition	11 (Good)
6. Pool/riffle, run/bend ratio	1 (Poor)
7. Bank stability	9 (Excellent)
8. Bank vegetative stability	9 (Excellent)
9. Streamside cover	3 (Fair)
Overall score	**47 (Fair)**
Notes:	
Overall aquatic value: Low	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R4	**Location:** Humbolt Creek, Meroo Downs
Date: 16/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0787; 148.569 (GDA 2020)
Water level: low (< watermark)	**Likely flow nature:** episodic
Stream order (Strahler): 6	
State-mapped watercourse (DoR 2022): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, major risk of impact	
Water quality	
Time (EST): 10:43	**Water temperature:** 12.9˚C
Sp. Conductivity: 157.5 µS/cm	**pH:** 7.2
Dissolved oxygen: 82.5%	**Dissolved oxygen:** 8.72 mg/L
Turbidity: 916 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 60%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 1.5 m	**Bankfull width:** 20 m
Maximum depth: 0.2 m	**Bankfull height:** 1.5 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m) pool, large woody debris, run	
Habitat attributes: detritus (L), sticks (L), branches (L), filamentous algae (L), bank overhang (L), trailing bank vegetation (L), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing, natural	
Adjacent landuse (left bank): non-irrigated cropping, natural	
Bed, edge and bank characteristics	
Bed substrates: 60% silt/clay (<0.05 mm), 39% sand (0.05-2 mm), 1% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 80% silt/clay (<0.05 mm), 19% sand (0.05-2 mm), 1% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (S)
Local catchment erosion: cattle pugging (S)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 20 m
Bare ground: M	**Grasses/forbs:** S
Shrubs: S	**Trees <10 m:** M
Trees >10m: S	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Borderline remnant
Vegetation status: regrowth	**Dominant stratum:** tree
Health: good	**Dieback:** not detected
EDL height: 11 m	**EDL cover:** 35%
Canopy species: *Eucalyptus coolabah* (D), *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (O)	
Sub-canopy species: *Melaleuca linariifolia* (D), *Acacia harpophylla (A), Lysiphyllum hookeri* (O)	
Shrub species:	
Ground species: *Basilicum polystachyon* (F), *Cyperus sp.* (O), *Alternanthera denticulata* (O), *Paspalidium sp.* (O), *Other sp.* (O), *Parthenium hysterophorus** (O)	
Macrophytes	
Submerged macrophytes:	
Floating macrophytes:	
Emergent macrophytes: *Cyperus* sp. (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	5 (Poor)
2. Embeddedness	5 (Poor)
3. Velocity/depth category	6 (Fair)
4. Channel alteration	2 (Poor)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	8 (Good)
8. Bank vegetative stability	4 (Fair)
9. Streamside cover	9 (Excellent)
Overall score	**47 (Fair)**
Notes:	
Overall aquatic value: Moderate	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R5	**Location:** Comet River, Meroo Downs
Date: 16/08/2022	**Season:** Dry
Assessor: DM	**Coordinates:** -24.0935; 148.534 (GDA 2020)
Water level: low (< watermark)	**Likely flow nature:** seasonal
Stream order (Strahler): 7	
State-mapped watercourse (DoR 2022): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, major risk of impact	
Water quality	
Time (EST): 12:11	**Water temperature:** 15.3˚C
Sp. Conductivity: 209.1 µS/cm	**pH:** 8
Dissolved oxygen: 98%	**Dissolved oxygen:** 9.55 mg/L
Turbidity: 48 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 6 m	**Bankfull width:** 35 m
Maximum depth: 1.5 m	**Bankfull height:** 7 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool 0% dry	
Variety of habitat: shallow (<0.5 m),pool,large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), periphyton (L), bank overhang (L), trailing bank vegetation (S), blanketing silt (L)	
Upstream landuse: non-irrigated cropping, moderate grazing	
Adjacent landuse (right bank): Natural, non-irrigated cropping	
Adjacent landuse (left bank): natural	
Bed, edge and bank characteristics	
Bed substrates: 80% silt/clay (<0.05 mm), 20% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 80% silt/clay (<0.05 mm), 20% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy sand	**Bank stability:** moderately stable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (L), sand (M)
Local catchment erosion: bank slumping (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 30 m	**Width of riparian zone on right bank:** 30 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: S	**Trees <10 m:** S
Trees >10m: S	**Exotic riparian species:** S
Composition and health	
State-mapped RE: 11.3.25	**Verified RE:** 11.3.25
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** not detected
EDL height: 20 m	**EDL cover:** 40%
Canopy species: *Eucalyptus tereticornis* (D), *Corymbia tessellaris* (F), *E. coolabah* (F)	
Sub-canopy species: *Lysiphyllum hookeri* (F), *Melaleuca linariifolia* (F), *E. coolabah* (F), *E. tereticornis* (F), *Acacia harpophylla* (O), *A. salicina* (O), *Terminalia oblongata* (O)	
Shrub species: *Melaleuca linariifolia* (F), *Parkinsonia aculeata** (O)	
Ground species: *Megathyrsus maximus var. maximus** (D), *Cynodon dactylon var. dactylon** (A), *Xanthium occidentale** (F), *Bothriochloa bladhii* (F)	
Macrophytes	
Submerged macrophytes:	
Floating macrophytes:	
Emergent macrophytes:	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: yes	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes: Permanency of water unknown; requires dry season survey	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	3 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	6 (Fair)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	6 (Fair)
7. Bank stability	6 (Good)
8. Bank vegetative stability	9 (Excellent)
9. Streamside cover	9 (Excellent)
Overall score	**49 (Fair)**
Notes:	
Overall aquatic value: High	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R6	**Location:** Comet River, Meroo Downs
Date: 16/08/2022	**Season:** Dry
Assessor: DM	**Coordinates:** -24.0728; 148.5418 (GDA 2020)
Water level: low (< watermark)	**Likely flow nature:** seasonal
Stream order (Strahler): 7	
State-mapped watercourse (DoR 2022): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, major risk of impact	
Water quality	
Time (EST): 13:20	**Water temperature:** 19.6˚C
Sp. Conductivity: 212 µS/cm	**pH:** 7.9
Dissolved oxygen: 90%	**Dissolved oxygen:** 8.22 mg/L
Turbidity: NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 6 m	**Bankfull width:** 25 m
Maximum depth: 2 m	**Bankfull height:** 7 m
Habitat types: 0% riffle, 5% run, 95% sandy pool, 0% rocky pool 0% dry	
Variety of habitat: shallow (<0.5 m),deep (>0.5 m),pool,run,large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (N), periphyton (L), moss (N), filamentous algae (N), macrophytes (N), bank overhang (N), trailing bank vegetation (S), blanketing silt (L), substrate anoxia (N)	
Upstream landuse: moderate grazing,non-irrigated cropping,natural	
Adjacent landuse (right bank): Natural,non-irrigated cropping	
Adjacent landuse (left bank): natural	
Bed, edge and bank characteristics	
Bed substrates: 20% silt/clay (<0.05 mm), 80% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 30% silt/clay (<0.05 mm), 70% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy sand	**Bank stability:** moderately stable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: flat U shaped	**Recent deposits:** silt (L), sand (M)
Local catchment erosion: None detected	

Upstream

Left bank

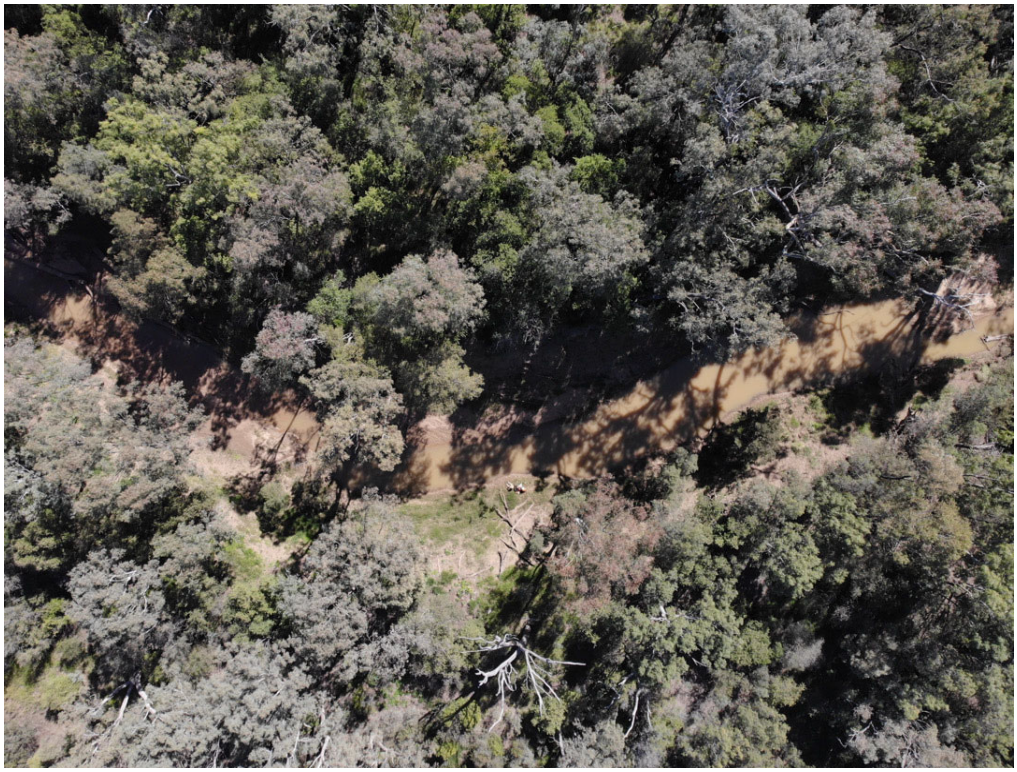
Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 30 m	**Width of riparian zone on right bank:** 30 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: S	**Trees <10 m:** L
Trees >10m: M	**Exotic riparian species:** S
Composition and health	
State-mapped RE: 11.3.25	**Verified RE:** 11.3.25
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** not detected
EDL height: 19 m	**EDL cover:** 40%
Canopy species: *Eucalyptus tereticornis* (D), *E. coolabah* (F), *Corymbia tessellaris* (O)	
Sub-canopy species: *Melaleuca linariifolia* (O), *Terminalia oblongata* (F), *Acacia salicina* (O), *Lysiphyllum hookeri* (A)	
Shrub species: *Melaleuca linariifolia* (F), *Parkinsonia aculeata** (O), *Geijera parviflora* (O), *Eucalyptus coolabah* (O)	
Ground species: *Megathyrsus maximus** (D), *Xanthium occidentale** (O), *Cynodon dactylon var. dactylon** (O), *Lomandra hystrix* (F)	
Macrophytes	
Submerged macrophytes: None detected	
Floating macrophytes: None detected	
Emergent macrophytes: None detected	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: yes	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes: Permanency of water unknown; requires dry season survey	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	5 (Poor)
2. Embeddedness	5 (Poor)
3. Velocity/depth category	6 (Fair)
4. Channel alteration	6 (Fair)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	6 (Fair)
7. Bank stability	8 (Good)
8. Bank vegetative stability	8 (Good)
9. Streamside cover	9 (Excellent)
Overall score	**56 (Fair)**
Notes:	
Overall aquatic value: High	



Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R7	**Location:** unnamed tributary of Comet River, Meroo Downs
Date: 16/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0786; 148.5853 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
Stream order (Strahler): 1	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, low risk of impact	
Water quality	
Time (EST): 14:53	**Water temperature:** NA/dry
Sp. Conductivity: NA/dry	**pH:** NA/dry
Dissolved oxygen: NA/dry	**Dissolved oxygen:** NA/dry
Turbidity: NA/dry	**Ion sample collected:** no
Observations within 2 m of sampling point	
Shading: NA/dry	**Water colour:** NA/dry
Water odour: NA/dry	**Water surface:** NA/dry
Algae on substrate: NA/dry	**Algae in water column:**
Emergent macrophytes: NA	**Submerged macrophytes:** NA
Floating macrophytes: NA/dry	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 5 m
Maximum depth: 0 m	**Bankfull height:** 0.6 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool 100% dry	
Variety of habitat:	
Habitat attributes:	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 75% silt/clay (<0.05 mm), 23% sand (0.05-2 mm), 2% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy clay	**Bank stability:** moderately stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (L)
Local catchment erosion: rill (L), bank slumping (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 0 m	**Width of riparian zone on right bank:** 0 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** N
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: exotic	**Dominant stratum:** grassland
Health: completely degraded	**Dieback:** not detected
EDL height: 0.5 m	**EDL cover:** 95%
Canopy species:	
Sub-canopy species:	
Shrub species: *Acacia harpophylla* (R), *Sesbania cannabina* (R)	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** (F), *Malvastrum americanum var. stellatum* (O)	
Macrophytes	
Submerged macrophytes:	
Floating macrophytes:	
Emergent macrophytes: *Echinochloa colona** (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	1 (Poor)
2. Embeddedness	1 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	3 (Poor)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	0 (Poor)
7. Bank stability	8 (Good)
8. Bank vegetative stability	9 (Excellent)
9. Streamside cover	3 (Fair)
Overall score	**28 (Poor)**
Notes: Blade-ploughed paddock	
Overall aquatic value: Low	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R8	**Location:** tributary of Three Mile Creek, Togara Station
Date: 18/08/2022	**Season:** Dry
Assessor: DM	**Coordinates:** -24.0294; 148.6111 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** episodic
Stream order (Strahler): 2	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, moderate risk of impact	
Water quality	
Time (EST): 12:56	**Water temperature:** 13.6˚C
Sp. Conductivity: 165 µS/cm	**pH:** 7
Dissolved oxygen: 100%	**Dissolved oxygen:** 10.05 mg/L
Turbidity: 245 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: S	**Algae in water column:** N
Emergent macrophytes: L	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 4 m	**Bankfull width:** 15 m
Maximum depth: 0.4 m	**Bankfull height:** 1 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m) pool, macrophytes	
Habitat attributes: detritus (L), sticks (L), branches (L), periphyton (L), filamentous algae (S), macrophytes (S), bank overhang (L), trailing bank vegetation (M), blanketing silt (S)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** moderately stable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (N)
Local catchment erosion: gully (L), rill (L), cattle pugging (S)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 8 m	**Width of riparian zone on right bank:** 8 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: exotic	**Dominant stratum:** grassland
Health: poor	**Dieback:** 26-75
EDL height: 0.5 m	**EDL cover:** 80%
Canopy species: *Acacia harpophylla* (O)	
Sub-canopy species:	
Shrub species:	
Ground species: *Chloris* sp. (D), *Senecio brigalowensis* (F), *Echinochloa colona** (F), *Diplachne fusca* (O), *Leptochloa digitata* (O), *Portulaca oleracea** (O), *Ammannia multiflora* (O), *Cynodon dactylon var. dactylon** (F)	
Macrophytes	
Submerged macrophytes: None detected	
Floating macrophytes: None detected	
Emergent macrophytes: *Diplachne fusca* (L), *Cyperus difformis* (L), *Leptochloa digitata* (L), *Echinochloa colona** (L), *Cyperus concinnus* (L), *Cyperus exaltatus* (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	1 (Poor)
2. Embeddedness	1 (Poor)
3. Velocity/depth category	4 (Poor)
4. Channel alteration	3 (Poor)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	7 (Good)
8. Bank vegetative stability	6 (Good)
9. Streamside cover	5 (Fair)
Overall score	**34 (Poor)**
Notes:	
Overall aquatic value: Low	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R9	**Location:** Rockland Creek, Memaloo Station
Date: 19/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0759; 148.7203 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** episodic
Stream order (Strahler): 3	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, high risk of impact	
Water quality	
Time (EST): 07:08	**Water temperature:** 10.7˚C
Sp. Conductivity: 170.8 µS/cm	**pH:** 7.4
Dissolved oxygen: 78%	**Dissolved oxygen:** 8.68 mg/L
Turbidity: 498 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 100%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 1 m	**Bankfull width:** 12 m
Maximum depth: 0.3 m	**Bankfull height:** 2 m
Habitat types: 0% riffle, 0% run, 15% sandy pool, 0% rocky pool, 85% dry	
Variety of habitat: shallow (<0.5 m),pool,large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), bank overhang (L), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing, natural	
Adjacent landuse (left bank): moderate grazing, natural	
Bed, edge and bank characteristics	
Bed substrates: 45% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 2% gravel (2-4 mm), 40% pebble (4-64 mm), 3% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 82% silt/clay (<0.05 mm), 15% sand (0.05-2 mm), 1% gravel (2-4 mm), 1% pebble (4-64 mm), 1% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy loam	**Bank stability:** moderately unstable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (L), sand (L)
Local catchment erosion: gully (L), rill (L), bank slumping (S), cattle pugging (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 20 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: M	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.25/11.3.2
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** 1-10
EDL height: 18 m	**EDL cover:** 35%
Canopy species: *Eucalyptus tereticornis* (D), *Corymbia tessellaris* (A), *E. populnea* (A)	
Sub-canopy species: *C. tessellaris* (D), *Acacia harpophylla* (F), *A. salicina* (F), *E. populnea* (F), *Terminalia oblongata* (O)	
Shrub species: *Eremophila mitchellii* (O), *A. salicina* (O), *Terminalia oblongata* (O), *Vachellia farnesiana** (O), *Acacia harpophylla* (O)	
Ground species: *Cenchrus ciliaris** (D), *Megathyrsus maximus** (A), *Bothriochloa bladhii* (A), *Parthenium hysterophorus** (F), *Polymeria* sp. (F)	
Macrophytes	
Submerged macrophytes: None detected	
Floating macrophytes: None detected	
Emergent macrophytes: None detected	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	15 (Good)
2. Embeddedness	15 (Good)
3. Velocity/depth category	1 (Poor)
4. Channel alteration	10 (Good)
5. Bottom scouring and deposition	7 (Fair)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	5 (Fair)
8. Bank vegetative stability	7 (Good)
9. Streamside cover	9 (Excellent)
Overall score	**74 (Good)**
Notes:	
Overall aquatic value: Moderate	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R10	**Location:** Humbolt Creek, Meroo Station
Date: 19/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0931; 148.5918 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** seasonal
Stream order (Strahler): 5	
State-mapped watercourse (DoR 2022): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, major risk of impact	
Water quality	
Time (EST): 10:55	**Water temperature:** 11.5˚C
Sp. Conductivity: 160.4 µS/cm	**pH:** 6.7
Dissolved oxygen: 77%	**Dissolved oxygen:** 8.1 mg/L
Turbidity: >1000 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 50%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 10 m	**Bankfull width:** 35 m
Maximum depth: 2+ m	**Bankfull height:** 4 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m),deep (>0.5 m),pool,large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), bank overhang (S), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 98% silt/clay (<0.05 mm), 2% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 99% silt/clay (<0.05 mm), 1% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (L), sand (N)
Local catchment erosion: pugging (L)	

Upstream

Left bank

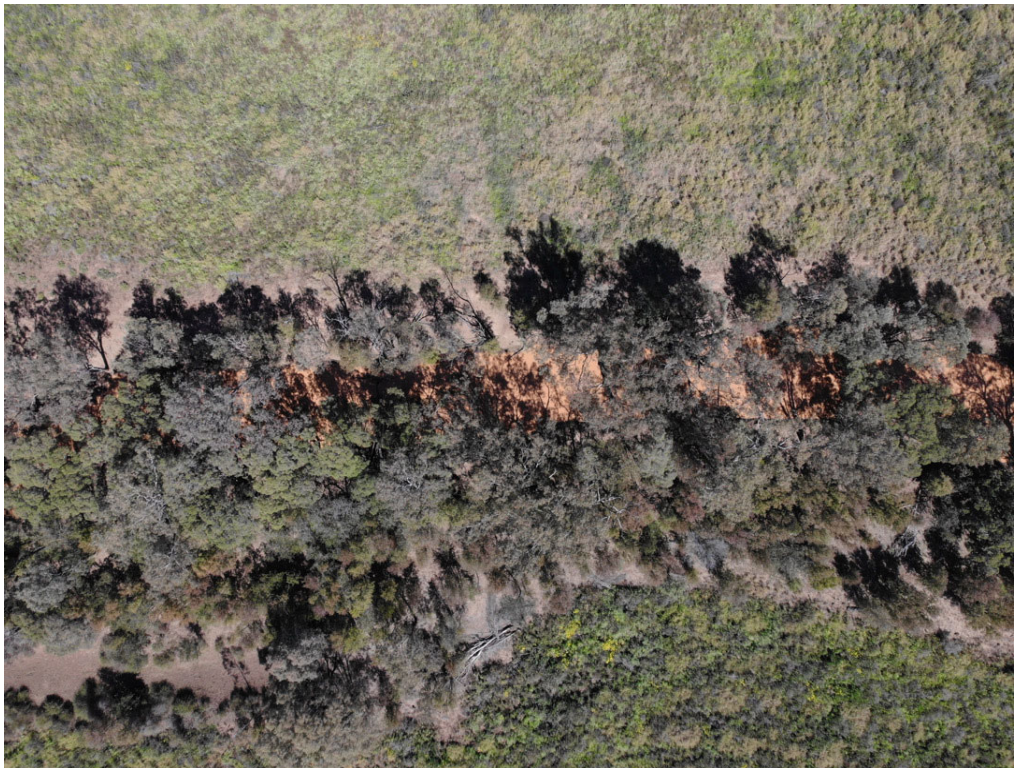
Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 8 m	**Width of riparian zone on right bank:** 20 m
Bare ground: E	**Grasses/forbs:** L
Shrubs: L	**Trees <10 m:** S
Trees >10m: M	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.37
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** not detected
EDL height: 17 m	**EDL cover:** 60%
Canopy species: *Eucalyptus coolabah* (D)	
Sub-canopy species: *Acacia harpophylla* (D), *Melaleuca linariifolia* (F), *Melaleuca bracteata* (O), *Terminalia oblongata* subsp. *oblongata* (A), *Lysiphyllum hookeri* (O)	
Shrub species: *Lysiphyllum hookeri* (O), *Duma florulenta* (O), *Terminalia oblongata* subsp. *oblongata* (O)	
Ground species: *Malvastrum americanum var. americanum** (O), *Basilicum polystachyon* (O), *Gamochaeta sp.* (O), *Alternanthera denticulata* (O)	
Macrophytes	
Submerged macrophytes:	
Floating macrophytes:	
Emergent macrophytes: *Duma florulenta* (L), *Cyperus exaltatus* (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: no burrows detected	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	6 (Fair)
2. Embeddedness	5 (Poor)
3. Velocity/depth category	5 (Poor)
4. Channel alteration	7 (Fair)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	9 (Excellent)
8. Bank vegetative stability	8 (Good)
9. Streamside cover	9 (excellent)
Overall score	**58 (Fair)**
Notes:	
Overall aquatic value: Moderate	



Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

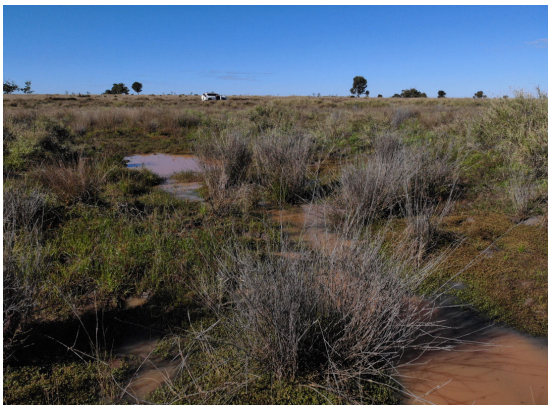
Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

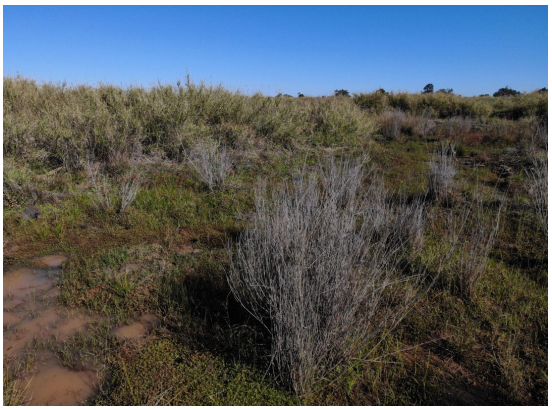
Site code: L1	**Location:** lacustrine wetland, Meroo Downs
Date: 16/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0606; 148.5751 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** episodic
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): no	
Water quality	
Time (EST): 08:43	**Water temperature:** 10.9˚C
Sp. Conductivity: 205.2 µS/cm	**pH:** 7.3
Dissolved oxygen: 49.6%	**Dissolved oxygen:** 5.47 mg/L
Turbidity: 346 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: L	**Algae in water column:** N
Emergent macrophytes: M	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 7 m	**Bankfull width:** 100 m
Maximum depth: 0.2 m	**Bankfull height:** 1 m
Habitat types: 0% riffle, 0% run, 5% sandy pool, 0% rocky pool, 95% dry	
Variety of habitat: macrophytes, shallow (<0.5 m) pool	
Habitat attributes: detritus (L), macrophytes (L), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 94% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 1% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 94% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 1% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** moderately stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: cattle pugging (L)	

Upstream

Left bank



Downstream



Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 1 m	**Width of riparian zone on right bank:** 1 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: N	**Trees <10 m:** N
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: exotic	**Dominant stratum:** grassland
Health: poor	**Dieback:** not detected
EDL height: 1 m	**EDL cover:** 90%
Canopy species:	
Sub-canopy species:	
Shrub species:	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** (F), *Cyperus concinnus* (F), *Leptochloa digitata* (O), *Cyperus bifax* (O), *Ammannia multiflora* (F), *Marsilea hirsuta* (F), *Basilicum polystachyon* (O), *Alternanthera denticulata* (O), *Malvastrum americanum var.*	

Macrophytes
Submerged macrophytes:
Floating macrophytes:
Emergent macrophytes: *Cyperus concinnus* (L), *Marsilea hirsuta* (L), *Leptochloa digitata* (L), *Cyperus sp.* (L), *Eleocharis sp.* (L), *Echinochloa colona** (L)

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes:
Overall aquatic value: Low

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: L2	**Location:** lacustrine wetland, Meroo Downs
Date: 16/08/2022	**Season:** Dry
Assessor: DM	**Coordinates:** -24.0539; 148.5601 (GDA 2020)
Water level: no flow – isolated	**Likely flow nature:** semi-permanent waterbody with ephemeral inflow
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, low risk of impact	
Water quality	
Time (EST): 16:06	**Water temperature:** 17.1˚C
Sp. Conductivity: 215.2 µS/cm	**pH:** 7.9
Dissolved oxygen: 99.3%	**Dissolved oxygen:** 9.59 mg/L
Turbidity: >1,000 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** moderately turbid
Water odour: none detected	**Water surface:** normal
Algae on substrate: S	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 70 m	**Bankfull width:** 250 m
Maximum depth: 2+ m	**Bankfull height:** 5 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep, pool	
Habitat attributes: periphyton (S)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 80% silt/clay (<0.05 mm), 20% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay	**Bank stability:** moderately stable
Bed stability: moderate erosion	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** none detected
Local catchment erosion: gully (L), rill (L), tunnel (L), sheet (L), bank slumping (L), cattle pugging (E)	

Upstream

Left bank

Downstream

Right bank

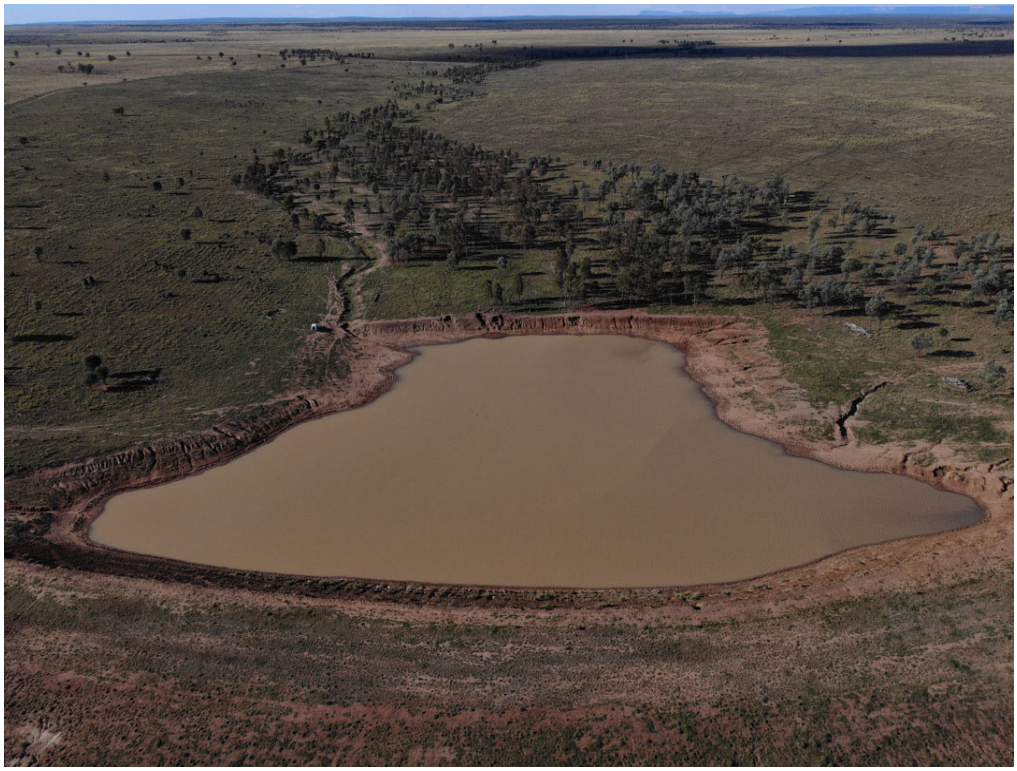
Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 5 m	**Width of riparian zone on right bank:** 5 m
Bare ground: S	**Grasses/forbs:** M
Shrubs: L	**Trees <10 m:** S
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: regrowth	**Dominant stratum:** tree
Health: average	**Dieback:** not detected
EDL height: 8 m	**EDL cover:** 35%
Canopy species: *Eucalyptus populnea* (D), *Acacia harpophylla* (O), *A. salicina* (O)	
Sub-canopy species:	
Shrub species: *Acacia harpophylla* (R)	
Ground species: *Cenchrus ciliaris** (D), *Bothriochloa* sp. (O), *Gomphrena celosioides** (O), *Eragrostis sp.* (O), *Cynodon dactylon var. dactylon** (O), *Chloris inflata** (O), *Urochloa mosambicensis** (O)	

Macrophytes
Submerged macrophytes: None detected
Floating macrophytes: None detected
Emergent macrophytes: None detected

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes:

Overall aquatic value: Low



Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: L3	**Location:** lacustrine waterbody, Togara Station
Date: 17/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0557; 148.6443 (GDA 2020)
Water level: no flow – isolated	**Likely flow nature:** semi-permanent waterbody with ephemeral inflow
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, moderate risk of impact	
Water quality	
Time (EST): 07:37	**Water temperature:** 14.9˚C
Sp. Conductivity: 99.6 µS/cm	**pH:** 6.7
Dissolved oxygen: 37.3%	**Dissolved oxygen:** 3.72 mg/L
Turbidity: 17.9 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: E	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 40 m	**Bankfull width:** 100 m
Maximum depth: 2+ m	**Bankfull height:** 5 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep, pool, macrophytes	
Habitat attributes: detritus (L), sticks (N), periphyton (L), filamentous algae (S), macrophytes (E), trailing bank vegetation (M)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** none detected
Local catchment erosion: gully (L), rill (L), bank slumping (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 8 m	**Width of riparian zone on right bank:** 8 m
Bare ground: S	**Grasses/forbs:** M
Shrubs: L	**Trees <10 m:** L
Trees >10m: L	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: exotic	**Dominant stratum:** grassland
Health: average	**Dieback:** not detected
EDL height: 1 m	**EDL cover:** 95%
Canopy species: *Eucalyptus cambageana* (D), *Eucalyptus tereticornis* (O)	
Sub-canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (O)	
Shrub species: *Acacia harpophylla* (R), *Carissa ovata* (R), *Eremophila sp.* (R), *Eremophila mitchellii* (R)	
Ground species: *Eleocharis plana* (D), *Marsilea drummondii* (F), *Megathyrsus maximus** (F), *Cenchrus ciliaris** (O), *Urochloa mosambicensis** (O)	

Macrophytes
Submerged macrophytes: *Potamogeton crispus* (L)
Floating macrophytes:
Emergent macrophytes: *Eleocharis plana* (E), *Ludwigia peploides* subsp. *montevidensis* (M), *Cyperus exaltatus* (S), *Persicaria attenuata* (S), *Marsilea drummondii* (E), *Leptochloa digitata* (L), *Ottelia ovalifolia* (S), *Echinochloa colona** (L), *Eclipta prostrata* (L), *Diplachne fusca* (L)

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes: Dam fenced off from cattle

Overall aquatic value: Low

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: L4	**Location:** lacustrine waterbody, Meroo Station
Date: 19/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0756; 148.7085 (GDA 2020)
Water level: no flow – isolated	**Likely flow nature:** semi-permanent waterbody with ephemeral inflow
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, low risk of impact	
Water quality	
Time (EST): 08:12	**Water temperature:** 15.9˚C
Sp. Conductivity: 221.2 µS/cm	**pH:** 8.6
Dissolved oxygen: 84.4%	**Dissolved oxygen:** 8.18 mg/L
Turbidity: 37 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: S	**Algae in water column:** N
Emergent macrophytes: L	**Submerged macrophytes:** L
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 60 m	**Bankfull width:** 200 m
Maximum depth: 1.5+ m	**Bankfull height:** 4 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep, pool, macrophytes	
Habitat attributes: detritus (L), periphyton (L), filamentous algae (L), macrophytes (L), trailing bank vegetation (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** none detected
Local catchment erosion: cattle pugging (E)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 1 m	**Width of riparian zone on right bank:** 1 m
Bare ground: M	**Grasses/forbs:** S
Shrubs: N	**Trees <10 m:** N
Trees >10m: N	**Exotic riparian species:** N
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: cleared	**Dominant stratum:** forbland
Health: average	**Dieback:** not detected
EDL height: 0.1 m	**EDL cover:** 30%
Canopy species:	
Sub-canopy species:	
Shrub species:	
Ground species: *Polygonum plebeium* (D), *Persicaria decipiens* (O), *Ludwigia peploides* subsp. *montevidensis* (O), *Centipeda minima* (D), *Glinus lotoides* (O), *Cyperus pygmaeus* (O), *Phyla canescens** (O)	

Macrophytes
Submerged macrophytes: *Other sp.* (L)
Floating macrophytes:
Emergent macrophytes: *Persicaria decipiens* (L), *Persicaria attenuata* (L), *Ludwigia peploides* subsp. *montevidensis* (L), *Leptochloa digitata* (L), *Juncus sp.* (L), *Ottelia ovalifolia* (L), *Marsilea drummondii* (L), *Cyperus difformis* , *Echinochloa colona** (L), *Eleocharis plana* (L)

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes:
Overall aquatic value: Low

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: HES1	**Location:** HES wetland, Togara Station
Date: 17/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0175; 148.6452 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** episodic
Stream order (Strahler): 1	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, moderate risk of impact	
Water quality	
Time (EST): 10:12	**Water temperature:** 13.8˚C
Sp. Conductivity: 175 µS/cm	**pH:** 7
Dissolved oxygen: 39.8%	**Dissolved oxygen:** 3.98 mg/L
Turbidity: 39.8 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** moderately turbid
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 1.5 m	**Bankfull width:** 4 m
Maximum depth: 0.2 m	**Bankfull height:** 1 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing,Natural	
Adjacent landuse (left bank): moderate grazing,natural	
Bed, edge and bank characteristics	
Bed substrates: 10% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 10% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy sand	**Bank stability:** moderately stable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (L), sand (L)
Local catchment erosion: gully (L), rill (L), bank slumping (L), cattle pugging (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 8 m	**Width of riparian zone on right bank:** 8 m
Bare ground: S	**Grasses/forbs:** M
Shrubs: S	**Trees <10 m:** S
Trees >10m: S	**Exotic riparian species:** S
Composition and health	
State-mapped RE: 11.5.16 downstream, non-remnant upstream	**Verified RE:** 11.5.3 downstream, regrowth 11.5.3 upstream
Vegetation status: remnant downstream, non-remnant upstream	**Dominant stratum:** tree
Health: average	**Dieback:** 1-10
EDL height: 10 m	**EDL cover:** 30%
Canopy species: *Eucalyptus populnea* (D)	
Sub-canopy species: *Eucalyptus populnea* (F), *Allocasuarina luehmannii* (O), *Acacia sp.* (O), *Geijera parviflora* (O)	
Shrub species: *Eremophila mitchellii* (O), *Grevillea striata* (O), *Atalaya hemiglauca* (O), *Melaleuca viridiflora* (R), *Cassia brewsteri* (O)	
Ground species: *Urochloa mosambicensis** (D), *Bothriochloa sp.* (O), *Heteropogon contortus* (O), *Stylosanthes scabra** (O), *Melinis repens** (O), *Aristida sp.* (O)	
Macrophytes	
Submerged macrophytes: None detected	
Floating macrophytes: None detected	
Emergent macrophytes: *Ludwigia octovalvis* (L), *Cyperus exaltatus* (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	3 (Poor)
2. Embeddedness	3 (Poor)
3. Velocity/depth category	2 (Poor)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	5 (Fair)
8. Bank vegetative stability	4 (Fair)
9. Streamside cover	9 (Excellent)
Overall score	**40 (Fair)**
Notes:	
Overall aquatic value: High (mapped HES wetland)	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: HES2	**Location:** HES wetland, Togara Station
Date: 17/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0187; 148.6533 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DoR 2022): no, not applicable	
Likely a watercourse: no	
State-mapped waterway providing for fish passage (DAF 2020): no	
Water quality	
Time (EST): 11:20	**Water temperature:** NA/dry
Sp. Conductivity: NA/dry	**pH:** NA/dry
Dissolved oxygen: NA/dry	**Dissolved oxygen:** NA/dry
Turbidity: NA/dry	**Ion sample collected:** no
Observations within 2 m of sampling point	
Shading: NA/dry	**Water colour:** NA/dry
Water odour: NA/dry	**Water surface:** NA/dry
Algae on substrate: NA/dry	**Algae in water column:**
Emergent macrophytes: NA	**Submerged macrophytes:** NA
Floating macrophytes: NA/dry	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** NA m
Maximum depth: 0 m	**Bankfull height:** NA m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat:	
Habitat attributes:	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 15% silt/clay (<0.05 mm), 85% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 15% silt/clay (<0.05 mm), 85% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy sand	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:**
Channel shape:	**Recent deposits:** none detected
Local catchment erosion: none detected	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: NA	**Width of riparian zone on right bank:** NA
Bare ground: L	**Grasses/forbs:** E
Shrubs: S	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: regrowth	**Dominant stratum:** shrubland
Health: good	**Dieback:** not detected
EDL height: 3 m	**EDL cover:** 35%
Canopy species: *Acacia leiocalyx* subsp. *leiocalyx* (D), *Allocasuarina luehmannii* (F), *Eucalyptus populnea* (F), *Grevillea striata* (O)	
Sub-canopy species:	
Shrub species:	
Ground species: *Aristida sp.* (D), *Heteropogon contortus* (O), *Melinis repens** (O), *Stylosanthes scabra** (O), *Sida sp.* (O), *Senecio brigalowensis* (O)	

Macrophytes
Submerged macrophytes: none detected
Floating macrophytes: none detected
Emergent macrophytes: none detected

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes:
Overall aquatic value: High (mapped HES wetland)

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: HES3	**Location:** HES wetland, Togara Station
Date: 17/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0154; 148.655 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
Stream order (Strahler): 1	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, moderate risk of impact	
Water quality	
Time (EST): 11:54	**Water temperature:** NA/dry
Sp. Conductivity: NA/dry	**pH:** NA/dry
Dissolved oxygen: NA/dry	**Dissolved oxygen:** NA/dry
Turbidity: NA/dry	**Ion sample collected:** no
Observations within 2 m of sampling point	
Shading: NA/dry	**Water colour:** NA/dry
Water odour: NA/dry	**Water surface:** NA/dry
Algae on substrate: NA/dry	**Algae in water column:** NA
Emergent macrophytes: NA	**Submerged macrophytes:** NA
Floating macrophytes: NA/dry	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 20 m
Maximum depth: 0 m	**Bankfull height:** 0.3 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: macrophytes	
Habitat attributes: detritus (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape:	**Recent deposits:** silt (N), sand (N)
Local catchment erosion: cattle pugging (S)	

Upstream

Left bank

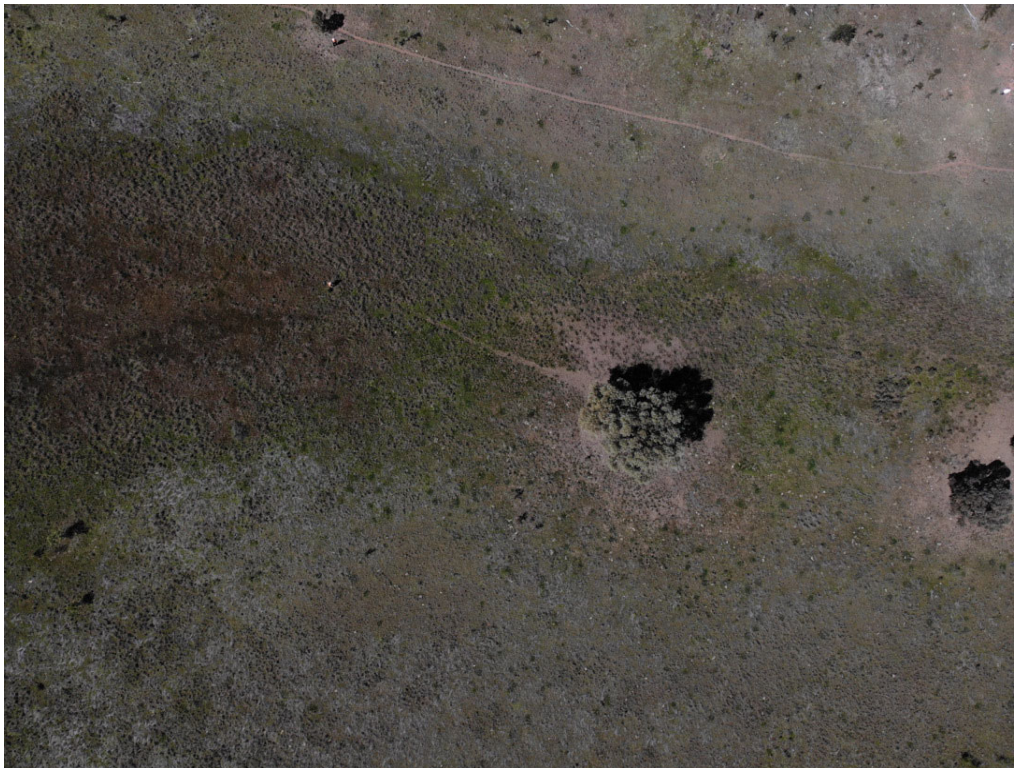
Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 1 m	**Width of riparian zone on right bank:** 1 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: cleared	**Dominant stratum:** forbland
Health: average	**Dieback:** not detected
EDL height: 0.5 m	**EDL cover:** 95%
Canopy species: *Acacia harpophylla* (O), *Eucalyptus populnea* (O)	
Sub-canopy species:	
Shrub species: *Allocasuarina luehmannii* (O), *Vachellia farnesiana** (O)	
Ground species: *Bothriochloa sp.* (D), *Centipeda minima* (F), *Senecio brigalowensis* (O), *Cyperus victoriensis (A), Lobelia sp.* (O), *Diplachne fusca* (O), *Alternanthera denticulata* (O), *Other sp.* (O)	
Macrophytes	
Submerged macrophytes: none detected	
Floating macrophytes: none detected	
Emergent macrophytes: *Cyperus concinnus* (L), *Cyperus victoriensis* (M), *Diplachne fusca* (L), *Echinochloa colona** (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	3 (Poor)
2. Embeddedness	3 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	12 (Excellent)
5. Bottom scouring and deposition	8 (Good)
6. Pool/riffle, run/bend ratio	1 (Poor)
7. Bank stability	9 (Excellent)
8. Bank vegetative stability	9 (Excellent)
9. Streamside cover	4 (Fair)
Overall score	**49 (Fair)**
Notes:	
Overall aquatic value: High (mapped HES wetland)	



Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: HES4	**Location:** HES wetland, Togara Station
Date: 17/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -23.9919; 148.6177 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** episodic
State-mapped watercourse (DoR 2022): not applicable	
Likely a watercourse:	
State-mapped waterway providing for fish passage (DAF 2020): no	
Water quality	
Time (EST): 13:32	**Water temperature:** NA/dry
Sp. Conductivity: NA/dry	**pH:** NA/dry
Dissolved oxygen: NA/dry	**Dissolved oxygen:** NA/dry
Turbidity: NA/dry	**Ion sample collected:** no
Observations within 2 m of sampling point	
Shading: NA/dry	**Water colour:** NA/dry
Water odour: NA/dry	**Water surface:** NA/dry
Algae on substrate: NA/dry	**Algae in water column:**
Emergent macrophytes: NA	**Submerged macrophytes:** NA
Floating macrophytes: NA/dry	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** NA m
Maximum depth: 0 m	**Bankfull height:** NA m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat: macrophytes, large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), macrophytes (L)	
Upstream landuse: natural	
Adjacent landuse (right bank): natural	
Adjacent landuse (left bank): natural	
Bed, edge and bank characteristics	
Bed substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:**
Channel shape:	**Recent deposits:** none detected
Local catchment erosion: cattle pugging (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: NA	**Width of riparian zone on right bank:** NA
Bare ground: E	**Grasses/forbs:** L
Shrubs: L	**Trees <10 m:** M
Trees >10m: L	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.5.16 borderline RE/regrowth
Vegetation status: regrowth	**Dominant stratum:** tree
Health: good	**Dieback:** not detected
EDL height: 10 m	**EDL cover:** 50%
Canopy species: *Casuarina cristata* (D)	
Sub-canopy species: *Melaleuca bracteata* (D), *Terminalia oblongata* subsp. *oblongata* (O)	
Shrub species: *Duma florulenta* (F), *Other sp.* (O), *Casuarina cristata* (O)	
Ground species: *Paspalidium sp.* (O), *Alternanthera denticulata* (O), *Cyperus concinnus* (O), *Sonchus oleraceus** (O), *Senecio brigalowensis* (O), *Sida sp.* (O), *Eriochloa pseudoacrotricha* (O), *Malva sp.* (O), *Centipeda minima* (O)	

Macrophytes
Submerged macrophytes:
Floating macrophytes:
Emergent macrophytes: *Duma florulenta* (L), *Cyperus concinnus* (L), *Marsilea sp.* (L), *Ludwigia peploides* subsp. *montevidensis* (L)

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes:
Overall aquatic value: High

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: HES5	**Location:** HES wetland, Togara Station
Date: 18/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -23.9905; 148.6428 (GDA 2020)
Water level: no flow – isolated	**Likely flow nature:** seasonal waterrbody with ephemeral inflow
State-mapped watercourse (DoR 2022): not applicable	
Likely a watercourse: not applicable	
State-mapped waterway providing for fish passage (DAF 2020): no	
Water quality	
Time (EST): 07:38	**Water temperature:** 13.1˚C
Sp. Conductivity: 109.6 µS/cm	**pH:** 8.0
Dissolved oxygen: 115.5%	**Dissolved oxygen:** 12.22 mg/L
Turbidity: 55.3 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 50%	**Water colour:** moderately turbid
Water odour: none detected	**Water surface:** scum
Algae on substrate: E	**Algae in water column:** N
Emergent macrophytes: S	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 50 m	**Bankfull width:** 70 m
Maximum depth: 1.5+ m	**Bankfull height:** 4 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep, pool, macrophytes	
Habitat attributes: detritus (L), periphyton (S), filamentous algae (E), macrophytes (S), bank overhang (S), trailing bank vegetation (E)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** none detected
Local catchment erosion: cattle pugging (S)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: S	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: cleared	**Dominant stratum:** shrubland
Health: poor	**Dieback:** 26-75
EDL height: 5 m	**EDL cover:** 20%
Canopy species: *Melaleuca bracteata* (D), *Acacia harpophylla* (F)	
Sub-canopy species:	
Shrub species: *Melaleuca bracteata* (O), *Duma florulenta* (O)	
Ground species: *Cenchrus ciliaris** (D), *Senecio brigalowensis* (O), *Cyperus exaltatus* (F), *Sida sp.* (O), *Parthenium hysterophorus** (F), *Megathyrsus maximus** (O), *Other sp.* (O), *Cyperus pygmaeus* (O), *Basilicum polystachyon* (O), *Eriochloa pseudoacrotricha* (O)	

Macrophytes
Submerged macrophytes: none detected
Floating macrophytes: none detected
Emergent macrophytes: *Cyperus exaltatus* (S), *Ludwigia octovalvis* (L), *Marsilea drummondii* (S), *Ottelia ovalifolia* (L), *Duma florulenta* (L), *Diplachne fusca* (L), *Juncus sp.* (L), *Eleocharis blakeana* (L)

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes: Tree/shrub-lined gilgai depressions within broader cleared wetland.

Overall aquatic value: High (mapped HES wetland)

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: P1	**Location:** mapped palustrine waterbody, Togara Station
Date: 18/08/2022	**Season:** dry
Assessor: DM	**Coordinates:** -24.0025; 148.6689 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** not a wetland
State-mapped watercourse (DoR 2022): not applicable	
Likely a watercourse: no	
State-mapped waterway providing for fish passage (DAF 2020): no	
Water quality	
Time (EST): 14:58	**Water temperature:** NA/dry
Sp. Conductivity: NA/dry	**pH:** NA/dry
Dissolved oxygen: NA/dry	**Dissolved oxygen:** NA/dry
Turbidity: NA/dry	**Ion sample collected:** no
Observations within 2 m of sampling point	
Shading: NA/dry	**Water colour:** NA/dry
Water odour: NA/dry	**Water surface:** NA/dry
Algae on substrate: NA/dry	**Algae in water column:** NA/dry
Emergent macrophytes: NA	**Submerged macrophytes:** NA
Floating macrophytes: NA/dry	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** NA m
Maximum depth: 0 m	**Bankfull height:** NA m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat:	
Habitat attributes: detritus (L)	
Upstream landuse: light grazing, natural	
Adjacent landuse (right bank): light grazing, natural	
Adjacent landuse (left bank): light grazing, natural	
Bed, edge and bank characteristics	
Bed substrates: 50% silt/clay (<0.05 mm), 50% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 50% silt/clay (<0.05 mm), 50% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy loam	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:**
Channel shape:	**Recent deposits:** none detected
Local catchment erosion: sheet (L)	

Upstream

Left bank

Downstream

Right bank

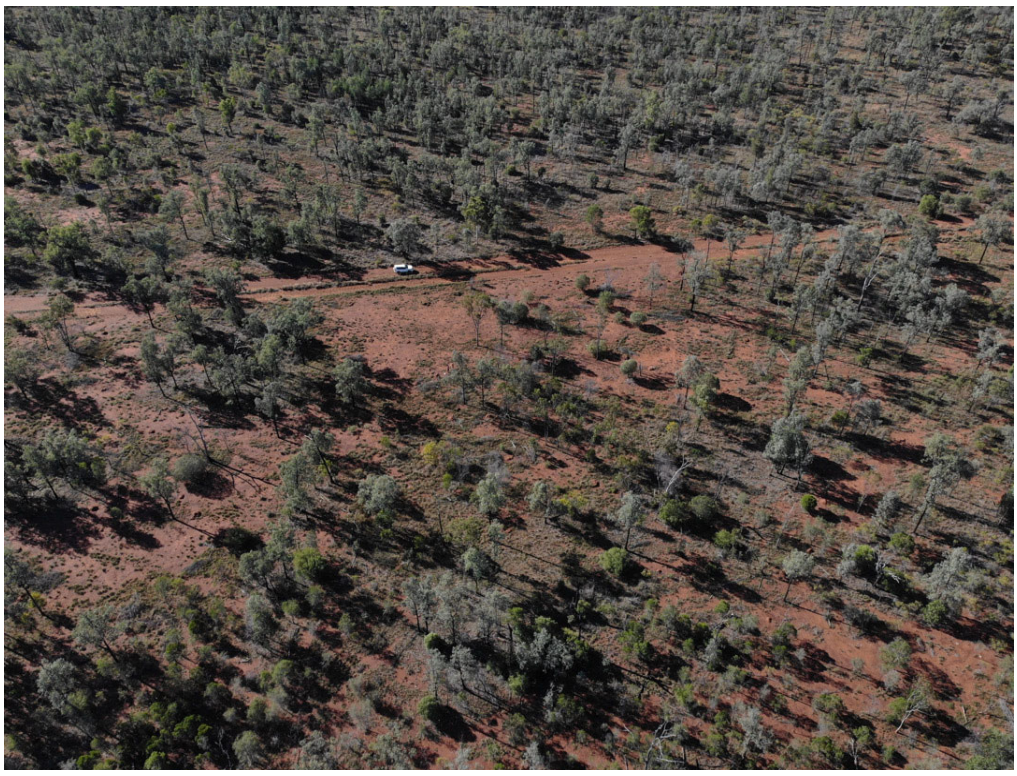
Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: NA m	**Width of riparian zone on right bank:** NA m
Bare ground: S	**Grasses/forbs:** S
Shrubs: S	**Trees <10 m:** S
Trees >10m: N	**Exotic riparian species:** L
Composition and health	
State-mapped RE: 11.5.3	**Verified RE:** 11.5.3
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** 1-10
EDL height: 8 m	**EDL cover:** 20%
Canopy species: *Eucalyptus melanophloia* (D), *Eucalyptus populnea* (O), *Corymbia dallachiana* (R)	
Sub-canopy species: *Alphitonia sp.* (O), *Eucalyptus melanophloia* (O), *Melaleuca viridiflora* (O)	
Shrub species: *Acacia leiocalyx* subsp. *leiocalyx (A), Erythroxylum australe* (O), *Petalostigma pubescens* (O), *Grewia latifolia* (O), *Senna artemisioides* (F)	
Ground species: *Triodia sp.* (D), *Themeda triandra* (O), *Melinis repens** (O), *Sida sp.* (O), *Heteropogon contortus* (O), *Other sp.* (O)	

Macrophytes
Submerged macrophytes: none detected
Floating macrophytes: none detected
Emergent macrophytes: none detected

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes: no wetland features detected; unlikely to be a wetland

Overall aquatic value: Low



Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R1	**Location:** unnamed tributary of Comet River, Meroo Downs
Date: 15/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0875; 148.6333 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
Stream order (Strahler): 1	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, low risk of impact	
Water quality	
Time (EST): 15:00	**Water temperature:** NA/dry
Sp. Conductivity: NA/dry	**pH:** NA/dry
Dissolved oxygen: NA/dry	**Dissolved oxygen:** NA/dry
Turbidity: NA/dry	**Ion sample collected:** no
Observations within 2 m of sampling point	
Shading: NA/dry	**Water colour:** NA/dry
Water odour: NA/dry	**Water surface:** NA/dry
Algae on substrate: No	**Algae in water column:** NA/dry
Emergent macrophytes: No	**Submerged macrophytes:** NA
Floating macrophytes: NA/dry	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 10 m
Maximum depth: 0 m	**Bankfull height:** 1 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat:	
Habitat attributes:	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 91% silt/clay (<0.05 mm), 2% sand (0.05-2 mm), 5% gravel (2-4 mm), 2% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 91% silt/clay (<0.05 mm), 2% sand (0.05-2 mm), 5% gravel (2-4 mm), 2% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: gravelly clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** None detected
Local catchment erosion: cattle pugging (S)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 1 m	**Width of riparian zone on right bank:** 1 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: exotic	**Dominant stratum:** grassland
Health: degraded	**Dieback:** not detected
EDL height: 1 m	**EDL cover:** 90%
Canopy species: *Eucalyptus populnea* (R), *Eucalyptus cambageana* (R)	
Sub-canopy species:	
Shrub species: *Acacia harpophylla* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Atalaya hemiglauca* (O), *Sesbania cannabina* (O)	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** (A), *Sida rhombifolia** (O), *Malvastrum americanum var. americanum** (O), *Bothriochloa bladhii* (O), *Clitoria ternatea** (O), *Aristida* sp. (O)	
Macrophytes	
Submerged macrophytes: NA	
Floating macrophytes: NA	
Emergent macrophytes: None detected	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	1 (Poor)
2. Embeddedness	1 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	12 (Excellent)
5. Bottom scouring and deposition	10 (Good)
6. Pool/riffle, run/bend ratio	3 (Poor)
7. Bank stability	9 (Excellent)
8. Bank vegetative stability	9 (Excellent)
9. Streamside cover	4 (Fair)
Overall score	**49 (Fair)**
Notes:	
Overall aquatic value: low	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R2	**Location:** unnamed tributary of Comet River, Meroo Downs
Date: 13/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.083; 148.6186 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** ephemeral
Stream order (Strahler): 1	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, low risk of impact	
Water quality	
Time (EST): 15:34	**Water temperature:** 29.6˚C
Sp. Conductivity: 161 µS/cm	**pH:** 6.1
Dissolved oxygen: 53.1%	**Dissolved oxygen:** 3.9 mg/L
Turbidity: >1000 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 80%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0.5 m	**Bankfull width:** 20 m
Maximum depth: 0.2 m	**Bankfull height:** 1.7 m
Habitat types: 0% riffle, 0% run, 3% sandy pool, 0% rocky pool, 97% dry	
Variety of habitat: shallow (<0.5 m) pool, large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), bank overhang (L), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 40% silt/clay (<0.05 mm), 54% sand (0.05-2 mm), 5% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 60% silt/clay (<0.05 mm), 34% sand (0.05-2 mm), 5% gravel (2-4 mm), 1% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay	**Bank stability:** unstable
Bed stability: extensive deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (E)
Local catchment erosion: gully (E), rill (S),tunnel (L), sheet (L), bank slumping (L), cattle pugging (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: S	**Grasses/forbs:** M
Shrubs: S	**Trees <10 m:** S
Trees >10m: N	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: regrowth	**Dominant stratum:** tree
Health: poor	**Dieback:** 1-10
EDL height: 6 m	**EDL cover:** 20%
Canopy species: *Acacia harpophylla* (D), *Eucalyptus populnea* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Geijera parviflora* (O)	
Sub-canopy species:	
Shrub species: *Acacia harpophylla* (D), *Santalum lanceolatum* (O), *Carissa ovata* (O)	
Ground species: *Cenchrus ciliaris** (D), *Urochloa mosambicensis** (F), *Bothriochloa bladhii* (F), *Heteropogon contortus* (O), *Parthenium hysterophorus** (O)	
Macrophytes	
Submerged macrophytes: NA	
Floating macrophytes: NA	
Emergent macrophytes: None detected	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	1 (Poor)
2. Embeddedness	1 (Poor)
3. Velocity/depth category	1 (Poor)
4. Channel alteration	3 (Poor)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	5 (Fair)
8. Bank vegetative stability	2 (Poor)
9. Streamside cover	9 (Excellent)
Overall score	**29 (Poor)**
Notes:	
Overall aquatic value: Low	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R4	**Location:** Humboldt Creek, Meroo Downs
Date: 15/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0787; 148.569 (GDA 2020)
Water level: low (< watermark)	**Likely flow nature:** episodic
Stream order (Strahler): 6	
State-mapped watercourse (DoR 2022): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, major risk of impact	
Water quality	
Time (EST): 12:38	**Water temperature:** 30.7˚C
Sp. Conductivity: 121 µS/cm	**pH:** 6.8
Dissolved oxygen: 19.1%	**Dissolved oxygen:** 1.41 mg/L
Turbidity: >1000 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 60%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 2 m	**Bankfull width:** 20 m
Maximum depth: 0.25 m	**Bankfull height:** 1.5 m
Habitat types: 0% riffle, 10% run, 90% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m) pool, run, large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), filamentous algae (L), bank overhang (L), trailing bank vegetation (L), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing, natural	
Adjacent landuse (left bank): non-irrigated cropping, natural	
Bed, edge and bank characteristics	
Bed substrates: 60% silt/clay (<0.05 mm), 39% sand (0.05-2 mm), 1% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 80% silt/clay (<0.05 mm), 19% sand (0.05-2 mm), 1% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: moderate erosion	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (E), sand (S)
Local catchment erosion: cattle pugging (E)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 20 m
Bare ground: M	**Grasses/forbs:** S
Shrubs: S	**Trees <10 m:** M
Trees >10m: S	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Borderline remnant
Vegetation status: regrowth	**Dominant stratum:** tree
Health: good	**Dieback:** not detected
EDL height: 11 m	**EDL cover:** 35%
Canopy species: *Eucalyptus coolabah* (D), *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (O)	
Sub-canopy species: *Melaleuca linariifolia* (D), *Acacia harpophylla* (A), *Lysiphyllum hookeri* (O)	
Shrub species:	
Ground species: *Basilicum polystachyon* (F), *Cyperus difformis* (O), *Megathyrsus maximus** (F), *Alternanthera denticulata* (O)	
Macrophytes	
Submerged macrophytes:	
Floating macrophytes:	
Emergent macrophytes: *Cyperus difformis* (L), *Leptochloa digitata* (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	5 (Poor)
2. Embeddedness	5 (Poor)
3. Velocity/depth category	6 (Fair)
4. Channel alteration	2 (Poor)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	8 (Good)
8. Bank vegetative stability	2 (Poor)
9. Streamside cover	9 (Excellent)
Overall score	**45 (Fair)**
Notes:	
Overall aquatic value: Moderate	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R7	**Location:** unnamed tributary of Comet River, Meroo Downs
Date: 15/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0786; 148.5853 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** ephemeral
Stream order (Strahler): 1	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, low risk of impact	
Water quality	
Time (EST): 13:38	**Water temperature:** 37.1˚C
Sp. Conductivity: 202 µS/cm	**pH:** 7.7
Dissolved oxygen: 92.4%	**Dissolved oxygen:** 6.25 mg/L
Turbidity: 110 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** moderately turbid
Water odour: N	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0.5 m	**Bankfull width:** 5 m
Maximum depth: 0.2 m	**Bankfull height:** 0.6 m
Habitat types: 0% riffle, 0% run, 5% sandy pool, 0% rocky pool, 95% dry	
Variety of habitat: shallow (<0.5 m) pool	
Habitat attributes:	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 75% silt/clay (<0.05 mm), 23% sand (0.05-2 mm), 2% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy clay	**Bank stability:** moderately stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (L), sand (L)
Local catchment erosion: rill (L), bank slumping (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 1 m	**Width of riparian zone on right bank:** 1 m
Bare ground: N	**Grasses/forbs:** E
Shrubs: S	**Trees <10 m:** N
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: exotic	**Dominant stratum:** grassland
Health: completely degraded	**Dieback:** not detected
EDL height: 0.8 m	**EDL cover:** 100%
Canopy species:	
Sub-canopy species:	
Shrub species: *Acacia harpophylla* (R), *Sesbania cannabina* (O)	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** (F), *Bothriochloa bladhii* (O), *Echinochloa colona** (O), *Malvastrum americanum var. americanum**	
Macrophytes	
Submerged macrophytes:	
Floating macrophytes:	
Emergent macrophytes: *Echinochloa colona** (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes: I	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	1 (Poor)
2. Embeddedness	1 (Poor)
3. Velocity/depth category	1 (Poor)
4. Channel alteration	3 (Poor)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	1 (Poor)
7. Bank stability	8 (Good)
8. Bank vegetative stability	9 (Excellent)
9. Streamside cover	3 (Fair)
Overall score	**30 (Poor)**
Notes: Blade-ploughed paddock	
Overall aquatic value: Low	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R8	**Location:** tributary of Three Mile Creek, Togara Station
Date: 16/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0292; 148.6111 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** episodic
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): no	
Water quality	
Time (EST): 13:53	**Water temperature:** 27.0 ˚C
Sp. Conductivity: 190 µS/cm	**pH:** 6.4
Dissolved oxygen: 9.1%	**Dissolved oxygen:** 0.71 mg/L
Turbidity: 655 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** opaque
Water odour: none detected	**Water surface:** algal scum
Algae on substrate: L	**Algae in water column:** N
Emergent macrophytes: L	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 4 m	**Bankfull width:** 15 m
Maximum depth: 0.5 m	**Bankfull height:** 1 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m) pool, macrophytes	
Habitat attributes: detritus (L), sticks (L), branches (L), periphyton (L), filamentous algae (S), macrophytes (S), bank overhang (L), trailing bank vegetation (M), blanketing silt (S)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** moderately stable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (L)
Local catchment erosion: gully (L), rill (L), cattle pugging (S)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 8 m	**Width of riparian zone on right bank:** 8 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: exotic	**Dominant stratum:** grassland
Health: poor	**Dieback:** 26-75
EDL height: 0.5 m	**EDL cover:** 80%
Canopy species: *Acacia harpophylla* (O)	
Sub-canopy species:	
Shrub species:	
Ground species: *Chloris* sp. (D), *Cynodon dactylon var. dactylon** (A), *Echinochloa colona** (O), *Diplachne fusca* (O), *Leptochloa digitata* (O)	
Macrophytes	
Submerged macrophytes: None detected	
Floating macrophytes: None detected	
Emergent macrophytes: *Leptochloa digitata* (L), *Cyperus betchei* (L), *Echinochloa colona** (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	1 (Poor)
2. Embeddedness	1 (Poor)
3. Velocity/depth category	3 (Poor)
4. Channel alteration	3 (Poor)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	7 (Good)
8. Bank vegetative stability	8 (Good)
9. Streamside cover	5 (Fair)
Overall score	**35 (Poor)**
Notes:	
Overall aquatic value: Low	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R9	**Location:** Rockland Creek, Memaloo Station
Date: 13/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0758; 148.7202 (GDA 2020)
Water level: low (< watermark)	**Likely flow nature:** episodic
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, high risk of impact	
Water quality	
Time (EST): 07:51	**Water temperature:** 25.7˚C
Sp. Conductivity: 89 µS/cm	**pH:** 6.8
Dissolved oxygen: 67.3%	**Dissolved oxygen:** 5.47 mg/L
Turbidity: >1000 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 80%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 2.5 m	**Bankfull width:** 12 m
Maximum depth: 0.5 m	**Bankfull height:** 2 m
Habitat types: 10% riffle, 70% run, 10% sandy pool, 10% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m),pool,run,riffle,large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), bank overhang (L), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing, natural	
Adjacent landuse (left bank): moderate grazing, natural	
Bed, edge and bank characteristics	
Bed substrates: 45% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 2% gravel (2-4 mm), 40% pebble (4-64 mm), 3% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 82% silt/clay (<0.05 mm), 15% sand (0.05-2 mm), 1% gravel (2-4 mm), 1% pebble (4-64 mm), 1% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy loam	**Bank stability:** moderately unstable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (L)
Local catchment erosion: gully (L), rill (L), bank slumping (S), cattle pugging (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 20 m	**Width of riparian zone on right bank:** 20 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: M	**Exotic riparian species:** M
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.3.25/11.3.2
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** 1-10
EDL height: 18 m	**EDL cover:** 35%
Canopy species: *Eucalyptus tereticornis* (D), *Corymbia tessellaris* (A), *E. populnea* (A)	
Sub-canopy species: *Corymbia tessellaris* (D), *Eucalyptus populnea* (F), *Acacia harpophylla* (F), *Acacia salicina* (F), *Terminalia oblongata* subsp. *oblongata* (O)	
Shrub species: *Eremophila mitchellii* (O), *Acacia salicina* (O), *Terminalia oblongata* subsp. *oblongata* (O), *Vachellia farnesiana** (O), *Acacia harpophylla* (O)	
Ground species: *Cenchrus ciliaris** (D), *Megathyrsus maximus** (A), *Bothriochloa bladhii* (A), *Parthenium hysterophorus** (F), *Polymeria* sp. (F)	
Macrophytes	
Submerged macrophytes:	
Floating macrophytes:	
Emergent macrophytes:	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely habitat	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	15 (Good)
2. Embeddedness	15 (Good)
3. Velocity/depth category	10 (Fair)
4. Channel alteration	10 (Good)
5. Bottom scouring and deposition	7 (Fair)
6. Pool/riffle, run/bend ratio	5 (Fair)
7. Bank stability	5 (Fair)
8. Bank vegetative stability	7 (Good)
9. Streamside cover	9 (Excellent)
Overall score	**83 (Good)**
Notes:	
Overall aquatic value: Moderate	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R11	**Location:** Comet River, Meroo Station
Date: 14/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0215; 148.533 (GDA 2020)
Water level: high (> watermark)	**Likely flow nature:** seasonal
State-mapped watercourse (DoR 2022): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, major risk of impact	
Water quality	
Time (EST): 09:37	**Water temperature:** 26.2˚C
Sp. Conductivity: 135 µS/cm	**pH:** 7.1
Dissolved oxygen: 75.4%	**Dissolved oxygen:** 6.1 mg/L
Turbidity: NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 15 m	**Bankfull width:** 50 m
Maximum depth: 2+ m	**Bankfull height:** 8 m
Habitat types: 0% riffle, 50% run, 50% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep (>0.5 m), pool, run, large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), bank overhang (L), trailing bank vegetation (E), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): natural	
Adjacent landuse (left bank): natural	
Bed, edge and bank characteristics	
Bed substrates: 25% silt/clay (<0.05 mm), 70% sand (0.05-2 mm), 5% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 75% silt/clay (<0.05 mm), 25% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay loam	**Bank stability:** moderately stable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (S)
Local catchment erosion: bank slumping (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 100 m	**Width of riparian zone on right bank:** 100 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: M	**Trees <10 m:** M
Trees >10m: M	**Exotic riparian species:** S
Composition and health	
State-mapped RE: 11.3.25/11.3.3	**Verified RE:** 11.3.25
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** not detected
EDL height: 28 m	**EDL cover:** 70%
Canopy species: *Eucalyptus tereticornis* (D), *Corymbia tessellaris* (A), *Casuarina cunninghamiana* (O)	
Sub-canopy species: *Lysiphyllum hookeri* (A), *Melaleuca linariifolia* (F), *Ficus opposita* (O), *Acacia salicina* (F), *Casuarina cunninghamiana* (O)	
Shrub species: *Melaleuca linariifolia* (F), *Acacia salicina* (F), *Lomandra longifolia* (O), *Xanthium occidentale** (F), *Lomandra hystrix* (O)	
Ground species: *Megathyrsus maximus** (D), *Alternanthera denticulata* (O), *Cyperus* sp. (O)	
Macrophytes	
Submerged macrophytes: None detected	
Floating macrophytes: None detected	
Emergent macrophytes: None detected	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: bycatch from turtle sampling	
Suitable habitat for EVNT turtle species: yes	
Turtle sampling undertaken: yes	
Aquatic vertebrates encountered: spangled perch (*Leiopotherapon unicolor*), bony bream (*Nematalosa erebi*), freshwater catfish (*Tandanus tandanus*), sleepy cod (*Oxyeleotris lineolata*), Hyrtl's catfish (*Neosilurus hyrtlii*), Agassiz's glassfish (*Ambassis agassizii*)	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	3 (Poor)
2. Embeddedness	3 (Poor)
3. Velocity/depth category	16 (Excellent)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	6 (Fair)
7. Bank stability	8 (Good)
8. Bank vegetative stability	10 (Excellent)
9. Streamside cover	10 (Excellent)
Overall score	**64 (Fair)**
Notes: 2 x baited fyke nets deployed for 1 night	
Overall aquatic value: High	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R12	**Location:** Comet River, Meroo Station
Date: 14/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.064; 148.544 (GDA 2020)
Water level: high (> watermark)	**Likely flow nature:** seasonal
State-mapped watercourse (DoR 2022): yes	
Likely a watercourse: yes - clear channel and bank structure, and clear presence of riparian vegetation structure	
State-mapped waterway providing for fish passage (DAF 2020): yes, major risk of impact	
Water quality	
Time (EST): 13:32	**Water temperature:** 26.8˚C
Sp. Conductivity: 161 µS/cm	**pH:** 6.7
Dissolved oxygen: 75.4%	**Dissolved oxygen:** 6.04 mg/L
Turbidity: >1000 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 95%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 20 m	**Bankfull width:** 45 m
Maximum depth: 2+ m	**Bankfull height:** 8 m
Habitat types: 0% riffle, 40% run, 60% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep, pool, run, large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), bank overhang (L), trailing bank vegetation (E), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): natural, light grazing	
Adjacent landuse (left bank): irrigated cropping	
Bed, edge and bank characteristics	
Bed substrates: 60% silt/clay (<0.05 mm), 35% sand (0.05-2 mm), 5% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 60% silt/clay (<0.05 mm), 35% sand (0.05-2 mm), 5% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay loam	**Bank stability:** moderately stable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (S)
Local catchment erosion: cattle pugging (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 50 m	**Width of riparian zone on right bank:** 50 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: S	**Trees <10 m:** S
Trees >10m: M	**Exotic riparian species:** S
Composition and health	
State-mapped RE: 11.3.25/11.3.3	**Verified RE:** 11.3.25
Vegetation status: remnant	**Dominant stratum:** tree
Health: good	**Dieback:** not detected
EDL height: 25 m	**EDL cover:** 60%
Canopy species: *Eucalyptus tereticornis* (D), *Eucalyptus coolabah* (A)	
Sub-canopy species: *Lysiphyllum hookeri* (A), *Acacia salicina* (F), *Melaleuca linariifolia* (A)	
Shrub species: *Melaleuca linariifolia* (F), *Acacia salicina* (O), *Acacia salicina* (O)	
Ground species: *Megathyrsus maximus** (D)	
Macrophytes	
Submerged macrophytes: None detected	
Floating macrophytes: None detected	
Emergent macrophytes: None detected	

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: yes
Turtle sampling undertaken: no
Aquatic vertebrates encountered: white-throated snapping turtle (*Elseya albagula*), sleepy cod (*Oxyeleotris lineolata*), Hyrtl's catfish (*Neosilurus hyrtlii*), spangled perch (*Leiopotherapon unicolor*), Agassiz's glassfish (*Ambassis agassizii*), eastern rainbowfish (*Melanotaenia splendida splendida*), bony bream (*Nematalosa erebi*)
Notes: screened irrigation water offtake on left bank

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	3 (Poor)
2. Embeddedness	3 (Poor)
3. Velocity/depth category	12 (Good)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	6 (Fair)
7. Bank stability	8 (Good)
8. Bank vegetative stability	10 (Excellent)
9. Streamside cover	10 (Excellent)
Overall score	**60 (Fair)**
Notes:	
Overall aquatic value: High	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: R13	**Location:** tributary of Rockland Creek, Memaloo Station
Date: 16/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0652; 148.7442 (GDA 2020)
Water level: no flow - dry	**Likely flow nature:** ephemeral
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, moderate risk of impact	
Water quality	
Time (EST): 07:47	**Water temperature:** NA/dry
Sp. Conductivity: NA/dry	**pH:** NA/dry
Dissolved oxygen: NA/dry	**Dissolved oxygen:** NA/dry
Turbidity: NA/dry	**Ion sample collected:** no
Observations within 2 m of sampling point	
Shading: NA/dry	**Water colour:** NA/dry
Water odour: NA/dry	**Water surface:** NA/dry
Algae on substrate: No	**Algae in water column:** NA/dry
Emergent macrophytes: No	**Submerged macrophytes:** NA
Floating macrophytes: NA/dry	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 0 m	**Bankfull width:** 8 m
Maximum depth: 0 m	**Bankfull height:** 1.5 m
Habitat types: 0% riffle, 0% run, 0% sandy pool, 0% rocky pool, 100% dry	
Variety of habitat:	
Habitat attributes: blanketing silt (S)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 20% silt/clay (<0.05 mm), 70% sand (0.05-2 mm), 5% gravel (2-4 mm), 5% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 50% silt/clay (<0.05 mm), 40% sand (0.05-2 mm), 5% gravel (2-4 mm), 5% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy clay	**Bank stability:** unstable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** silt (S), sand (S)
Local catchment erosion: gully (M), rill (S), tunnel (L), bank slumping (S), cattle pugging (S)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 8 m	**Width of riparian zone on right bank:** 8 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** S
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: regrowth	**Dominant stratum:** tree
Health: poor	**Dieback:** not detected
EDL height: 4 m	**EDL cover:** 20%
Canopy species: *Acacia harpophylla* (D)	
Sub-canopy species:	
Shrub species: *Acacia harpophylla* (O), *Sesbania cannabina* (O)	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** (O), *Urochloa mosambicensis** (O), *Enchylaena tomentosa* (O), *Sida rhombifolia** (O)	
Macrophytes	
Submerged macrophytes: None detected	
Floating macrophytes: None detected	
Emergent macrophytes: None detected	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	
Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	2 (Poor)
2. Embeddedness	2 (Poor)
3. Velocity/depth category	0 (Poor)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	3 (Poor)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	2 (Poor)
8. Bank vegetative stability	5 (Fair)
9. Streamside cover	9 (Excellent)
Overall score	**32 (Poor)**
Notes:	
Overall aquatic value: Low	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: L1	**Location:** lacustrine wetland, Meroo Downs
Date: 13/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0607; 148.5753 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** episodic
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): no	
Water quality	
Time (EST): 12:49	**Water temperature:** 27.6˚C
Sp. Conductivity: 159 µS/cm	**pH:** 6.4
Dissolved oxygen: 4%	**Dissolved oxygen:** 0.4 mg/L
Turbidity: 464 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 10%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: E	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 8 m	**Bankfull width:** 100 m
Maximum depth: 0.3 m	**Bankfull height:** 1 m
Habitat types: 0% riffle, 0% run, 5% sandy pool, 0% rocky pool, 95% dry	
Variety of habitat: macrophytes, shallow (<0.5 m) pool	
Habitat attributes: detritus (L), macrophytes (L), blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 94% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 1% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 94% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 1% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** moderately stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** None detected
Local catchment erosion: cattle pugging (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 1 m	**Width of riparian zone on right bank:** 1 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: N	**Trees <10 m:** N
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: exotic	**Dominant stratum:** grassland
Health: poor	**Dieback:** not detected
EDL height: 1 m	**EDL cover:** 90%
Canopy species:	
Sub-canopy species:	
Shrub species: *Sesbania cannabina* (F)	
Ground species: *Cenchrus ciliaris** (D), *Parthenium hysterophorus** (F), *Cyperus concinnus* (F), *Leptochloa digitata* (O), *Ammannia multiflora* (F), *Marsilea hirsuta* (F), *Basilicum polystachyon* (O), *Alternanthera denticulata* (O)	

Macrophytes
Submerged macrophytes:
Floating macrophytes:
Emergent macrophytes: *Leptochloa digitata* (S), *Marsilea hirsuta* (L), *Ludwigia octovalvis* (S), *Echinochloa colona** (L), *Juncus usitatus* (L), *Diplachne fusca* (L), *Cyperus concinnus* (L), *C. difformis* (L)

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken:
Aquatic vertebrates encountered:
Notes:
Overall aquatic value: Low

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: L2	**Location:** lacustrine waterbody, Meroo Downs
Date: 13/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0535; 148.5599 (GDA 2020)
Water level: no flow – isolated	**Likely flow nature:** semi-permanent waterbody with ephemeral inflow
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, low risk of impact	
Water quality	
Time (EST): 14:18	**Water temperature:** 30.1˚C
Sp. Conductivity: 141 µS/cm	**pH:** 8.6
Dissolved oxygen: 130.3%	**Dissolved oxygen:** 9.6 mg/L
Turbidity: 42.5 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: L	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 100 m	**Bankfull width:** 250 m
Maximum depth: 2+ m	**Bankfull height:** 5 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep, pool	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 80% silt/clay (<0.05 mm), 20% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 80% silt/clay (<0.05 mm), 20% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay	**Bank stability:** moderately unstable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** none detected
Local catchment erosion: sheet (L), cattle pugging (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 5 m	**Width of riparian zone on right bank:** 5 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** S
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: regrowth	**Dominant stratum:** tree
Health: average	**Dieback:** not detected
EDL height: 8 m	**EDL cover:** 35%
Canopy species: *Eucalyptus populnea* (D), *Acacia harpophylla* (O), *Acacia salicina* (O)	
Sub-canopy species:	
Shrub species: *Acacia harpophylla* (R), *Ficus opposita* (O)	
Ground species: *Cenchrus ciliaris** (D), *Urochloa mosambicensis** (F), *Bothriochloa* sp. (O), *Glinus lotoides* (O), *Gomphrena celosioides** (O), *Eragrostis* sp. (O), *Centipeda minima* (O), *Cynodon dactylon var. dactylon** (O)	

Macrophytes
Submerged macrophytes: None detected
Floating macrophytes: None detected
Emergent macrophytes: None detected
Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes:
Notes:
Overall aquatic value: Low

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: L3	**Location:** lacustrine waterbody, Togara Station
Date: 13/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0557; 148.6441 (GDA 2020)
Water level: no flow – isolated	**Likely flow nature:** semi-permanent waterbody with ephemeral inflow
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, moderate risk of impact	
Water quality	
Time (EST): 11:07	**Water temperature:** 31.4˚C
Sp. Conductivity: 117 µS/cm	**pH:** 6.5
Dissolved oxygen: 91.8%	**Dissolved oxygen:** 6.77 mg/L
Turbidity: 26.9 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 50%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: L	**Algae in water column:** N
Emergent macrophytes: E	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 40 m	**Bankfull width:** 100 m
Maximum depth: 2+ m	**Bankfull height:** 5 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep, pool, macrophytes	
Habitat attributes: detritus (L), periphyton (L), filamentous algae (S), macrophytes (E), trailing bank vegetation (M)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** None detected
Local catchment erosion: gully (L), rill (L), bank slumping (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 8 m	**Width of riparian zone on right bank:** 8 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: L	**Trees <10 m:** L
Trees >10m: L	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: exotic	**Dominant stratum:** grassland
Health: average	**Dieback:** not detected
EDL height: 1 m	**EDL cover:** 95%
Canopy species: *Eucalyptus cambageana* (D), *Eucalyptus tereticornis* (O)	
Sub-canopy species: *Acacia harpophylla* (D), *Terminalia oblongata* subsp. *oblongata* (O)	
Shrub species: *Acacia harpophylla* (R), *Carissa ovata* (R), *Eremophila* sp. (R), *Eremophila mitchellii* (R)	
Ground species: *Eleocharis plana* (D), *Marsilea drummondii* (F), *Megathyrsus maximus** (F), *Cenchrus ciliaris** (O), *Urochloa mosambicensis** (O)	

Macrophytes
Submerged macrophytes: *Potamogeton crispus* (L)
Floating macrophytes: *Ottelia ovalifolia* (S), *Azolla filiculoides* (L)
Emergent macrophytes: *Persicaria attenuata* (S), *Ludwigia peploides* subsp. *montevidensis* (E), *Cyperus exaltatus* (M), *Marsilea drummondii* (E), *Leptochloa digitata* (L), *Echinochloa colona** (L), *Eclipta prostrata* (L), *Diplachne fusca var. fusca* (L), *Persicaria orientalis* (L), *Eleocharis plana* (E), *Cyperus betchei* (L), *Monochoria cyanea* (L), *Damasonium minus* (L), *Cyperus difformis* (L), *Eleocharis philippinensis* (L)
Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes:
Overall aquatic value: Low

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

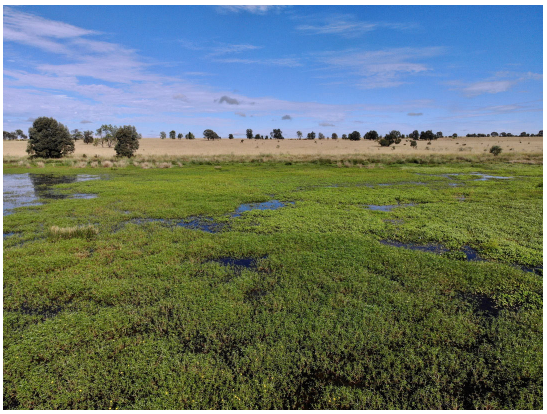
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: L4	**Location:** lacustrine waterbody, Meroo Station
Date: 13/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0782; 148.7082 (GDA 2020)
Water level: no flow – isolated	**Likely flow nature:** semi-permanent waterbody with ephemeral inflow
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely a drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, low risk of impact	
Water quality	
Time (EST): 08:55	**Water temperature:** 27.8˚C
Sp. Conductivity: 170 µS/cm	**pH:** 7.7
Dissolved oxygen: 74.1%	**Dissolved oxygen:** 5.81 mg/L
Turbidity: 31.3 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: S	**Algae in water column:** N
Emergent macrophytes: E	**Submerged macrophytes:** L
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 150 m	**Bankfull width:** 200 m
Maximum depth: 2+ m	**Bankfull height:** 4 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep, pool, macrophytes	
Habitat attributes: detritus (L), periphyton (L), filamentous algae (L), macrophytes (E), trailing bank vegetation (M)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 90% silt/clay (<0.05 mm), 10% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: sandy clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** none detected
Local catchment erosion: cattle pugging (L)	

Upstream

Left bank

Downstream



Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 1 m	**Width of riparian zone on right bank:** 1 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: N	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: cleared	**Dominant stratum:** forbland
Health: good	**Dieback:** not detected
EDL height: 0.4 m	**EDL cover:** 80%
Canopy species:	
Sub-canopy species:	
Shrub species:	
Ground species: *Ludwigia peploides* subsp. *montevidensis* (D), *Centipeda minima* (F), *Leptochloa digitata* (F), *Glinus lotoides* (O), *Monochoria cyanea* (O), *Marsilea drummondii* (F), *Marsilea hirsuta* (O), *Cyperus exaltatus* (O), *Caldesia oligococca* (R), *Persicaria attenuata* (F), *Ludwigia octovalvis* (O), *Juncus usitatus* (O), *Cyperus difformis* (O), *Eclipta prostrata** (O), *Eleocharis* sp. (O), *Eleocharis plana*, *Phyla canescens** (O), *Persicaria decipiens* (O), *Ottelia ovalifolia* (O), *Echinochloa colona** (O), *Diplachne fusca var. fusca* (O)	

Macrophytes
Submerged macrophytes:
Floating macrophytes:
Emergent macrophytes: *Ludwigia peploides* subsp. *montevidensis* (E), *Leptochloa digitata* (S), *Monochoria cyanea* (L), *Marsilea drummondii* (S), *Marsilea hirsuta* (L), *Cyperus exaltatus* (L), *Caldesia oligococca* (L), *Persicaria attenuata* (S), *Ludwigia octovalvis* (L), *Juncus usitatus* (L), *Cyperus difformis* (L), *Eclipta prostrata** (L), *Eleocharis* sp. (L), *Eleocharis plana* (L), *Persicaria decipiens* (L), *Ottelia ovalifolia* (L), *Echinochloa colona** (L), *Diplachne fusca* var. *fusca* (L)

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes:
Overall aquatic value: Low

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: HES1	**Location:** HES wetland, Togara Station
Date: 16/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -24.0174; 148.6454 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** episodic
Stream order (Strahler): 1	
State-mapped watercourse (DoR 2022): no, unmapped	
Likely a watercourse: no, likely drainage feature	
State-mapped waterway providing for fish passage (DAF 2020): yes, moderate risk of impact	
Water quality	
Time (EST): 09:08	**Water temperature:** 26.7˚C
Sp. Conductivity: 131 µS/cm	**pH:** 6.6
Dissolved oxygen: 15.9%	**Dissolved oxygen:** 1.33 mg/L
Turbidity: 268 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 0%	**Water colour:** moderately turbid
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: N	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 2.5 m	**Bankfull width:** 4 m
Maximum depth: 0.4 m	**Bankfull height:** 1 m
Habitat types: 0% riffle, 0% run, 20% sandy pool, 0% rocky pool, 80% dry	
Variety of habitat: large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L) blanketing silt (L)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 10% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 10% silt/clay (<0.05 mm), 90% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: loamy sand	**Bank stability:** moderately stable
Bed stability: moderate deposition	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** Silt (L), sand (M)
Local catchment erosion: gully (L), rill (L), bank slumping (L), cattle pugging (L)	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 8 m	**Width of riparian zone on right bank:** 8 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: S	**Trees <10 m:** S
Trees >10m: S	**Exotic riparian species:** S
Composition and health	
State-mapped RE: 11.5.16 downstream, non-remnant upstream	**Verified RE:** 11.5.3 downstream, non-remnant upstream (appears to have been recently pelleted)
Vegetation status: remnant downstream, non-remnant upstream	**Dominant stratum:** tree
Health: average	**Dieback:** 1-10
EDL height: 10 m	**EDL cover:** 30%
Canopy species: *Eucalyptus populnea* (D)	
Sub-canopy species: *Eucalyptus populnea* (F), *Allocasuarina luehmannii* (O), *Acacia* sp. (O), *Geijera parviflora* (O), *Melaleuca viridiflora* (R)	
Shrub species: *Eremophila mitchellii* (O), *Grevillea striata* (O), *Atalaya hemiglauca* (O), *Cassia brewsteri* (O)	
Ground species: *Urochloa mosambicensis** (D), *Bothriochloa bladhii* (O), *Heteropogon contortus* (O), *Stylosanthes scabra** (O), *Melinis repens** (O), *Aristida* sp. (O)	
Macrophytes	
Submerged macrophytes: None detected	
Floating macrophytes: None detected	
Emergent macrophytes: *Ludwigia octovalvis* (L), *Cyperus exaltatus* (L), *Cyperus difformis* (L), *Echinochloa colona** (L)	

Aquatic biota	
Aquatic macroinvertebrate sampling undertaken: no	
Habitat for platypus: unlikely	
Habitat for EVNT fish species: unlikely	
Fish sampling undertaken: no	
Suitable habitat for EVNT turtle species: unlikely	
Turtle sampling undertaken: no	
Aquatic vertebrates encountered:	
Notes:	

Aquatic habitat assessment scoring	
1. Bottom substrate/available cover	3 (Poor)
2. Embeddedness	3 (Poor)
3. Velocity/depth category	2 (Poor)
4. Channel alteration	5 (Fair)
5. Bottom scouring and deposition	5 (Fair)
6. Pool/riffle, run/bend ratio	4 (Fair)
7. Bank stability	5 (Fair)
8. Bank vegetative stability	4 (Fair)
9. Streamside cover	9 (Excellent)
Overall score	**40 (Fair)**
Notes:	
Overall aquatic value: High (mapped HES wetland)	

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: HES4	**Location:** HES wetland, Togara Station
Date: 16/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -23.9917; 148.6177 (GDA 2020)
Water level: no flow - isolated	**Likely flow nature:** episodic
State-mapped watercourse (DoR 2022): not applicable	
Likely a watercourse:	
State-mapped waterway providing for fish passage (DAF 2020): no	
Water quality	
Time (EST): 11:53	**Water temperature:** 31˚C
Sp. Conductivity: 121 µS/cm	**pH:** 6.5
Dissolved oxygen: 51.1%	**Dissolved oxygen:** 3.71 mg/L
Turbidity: NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 10%	**Water colour:** opaque
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: L	**Submerged macrophytes:** N
Floating macrophytes: N	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 1 m	**Bankfull width:** NA m
Maximum depth: 0.2 m	**Bankfull height:** NA m
Habitat types: 0% riffle, 0% run, 1% sandy pool, 0% rocky pool, 99% dry	
Variety of habitat: shallow (<0.5 m) pool, macrophytes, large woody debris	
Habitat attributes: detritus (L), sticks (L), branches (L), logs (L), macrophytes (L)	
Upstream landuse: natural	
Adjacent landuse (right bank): natural	
Adjacent landuse (left bank): natural	
Bed, edge and bank characteristics	
Bed substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 100% silt/clay (<0.05 mm), 0% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:**
Channel shape:	**Recent deposits:** none detected
Local catchment erosion: none detected	

Upstream

Left bank

Downstream

Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: NA	**Width of riparian zone on right bank:** NA m
Bare ground: M	**Grasses/forbs:** S
Shrubs: L	**Trees <10 m:** M
Trees >10m: L	**Exotic riparian species:** L
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** 11.5.16 borderline RE/regrowth
Vegetation status: regrowth	**Dominant stratum:** tree
Health: good	**Dieback:** not detected
EDL height: 10 m	**EDL cover:** 50%
Canopy species: *Casuarina cristata* (D)	
Sub-canopy species: *Melaleuca bracteata* (D), *Terminalia oblongata* subsp. *oblongata* (O)	
Shrub species: *Duma florulenta* (F), *Casuarina cristata* (O), *Abutilon* sp. (O), *Sclerolaena* sp. (O)	
Ground species: *Alternanthera denticulata* (O), *Eriochloa crebra* (O), *Cyperus concinnus* (O), *Centipeda minima* (O), *Walwhalleya subxerophila* (O)	

Macrophytes
Submerged macrophytes:
Floating macrophytes:
Emergent macrophytes: *Duma florulenta* (L), *Cyperus concinnus* (L), *Marsilea* sp. (L), *Diplachne fusca* (L), Walwhalleya subxerophila (L)

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes:
Overall aquatic value: high

Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Site code: HES5	**Location:** HES wetland, Togara Station
Date: 16/03/2023	**Season:** wet
Assessor: DM	**Coordinates:** -23.9904; 148.6428 (GDA 2020)
Water level: no flow – isolated	**Likely flow nature:** seasonal waterbody with ephemeral inflow
State-mapped watercourse (DoR 2022): not applicable	
Likely a watercourse: not applicable	
State-mapped waterway providing for fish passage (DAF 2020): no	
Water quality	
Time (EST): 10:37	**Water temperature:** 27.2˚C
Sp. Conductivity: 126 µS/cm	**pH:** 6.2
Dissolved oxygen: 23.4%	**Dissolved oxygen:** 1.9 mg/L
Turbidity: 45.4 NTU	**Ion sample collected:** yes
Observations within 2 m of sampling point	
Shading: 10%	**Water colour:** clear
Water odour: none detected	**Water surface:** normal
Algae on substrate: N	**Algae in water column:** N
Emergent macrophytes: E	**Submerged macrophytes:** E
Floating macrophytes: E	
Reach observations (100 m reach, or 10 x modal width)	
Mean wetted width: 50 m	**Bankfull width:** 70 m
Maximum depth: 1.5+ m	**Bankfull height:** 4 m
Habitat types: 0% riffle, 0% run, 100% sandy pool, 0% rocky pool, 0% dry	
Variety of habitat: shallow (<0.5 m), deep, pool, macrophytes	
Habitat attributes: detritus (L), periphyton (S), macrophytes (E), bank overhang (S), trailing bank vegetation (E)	
Upstream landuse: moderate grazing	
Adjacent landuse (right bank): moderate grazing	
Adjacent landuse (left bank): moderate grazing	
Bed, edge and bank characteristics	
Bed substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Edge substrates: 95% silt/clay (<0.05 mm), 5% sand (0.05-2 mm), 0% gravel (2-4 mm), 0% pebble (4-64 mm), 0% cobble (64-256 mm), 0% boulder (>256 mm), 0% bedrock	
Bank soils: clay	**Bank stability:** stable
Bed stability: bed stable	**Bank shape:** concave
Channel shape: U shaped	**Recent deposits:** none detected
Local catchment erosion: cattle pugging (L)	

Upstream

Left bank

Downstream

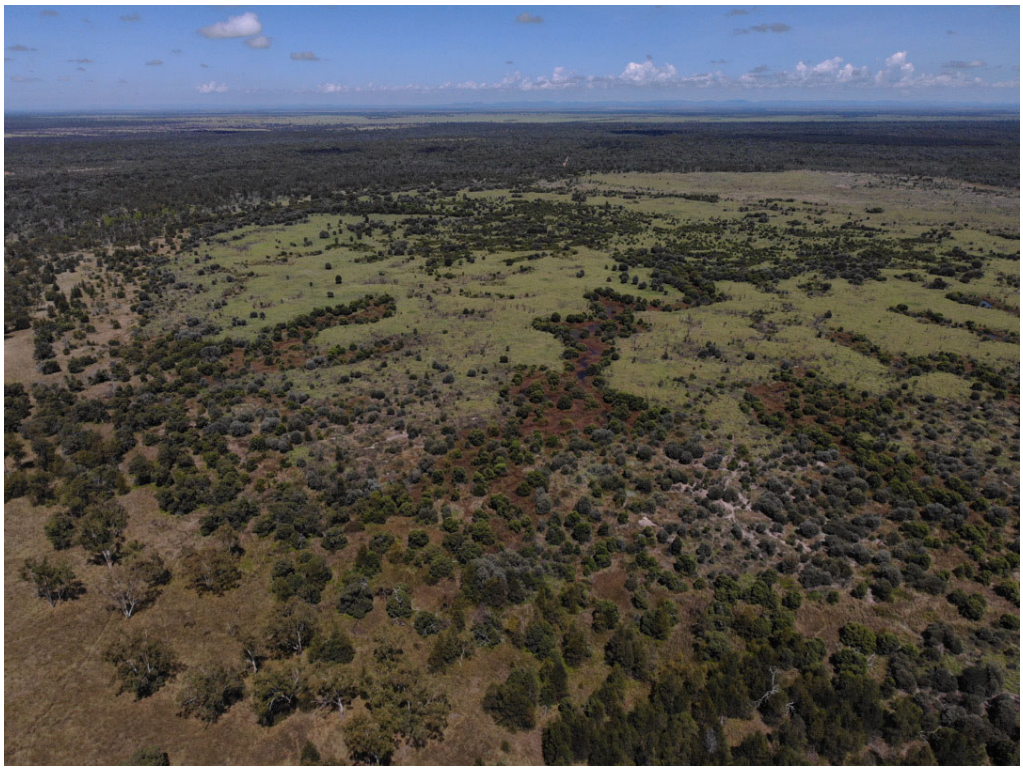
Right bank

Notes:
Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001).

Riparian vegetation	
Cover	
Width of riparian zone on left bank: 10 m	**Width of riparian zone on right bank:** 10 m
Bare ground: L	**Grasses/forbs:** E
Shrubs: S	**Trees <10 m:** L
Trees >10m: N	**Exotic riparian species:** E
Composition and health	
State-mapped RE: Non-remnant	**Verified RE:** Non-remnant
Vegetation status: cleared	**Dominant stratum:** shrubland
Health: poor	**Dieback:** 26-75
EDL height: 5 m	**EDL cover:** 20%
Canopy species: *Melaleuca bracteata* (D), *Acacia harpophylla* (F)	
Sub-canopy species:	
Shrub species: *Melaleuca bracteata* (O), *Duma florulenta* (O)	
Ground species: *Cenchrus ciliaris** (D), *Cyperus exaltatus* (F), *Sida* sp. (O), *Parthenium hysterophorus** (F), *Megathyrsus maximus** (O), *Basilicum polystachyon* (O)	

Macrophytes
Submerged macrophytes: *Najas tenuifolia* (E)
Floating macrophytes: *Azolla filiculoides* (E), *Ottelia ovalifolia* (E)
Emergent macrophytes: *Cyperus exaltatus* (M), *Ludwigia octovalvis* (L), *Cyperus difformis* (L), *Marsilea drummondii* (S), *Duma florulenta* (L), *Monochoria cyanea* (L), *Cyperus betchei* (L), *Cyperus concinnus* (L), *Philydrum lanuginosum* (L), *Diplachne fusca* (L)

Aquatic biota
Aquatic macroinvertebrate sampling undertaken: no
Habitat for platypus: unlikely habitat
Habitat for EVNT fish species: unlikely
Fish sampling undertaken: no
Suitable habitat for EVNT turtle species: unlikely
Turtle sampling undertaken: no
Aquatic vertebrates encountered:
Notes: Tree/shrub-lined gilgai depressions within broader cleared wetland.
Overall aquatic value: High (mapped HES wetland)



Aerial photograph from 100 m above ground level; upstream (left) to downstream (right)

Notes:

Aquatic cover categories: None detected (N), Little (L; 1-10%), Some (S; 10-50%), Moderate (M; 50-75%), Extensive (E; >75%), as per DNRM (2001). Terrestrial cover categories: Dominant (D), Abundant (A), Frequent (F), Occasional (O), Rare (R).

Appendix C: Water Sampling Analytical Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2224631**	Page	: 1 of 3
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: DPM22006 Mahalo North Project - Togara	Date Samples Received	: 23-Aug-2022 08:40
Order number	: ----	Date Analysis Commenced	: 24-Aug-2022
C-O-C number	: ----	Issue Date	: 02-Sep-2022 09:34
Sampler	: DAVID MOORE		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 4		
No. of samples analysed	: 4		

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, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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 Contract 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.

- 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**)			Sample ID	L3	HES1	R8	HES5	----
			Sampling date / time	17-Aug-2022 00:00	17-Aug-2022 00:00	18-Aug-2022 00:00	18-Aug-2022 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2224631-001**	**EB2224631-002**	**EB2224631-003**	**EB2224631-004**	--------
				Result	Result	Result	Result	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**45**	**84**	**52**	**59**	----
Total Alkalinity as CaCO3	----	1	mg/L	**45**	**84**	**52**	**59**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	<1	<1	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**5**	**7**	**20**	**2**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**2**	**10**	**4**	**9**	----
Magnesium	7439-95-4	1	mg/L	**3**	**7**	**3**	**2**	----
Sodium	7440-23-5	1	mg/L	**16**	**17**	**28**	**9**	----
Potassium	7440-09-7	1	mg/L	**4**	**5**	**5**	**7**	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**1.04**	**1.88**	**1.60**	**1.24**	----
ø Total Cations	----	0.01	meq/L	**1.14**	**1.94**	**1.79**	**1.18**	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB2224631**	Page	: 1 of 3
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: DPM22006 Mahalo North Project - Togara	Date Samples Received	: 23-Aug-2022
Order number	: ----	Date Analysis Commenced	: 24-Aug-2022
C-O-C number	: ----	Issue Date	: 02-Sep-2022
Sampler	: DAVID MOORE		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 4		
No. of samples analysed	: 4		

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, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

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

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
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
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED037P: Alkalinity by PC Titrator (QC Lot: 4539069)									
EB2224638-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	360	360	0.0	0% - 20%
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	11400	11300	0.8	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	11800	11700	0.8	0% - 20%
EB2224568-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	69	66	4.4	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	69	66	4.4	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 4539930)									
EB2224631-001	L3	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.0	No Limit
EB2224685-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	350	344	1.7	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 4539931)									
EB2224631-001	L3	ED045G: Chloride	16887-00-6	1	mg/L	5	5	0.0	No Limit
EB2224685-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	12500	12500	0.2	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 4540705)									
EB2223579-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	<1	<1	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	<1	<1	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	2	1	0.0	No Limit
		ED093F: Potassium	7440-09-7	1	mg/L	<1	<1	0.0	No Limit
EB2224297-003	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	39	39	0.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	27	28	0.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	72	73	1.8	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED037P: Alkalinity by PC Titrator (QCLot: 4539069)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	114	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4539930)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	101	85.0	118
				<1	100 mg/L	99.1	85.0	118
ED045G: Chloride by Discrete Analyser (QCLot: 4539931)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	96.0	90.0	115
				<1	1000 mg/L	103	90.0	115
ED093F: Dissolved Major Cations (QCLot: 4540705)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	96.7	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	103	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	105	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	98.5	70.0	130

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4539930)							
EB2224631-002	HES1	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	109	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 4539931)							
EB2224631-002	HES1	ED045G: Chloride	16887-00-6	400 mg/L	108	70.0	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2224631**	Page	: 1 of 4
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Telephone	: +61-7-3243 7222
Project	: DPM22006 Mahalo North Project - Togara	Date Samples Received	: 23-Aug-2022
Site	: ----	Issue Date	: 02-Sep-2022
Sampler	: DAVID MOORE	No. of samples received	: 4
Order number	: ----	No. of samples analysed	: 4

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
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Natural							
L3,	HES1	----	----	----	26-Aug-2022	24-Aug-2022	**2**
Clear Plastic Bottle - Natural							
R8,	HES5	----	----	----	26-Aug-2022	25-Aug-2022	**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
ED037P: Alkalinity by PC Titrator								
Clear Plastic Bottle - Natural (ED037-P)								
L3,	HES1	**17-Aug-2022**	**----**	----	----	**24-Aug-2022**	31-Aug-2022	✓
Clear Plastic Bottle - Natural (ED037-P)								
R8,	HES5	**18-Aug-2022**	**----**	----	----	**24-Aug-2022**	01-Sep-2022	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Clear Plastic Bottle - Natural (ED041G)								
L3,	HES1	**17-Aug-2022**	**----**	----	----	**25-Aug-2022**	14-Sep-2022	✓
Clear Plastic Bottle - Natural (ED041G)								
R8,	HES5	**18-Aug-2022**	**----**	----	----	**25-Aug-2022**	15-Sep-2022	✓
ED045G: Chloride by Discrete Analyser								
Clear Plastic Bottle - Natural (ED045G)								
L3,	HES1	**17-Aug-2022**	**----**	----	----	**25-Aug-2022**	14-Sep-2022	✓
Clear Plastic Bottle - Natural (ED045G)								
R8,	HES5	**18-Aug-2022**	**----**	----	----	**25-Aug-2022**	15-Sep-2022	✓
ED093F: Dissolved Major Cations								
Clear Plastic Bottle - Natural (ED093F)								
L3,	HES1	**17-Aug-2022**	**----**	----	----	**26-Aug-2022**	24-Aug-2022	×
Clear Plastic Bottle - Natural (ED093F)								
R8,	HES5	**18-Aug-2022**	**----**	----	----	**26-Aug-2022**	25-Aug-2022	×

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)							
Alkalinity by Auto Titrator	ED037-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	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
Alkalinity by Auto Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm.
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 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 Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EB2224631**

Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: dmoore@dpm-enviro.com.au	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: ----	Telephone	: +61-7-3243 7222
Facsimile	: ----	Facsimile	: +61-7-3243 7218
Project	: DPM22006 Mahalo North Project - Togara	Page	: 1 of 2
Order number	: ----	Quote number	: EB2019DPMENV0001 (EN/333)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: DAVID MOORE		

Dates

Date Samples Received	: 23-Aug-2022 08:40	Issue Date	: 24-Aug-2022
Client Requested Due Date	: 30-Aug-2022	Scheduled Reporting Date	: **30-Aug-2022**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 3	Temperature	: 2.3°C / 5.3°C / 3.0°C - Ice Bricks present
Receipt Detail	: HARD ESKIES	No. of samples received / analysed	: 4 / 4

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The laboratory will process these samples unless instructions are received from you indicating you do not wish to proceed. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	Sampling date / time	Sample ID	WATER - NT-01 & 02 Ca, Mg, Na, K, Cl, SO4, Alkalinity
EB2224631-001	17-Aug-2022 00:00	L3	✓
EB2224631-002	17-Aug-2022 00:00	HES1	✓
EB2224631-003	18-Aug-2022 00:00	R8	✓
EB2224631-004	18-Aug-2022 00:00	HES5	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

DAVID MOORE

- *AU Certificate of Analysis - NATA (COA)	Email	dmoore@dpm-enviro.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	dmoore@dpm-enviro.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	dmoore@dpm-enviro.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	dmoore@dpm-enviro.com.au
- A4 - AU Tax Invoice (INV)	Email	dmoore@dpm-enviro.com.au
- Chain of Custody (CoC) (COC)	Email	dmoore@dpm-enviro.com.au
- EDI Format - ENMRG (ENMRG)	Email	dmoore@dpm-enviro.com.au
- EDI Format - XTab (XTAB)	Email	dmoore@dpm-enviro.com.au

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8162 9130 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: ALSEnviro.Gladstone@alsglobal.com

MACKAY Unit 2/20 Caterpillar Drive Paget QLD 4740 Ph: 07 4952 5795 E: ALSEnviro.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 26 Ripon Way Wangara WA 6065 Ph: 08 9406 1301 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 13 Carlton Street Kirwan QLD 4817 Ph: 07 4773 0000 E: ALSEnviro.Townsville@alsglobal.com

WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: DPM Enviroscienses Pty Ltd	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT **(List due date):**	**FOR LABORATORY USE ONLY (Circle)**
OFFICE: Buderim		☐ Non Standard or urgent TAT **(List due date):**	Custody Seal Intact? Yes / No / N/A
PROJECT: Mahalo North Project – Togara **PROJECT NO.:** DPM22006	**ALS QUOTE NO.:** EN/333/20	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes / No / N/A
ORDER NUMBER: N/A **PURCHASE ORDER NO.:** N/A	**COUNTRY OF ORIGIN:** Australia	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: David Moore **CONTACT PH:** 0427 694 433		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: David Moore **SAMPLER MOBILE:** 0427 694 433	**RELINQUISHED BY:** S. Cuttle	**RECEIVED BY:** ANN RODDA	**RELINQUISHED BY:** Ala.m
COC Emailed to ALS? (YES / NO) **EDD FORMAT (or default):**	DATE/TIME: 19/8/22 14:41	DATE/TIME: 19.8.22 16:42	DATE/TIME: 22/08/22 1500
Email Reports to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au			**RECEIVED BY:** DATE/TIME: 23/8/22 0840
Email Invoice to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.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	Cations & Anions: Major (Ca, Mg, Na, K, Cl, SO_4, Alkalinity) + Ionic Balance (Suite NT-1 & NT-2)							Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	L3	17/08/2022	W	P	1	✓							
2	HES1	17/08/2022	W	P	1	✓							
3	R8	18/08/2022	W	P	1	✓							
4	HES5	18/08/2022	W	P	1	✓							
				TOTAL	4								

Environmental Division
Brisbane
Work Order Reference
EB2224631

Telephone : – 61-7-3243 7222

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	: **EB2224636**	Page	: 1 of 4
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: DPM22006 Mahalo North Project - Meroo	Date Samples Received	: 23-Aug-2022 08:40
Order number	: ----	Date Analysis Commenced	: 24-Aug-2022
C-O-C number	: ----	Issue Date	: 02-Sep-2022 09:34
Sampler	: DAVID MOORE		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 6		
No. of samples analysed	: 6		

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, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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 Contract 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.

- 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)			Sample ID	R4	R5	L1	L2	R6
			Sampling date / time	16-Aug-2022 00:00	16-Aug-2022 00:00	16-Aug-2022 00:00	16-Aug-2022 00:00	16-Aug-2022 00:00
Compound	CAS Number	LOR	Unit	EB2224636-001	EB2224636-002	EB2224636-003	EB2224636-004	EB2224636-005
				Result	Result	Result	Result	Result
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	49	94	97	94	94
Total Alkalinity as CaCO3	----	1	mg/L	49	94	97	94	94
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	4	2	<1	1	2
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	16	8	4	7	8
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	9	18	28	22	18
Magnesium	7439-95-4	1	mg/L	4	10	3	6	10
Sodium	7440-23-5	1	mg/L	16	13	8	8	13
Potassium	7440-09-7	1	mg/L	5	4	12	16	4
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	1.51	2.14	2.05	2.10	2.14
ø Total Cations	----	0.01	meq/L	1.60	2.39	2.30	2.35	2.39

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Sample ID	R10	----	----	----	----
				Sampling date / time	19-Aug-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB2224636-006	--------	--------	--------	--------
					Result	----	----	----	----
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**47**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L		**47**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**4**	----	----	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**16**	----	----	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**8**	----	----	----	----
Magnesium	7439-95-4	1	mg/L		**4**	----	----	----	----
Sodium	7440-23-5	1	mg/L		**16**	----	----	----	----
Potassium	7440-09-7	1	mg/L		**4**	----	----	----	----
EN055: Ionic Balance									
ø **Total Anions**	----	0.01	meq/L		**1.47**	----	----	----	----
ø **Total Cations**	----	0.01	meq/L		**1.53**	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB2224636**	Page	: 1 of 4
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: DPM22006 Mahalo North Project - Meroo	Date Samples Received	: 23-Aug-2022
Order number	: ----	Date Analysis Commenced	: 24-Aug-2022
C-O-C number	: ----	Issue Date	: 02-Sep-2022
Sampler	: DAVID MOORE		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 6		
No. of samples analysed	: 6		

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, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

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

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
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
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED037P: Alkalinity by PC Titrator (QC Lot: 4537578)									
EB2224568-006	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	687	728	5.8	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	687	728	5.8	0% - 20%
EB2224633-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	426	421	1.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	426	421	1.0	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 4537581)									
EB2224636-006	R10	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	47	48	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	47	48	0.0	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 4539930)									
EB2224631-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.0	No Limit
EB2224685-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	350	344	1.7	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 4539931)									
EB2224631-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	5	5	0.0	No Limit
EB2224685-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	12500	12500	0.2	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 4540706)									
EB2224632-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	16	16	0.0	0% - 50%
		ED093F: Magnesium	7439-95-4	1	mg/L	8	8	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	24	24	0.0	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED093F: Dissolved Major Cations (QC Lot: 4540706) - continued									
EB2224632-001	Anonymous	ED093F: Potassium	7440-09-7	1	mg/L	7	7	0.0	No Limit
EB2224636-006	R10	ED093F: Calcium	7440-70-2	1	mg/L	8	8	0.0	No Limit
		ED093F: Magnesium	7439-95-4	1	mg/L	4	4	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	16	16	0.0	0% - 50%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED037P: Alkalinity by PC Titrator (QCLot: 4537578)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	97.9	80.0	120
ED037P: Alkalinity by PC Titrator (QCLot: 4537581)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	99.0	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4539930)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	101	85.0	118
				<1	100 mg/L	99.1	85.0	118
ED045G: Chloride by Discrete Analyser (QCLot: 4539931)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	96.0	90.0	115
				<1	1000 mg/L	103	90.0	115
ED093F: Dissolved Major Cations (QCLot: 4540706)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	117	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	102	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	104	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	97.3	70.0	130

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4539930)							
EB2224631-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	109	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 4539931)							
EB2224631-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	108	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2224636**	Page	: 1 of 4
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Telephone	: +61-7-3243 7222
Project	: DPM22006 Mahalo North Project - Meroo	Date Samples Received	: 23-Aug-2022
Site	: ----	Issue Date	: 02-Sep-2022
Sampler	: DAVID MOORE	No. of samples received	: 6
Order number	: ----	No. of samples analysed	: 6

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

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

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
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) R4, R5, L1, L2, R6	**16-Aug-2022**	**----**	----	----	**24-Aug-2022**	30-Aug-2022	✓
Clear Plastic Bottle - Natural (ED037-P) R10	**19-Aug-2022**	**----**	----	----	**24-Aug-2022**	02-Sep-2022	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) R4, R5, L1, L2, R6	**16-Aug-2022**	**----**	----	----	**25-Aug-2022**	13-Sep-2022	✓
Clear Plastic Bottle - Natural (ED041G) R10	**19-Aug-2022**	**----**	----	----	**25-Aug-2022**	16-Sep-2022	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) R4, R5, L1, L2, R6	**16-Aug-2022**	**----**	----	----	**25-Aug-2022**	13-Sep-2022	✓
Clear Plastic Bottle - Natural (ED045G) R10	**19-Aug-2022**	**----**	----	----	**25-Aug-2022**	16-Sep-2022	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Filtered; Lab-acidified (ED093F) R4, R5, L1, L2, R6	**16-Aug-2022**	**----**	----	----	**26-Aug-2022**	13-Sep-2022	✓
Clear Plastic Bottle - Natural (ED093F) R10	**19-Aug-2022**	**----**	----	----	**26-Aug-2022**	26-Aug-2022	✓

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)							
Alkalinity by Auto Titrator	ED037-P	3	21	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	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
Alkalinity by Auto Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm.
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 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 Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EB2224636**

Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: dmoore@dpm-enviro.com.au	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: ----	Telephone	: +61-7-3243 7222
Facsimile	: ----	Facsimile	: +61-7-3243 7218
Project	: DPM22006 Mahalo North Project - Meroo	Page	: 1 of 2
Order number	: ----	Quote number	: EB2019DPMENV0001 (EN/333)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: DAVID MOORE		

Dates

Date Samples Received	: 23-Aug-2022 08:40	Issue Date	: 23-Aug-2022
Client Requested Due Date	: 30-Aug-2022	Scheduled Reporting Date	: **30-Aug-2022**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 3	Temperature	: 2.3°C / 5.3°C / 3.0°C - Ice Bricks present
Receipt Detail	: HARD ESKIES	No. of samples received / analysed	: 6 / 6

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The laboratory will process these samples unless instructions are received from you indicating you do not wish to proceed. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	Sampling date / time	Sample ID	WATER - NT-01 & 02 Ca, Mg, Na, K, Cl, SO4, Alkalinity
EB2224636-001	16-Aug-2022 00:00	R4	✓
EB2224636-002	16-Aug-2022 00:00	R5	✓
EB2224636-003	16-Aug-2022 00:00	L1	✓
EB2224636-004	16-Aug-2022 00:00	L2	✓
EB2224636-005	16-Aug-2022 00:00	R6	✓
EB2224636-006	19-Aug-2022 00:00	R10	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

DAVID MOORE

- *AU Certificate of Analysis - NATA (COA)	Email	dmoore@dpm-enviro.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	dmoore@dpm-enviro.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	dmoore@dpm-enviro.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	dmoore@dpm-enviro.com.au
- A4 - AU Tax Invoice (INV)	Email	dmoore@dpm-enviro.com.au
- Chain of Custody (CoC) (COC)	Email	dmoore@dpm-enviro.com.au
- EDI Format - ENMRG (ENMRG)	Email	dmoore@dpm-enviro.com.au
- EDI Format - XTab (XTAB)	Email	dmoore@dpm-enviro.com.au

21 esky MVTN12 6790

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 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 4976 7944 E: ALSEnviro.Gladstone@alsglobal.com

MACKAY Unit 2/20 Caterpillar Drive Paget QLD 4740 Ph: 07 4952 5795 E: ALSEnviro.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 26 Ripali Way Wangara WA 6065 Ph: 08 9406 1301 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 13 Carlton Street Kirwan QLD 4817 Ph: 07 4773 0000 E: ALSEnviro.Townsville@alsglobal.com

WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: DPM Envirosciences Pty Ltd	**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 USE ONLY (Circle)**
OFFICE: Buderim			Custody Seal Intact? Yes No N/A
PROJECT: Mahalo North Project - Meroo **PROJECT NO.:** DPM22006	**ALS QUOTE NO.:** EN/333/20	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: N/A **PURCHASE ORDER NO.:** N/A	**COUNTRY OF ORIGIN:** Australia	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: David Moore **CONTACT PH:** 0427 694 433		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: David Moore **SAMPLER MOBILE:** 0427 694 433	**RELINQUISHED BY:** S. Cuttle	**RECEIVED BY:** ANN RODDA	**RELINQUISHED BY:** Ella.m
COC Emailed to ALS? (YES / NO) **EDD FORMAT (or default):**	DATE/TIME: 19/8/22 14:41	DATE/TIME: 19.8.22 14:42	DATE/TIME: 22/08/22 1500
Email Reports to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au			**RECEIVED BY:** DATE/TIME: 23/8/22 0846
Email Invoice to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.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	Cations & Anions: Major (Ca, Mg, Na, K, Cl, SO_4, Alkalinity) + Ionic Balance (Suite NT-1 & NT-2)							Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	R4	16/08/2022	W	P, AP	2	✓							
2	R5	16/08/2022	W	P, AP	2	✓							
3	L1	16/08/2022	W	P, AP	2	✓							
4	L2	16/08/2022	W	P, AP	2	✓							
5	R6	16/08/2022	W	P, AP	2	✓							
6	R10	19/08/2022	W	P	1	✓							
				TOTAL	11								

Environmental Division
Brisbane
Work Order Reference
EB2224636

Telephone : +61-7-3243 7222

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	: **EB2308299**	Page	: 1 of 5
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: DPM22006 Mahalo North Project	Date Samples Received	: 20-Mar-2023 10:50
Order number	: ----	Date Analysis Commenced	: 21-Mar-2023
C-O-C number	: ----	Issue Date	: 29-Mar-2023 10:09
Sampler	: DAVID MOORE		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 14		
No. of samples analysed	: 14		

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, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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 Contract 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.

- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- 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**)

Compound	CAS Number	LOR	Unit	Sample ID	R2	R4	R7	R8	R9
				Sampling date / time	13-Mar-2023 00:00	15-Mar-2023 00:00	15-Mar-2023 00:00	16-Mar-2023 00:00	13-Mar-2023 00:00
					EB2308299-001	EB2308299-002	EB2308299-003	EB2308299-004	EB2308299-005
					Result	Result	Result	Result	Result
ED037P: Alkalinity by PC Titrator									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L		<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L		<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L		**42**	**72**	**78**	**52**	**31**
Total Alkalinity as CaCO3	----	1	mg/L		**42**	**72**	**78**	**52**	**31**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**4**	**1**	**1**	**6**	**2**
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	1	mg/L		**23**	**9**	**8**	**28**	**10**
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**5**	**11**	**14**	**3**	**3**
Magnesium	7439-95-4	1	mg/L		**4**	**4**	**5**	**2**	**1**
Sodium	7440-23-5	1	mg/L		**22**	**13**	**16**	**35**	**13**
Potassium	7440-09-7	1	mg/L		**4**	**8**	**7**	**5**	**4**
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**1.57**	**1.71**	**1.80**	**1.95**	**0.94**
ø Total Cations	----	0.01	meq/L		**1.64**	**1.65**	**1.98**	**1.96**	**0.90**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	R11	R12	HES1	HES4	HES5
			Sampling date / time	14-Mar-2023 00:00	14-Mar-2023 00:00	16-Mar-2023 00:00	16-Mar-2023 00:00	16-Mar-2023 00:00
Compound	CAS Number	LOR	Unit	EB2308299-006	EB2308299-007	EB2308299-008	EB2308299-009	EB2308299-010
				Result	Result	Result	Result	Result
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**50**	**62**	**51**	**51**	**61**
Total Alkalinity as CaCO3	----	1	mg/L	**50**	**62**	**51**	**51**	**61**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**5**	**4**	**1**	<1	<1
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**6**	**6**	**8**	**4**	**4**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**9**	**11**	**5**	**9**	**12**
Magnesium	7439-95-4	1	mg/L	**5**	**6**	**4**	**3**	**4**
Sodium	7440-23-5	1	mg/L	**11**	**13**	**14**	**8**	**10**
Potassium	7440-09-7	1	mg/L	**5**	**5**	**6**	**8**	**4**
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**1.27**	**1.49**	**1.26**	**1.13**	**1.33**
ø Total Cations	----	0.01	meq/L	**1.47**	**1.74**	**1.34**	**1.25**	**1.46**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	L1	L2	L3	L4	----
			Sampling date / time	13-Mar-2023 00:00	13-Mar-2023 00:00	13-Mar-2023 00:00	13-Mar-2023 00:00	----
Compound	CAS Number	LOR	Unit	EB2308299-011	EB2308299-012	EB2308299-013	EB2308299-014	--------
				Result	Result	Result	Result	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**46**	**64**	**48**	**85**	----
Total Alkalinity as CaCO3	----	1	mg/L	**46**	**64**	**48**	**85**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	<1	<1	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**3**	**5**	**8**	**4**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**10**	**11**	**3**	**13**	----
Magnesium	7439-95-4	1	mg/L	**2**	**4**	**2**	**7**	----
Sodium	7440-23-5	1	mg/L	**2**	**5**	**18**	**14**	----
Potassium	7440-09-7	1	mg/L	**11**	**16**	**5**	**6**	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**1.00**	**1.42**	**1.18**	**1.81**	----
ø Total Cations	----	0.01	meq/L	**1.03**	**1.50**	**1.22**	**1.99**	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB2308299**	Page	: 1 of 5
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: DPM22006 Mahalo North Project	Date Samples Received	: 20-Mar-2023
Order number	: ----	Date Analysis Commenced	: 21-Mar-2023
C-O-C number	: ----	Issue Date	: 29-Mar-2023
Sampler	: DAVID MOORE		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 14		
No. of samples analysed	: 14		

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, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

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

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the 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.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
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
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
ED037P: Alkalinity by PC Titrator (QC Lot: 4956814)									
EB2308299-001	R2	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	42	42	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	42	42	0.0	0% - 20%
EB2308299-011	L1	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.0	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	46	47	0.0	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	46	47	0.0	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 4943985)									
EB2308179-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	788	802	1.6	0% - 20%
EB2308189-006	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	10	10	0.0	0% - 50%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 4945557)									
EB2308299-001	R2	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	4	4	0.0	No Limit
EB2308360-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.0	No Limit
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 4953840)									
EB2307141-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	0.0	No Limit
EB2308421-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	29	29	0.0	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 4943982)									
EB2308179-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	298	306	2.5	0% - 20%
EB2308189-006	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	21	21	0.0	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 4945556)									
EB2308299-001	R2	ED045G: Chloride	16887-00-6	1	mg/L	23	23	0.0	0% - 20%
EB2308360-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	5620	5630	0.3	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
ED045G: Chloride by Discrete Analyser (QC Lot: 4953841)									
EB2307141-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	1380	1380	0.3	0% - 20%
EB2308421-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	<1	<1	0.0	No Limit
ED093F: Dissolved Major Cations (QC Lot: 4952804)									
EB2308761-006	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	170	168	1.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	58	58	0.0	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	207	203	1.6	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.0	No Limit
ED093F: Dissolved Major Cations (QC Lot: 4952872)									
EB2308286-005	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	67	67	0.0	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	468	469	0.3	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	3470	3480	0.4	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	72	75	3.2	0% - 20%
EB2308299-010	HES5	ED093F: Calcium	7440-70-2	1	mg/L	12	13	0.0	0% - 50%
		ED093F: Magnesium	7439-95-4	1	mg/L	4	4	0.0	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	10	10	0.0	0% - 50%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
ED037P: Alkalinity by PC Titrator (QCLot: 4956814)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	99.7	80.0	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4943985)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	106	85.0	118
				<1	100 mg/L	94.5	85.0	118
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4945557)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	102	85.0	118
				<1	100 mg/L	91.8	85.0	118
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4953840)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	102	85.0	118
				<1	100 mg/L	97.3	85.0	118
ED045G: Chloride by Discrete Analyser (QCLot: 4943982)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	95.0	90.0	115
				<1	1000 mg/L	104	90.0	115
ED045G: Chloride by Discrete Analyser (QCLot: 4945556)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	95.8	90.0	115
				<1	1000 mg/L	103	90.0	115
ED045G: Chloride by Discrete Analyser (QCLot: 4953841)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	96.8	90.0	115
				<1	1000 mg/L	96.8	90.0	115
ED093F: Dissolved Major Cations (QCLot: 4952804)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	113	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	106	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	100	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	103	70.0	130
ED093F: Dissolved Major Cations (QCLot: 4952872)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	50 mg/L	111	70.0	130
ED093F: Magnesium	7439-95-4	1	mg/L	<1	50 mg/L	103	70.0	130
ED093F: Sodium	7440-23-5	1	mg/L	<1	50 mg/L	98.8	70.0	130
ED093F: Potassium	7440-09-7	1	mg/L	<1	50 mg/L	101	70.0	130

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4943985)							
EB2308179-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	# Not Determined	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4945557)							
EB2308299-002	R4	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	99.3	70.0	130
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 4953840)							
EB2307141-003	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	104	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 4943982)							
EB2308179-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	113	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 4945556)							
EB2308299-002	R4	ED045G: Chloride	16887-00-6	400 mg/L	107	70.0	130
ED045G: Chloride by Discrete Analyser (QCLot: 4953841)							
EB2307141-003	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	70.0	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2308299**	Page	: 1 of 6
Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Telephone	: +61-7-3243 7222
Project	: DPM22006 Mahalo North Project	Date Samples Received	: 20-Mar-2023
Site	: ----	Issue Date	: 29-Mar-2023
Sampler	: DAVID MOORE	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.**
- **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

- **NO Quality Control Sample Frequency Outliers exist.**

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							
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA	EB2308179--002	Anonymous	**Sulfate as SO4 - Turbidimetric**	14808-79-8	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**
ED045G: Chloride by Discrete Analyser	EB2307141--003	Anonymous	**Chloride**	16887-00-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural							
R2,	R9,	----	----	----	28-Mar-2023	27-Mar-2023	**1**
L1,	L2,						
L3,	L4						
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Natural							
R11,	R12	----	----	----	28-Mar-2023	21-Mar-2023	**7**
Clear Plastic Bottle - Natural							
R4,	R7	----	----	----	28-Mar-2023	22-Mar-2023	**6**
Clear Plastic Bottle - Natural							
R8,	HES1,	----	----	----	28-Mar-2023	23-Mar-2023	**5**
HES4,	HES5						

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	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	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
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P) R2, R9, L1, L2, L3, L4	**13-Mar-2023**	**----**	----	----	**28-Mar-2023**	27-Mar-2023	×
Clear Plastic Bottle - Natural (ED037-P) R11, R12	**14-Mar-2023**	**----**	----	----	**28-Mar-2023**	28-Mar-2023	✓
Clear Plastic Bottle - Natural (ED037-P) R4, R7	**15-Mar-2023**	**----**	----	----	**28-Mar-2023**	29-Mar-2023	✓
Clear Plastic Bottle - Natural (ED037-P) R8, HES1, HES4, HES5	**16-Mar-2023**	**----**	----	----	**28-Mar-2023**	30-Mar-2023	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G) L2, L3, L4	**13-Mar-2023**	**----**	----	----	**21-Mar-2023**	10-Apr-2023	✓
Clear Plastic Bottle - Natural (ED041G) R2, R9	**13-Mar-2023**	**----**	----	----	**22-Mar-2023**	10-Apr-2023	✓
Clear Plastic Bottle - Natural (ED041G) L1	**13-Mar-2023**	**----**	----	----	**27-Mar-2023**	10-Apr-2023	✓
Clear Plastic Bottle - Natural (ED041G) R11, R12	**14-Mar-2023**	**----**	----	----	**22-Mar-2023**	11-Apr-2023	✓
Clear Plastic Bottle - Natural (ED041G) R4, R7	**15-Mar-2023**	**----**	----	----	**22-Mar-2023**	12-Apr-2023	✓
Clear Plastic Bottle - Natural (ED041G) HES4, HES5	**16-Mar-2023**	**----**	----	----	**21-Mar-2023**	13-Apr-2023	✓
Clear Plastic Bottle - Natural (ED041G) R8, HES1	**16-Mar-2023**	**----**	----	----	**22-Mar-2023**	13-Apr-2023	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G) L2, L3, L4	**13-Mar-2023**	**----**	----	----	**21-Mar-2023**	10-Apr-2023	✓
Clear Plastic Bottle - Natural (ED045G) R2, R9	**13-Mar-2023**	**----**	----	----	**22-Mar-2023**	10-Apr-2023	✓
Clear Plastic Bottle - Natural (ED045G) L1	**13-Mar-2023**	**----**	----	----	**27-Mar-2023**	10-Apr-2023	✓
Clear Plastic Bottle - Natural (ED045G) R11, R12	**14-Mar-2023**	**----**	----	----	**22-Mar-2023**	11-Apr-2023	✓
Clear Plastic Bottle - Natural (ED045G) R4, R7	**15-Mar-2023**	**----**	----	----	**22-Mar-2023**	12-Apr-2023	✓
Clear Plastic Bottle - Natural (ED045G) HES4, HES5	**16-Mar-2023**	**----**	----	----	**21-Mar-2023**	13-Apr-2023	✓
Clear Plastic Bottle - Natural (ED045G) R8, HES1	**16-Mar-2023**	**----**	----	----	**22-Mar-2023**	13-Apr-2023	✓

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
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Natural (ED093F)							
R11, R12	**14-Mar-2023**	**----**	----	----	**28-Mar-2023**	21-Mar-2023	×
Clear Plastic Bottle - Natural (ED093F)							
R4, R7	**15-Mar-2023**	**----**	----	----	**28-Mar-2023**	22-Mar-2023	×
Clear Plastic Bottle - Natural (ED093F)							
R8, HES1, HES4, HES5	**16-Mar-2023**	**----**	----	----	**28-Mar-2023**	23-Mar-2023	×
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
R2, R9, L1, L2, L3, L4	**13-Mar-2023**	**----**	----	----	**28-Mar-2023**	10-Apr-2023	✓

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)							
Alkalinity by Auto Titrator	ED037-P	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	6	54	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	3	21	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	6	58	**10.34**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by Auto Titrator	ED037-P	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	6	54	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	6	58	**10.34**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride by Discrete Analyser	ED045G	3	54	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	3	58	**5.17**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Chloride by Discrete Analyser	ED045G	3	54	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	3	58	**5.17**	**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
Alkalinity by Auto Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) on a settled supernatant aliquot of the sample using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride. In the presence of ferric ions the liberated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm.
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 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 Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	* EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM Schedule B(3)

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order : **EB2308299**

Client	: **DPM ENVIROSCIENCES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR DAVID MOORE	Contact	: Customer Services EB
Address	: 12 LAUREN DRIVE BUDERIM 4556	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: dmoore@dpm-enviro.com.au	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: ----	Telephone	: +61-7-3243 7222
Facsimile	: ----	Facsimile	: +61-7-3243 7218
Project	: DPM22006 Mahalo North Project	Page	: 1 of 2
Order number	: ----	Quote number	: EB2019DPMENV0001 (EN/333)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	: DAVID MOORE		

Dates

Date Samples Received	: 20-Mar-2023 10:50	Issue Date	: 20-Mar-2023
Client Requested Due Date	: 29-Mar-2023	Scheduled Reporting Date	: **29-Mar-2023**

Delivery Details

Mode of Delivery	: Client Drop Off	Security Seal	: Not Available
No. of coolers/boxes	: 1	Temperature	: 3.0° - Ice present
Receipt Detail	: SMALL ESKY	No. of samples received / analysed	: 14 / 14

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (3 weeks), Solid (2 months ± 1 week) from receipt of samples.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**
- Please be aware that APHA/NEPM recommends water and soil samples be chilled to less than or equal to 6°C for chemical analysis, and less than or equal to 10°C but unfrozen for Microbiological analysis. Where samples are received above this temperature, it should be taken into consideration when interpreting results. Refer to ALS EnviroMail 85 for ALS recommendations of the best practice for chilling samples after sampling and for maintaining a cool temperature during transit.
- **Please refer to the Proactive Holding Time Report table below which summarises breaches of recommended holding times that have occurred prior to samples/instructions being received at the laboratory. The laboratory will process these samples unless instructions are received from you indicating you do not wish to proceed. The absence of this summary table indicates that all samples have been received within the recommended holding times for the analysis requested.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory and displayed in brackets without a time component

Matrix: **WATER**

Laboratory sample ID	Sampling date / time	Sample ID	WATER - NT-01 & 02 Ca, Mg, Na, K, Cl, SO4, Alkalinity
EB2308299-001	13-Mar-2023 00:00	R2	✓
EB2308299-002	15-Mar-2023 00:00	R4	✓
EB2308299-003	15-Mar-2023 00:00	R7	✓
EB2308299-004	16-Mar-2023 00:00	R8	✓
EB2308299-005	13-Mar-2023 00:00	R9	✓
EB2308299-006	14-Mar-2023 00:00	R11	✓
EB2308299-007	14-Mar-2023 00:00	R12	✓
EB2308299-008	16-Mar-2023 00:00	HES1	✓
EB2308299-009	16-Mar-2023 00:00	HES4	✓
EB2308299-010	16-Mar-2023 00:00	HES5	✓
EB2308299-011	13-Mar-2023 00:00	L1	✓
EB2308299-012	13-Mar-2023 00:00	L2	✓
EB2308299-013	13-Mar-2023 00:00	L3	✓
EB2308299-014	13-Mar-2023 00:00	L4	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

DAVID MOORE

- *AU Certificate of Analysis - NATA (COA)	Email	dmoore@dpm-enviro.com.au
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	dmoore@dpm-enviro.com.au
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	dmoore@dpm-enviro.com.au
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	dmoore@dpm-enviro.com.au
- A4 - AU Tax Invoice (INV)	Email	dmoore@dpm-enviro.com.au
- Chain of Custody (CoC) (COC)	Email	dmoore@dpm-enviro.com.au
- EDI Format - XTab (XTAB)	Email	dmoore@dpm-enviro.com.au

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 1/1 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 4979 7346 E: ALSEnviro.Gladstone@alsglobal.com

MACKAY Unit 2/20 Caterpillar Drive Paget QLD 4740 Ph: 07 4952 5755 E: ALSEnviro.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 36 Rigali Way Wangara WA 6065 Ph: 08 9405 1301 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 10 Carlton Street Kirwan QLD 4817 Ph: 07 4796 0600 E: ALSEnviro.Townsville@alsglobal.com

WOLLONGONG 1/19-21 Relph Black Drive, Unit Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: DPM Enviroscience Pty Ltd	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)
OFFICE: Buderim		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: Mahalo North Project PROJECT NO.: DPM22006	ALS QUOTE NO.: EN/333/20	COC SEQUENCE NUMBER (Circle)	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: N/A PURCHASE ORDER NO.: N/A	COUNTRY OF ORIGIN: Australia	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: David Moore CONTACT PH: 0427 694 433		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: David Moore SAMPLER MOBILE: 0427 694 433	RELINQUISHED BY: P.MOORE	RECEIVED BY: SP	RELINQUISHED BY: RECEIVED BY:
COC Emailed to ALS? (YES / NO) EDD FORMAT (or default):	DATE/TIME: 20.3.23 10.50AM	DATE/TIME: 20/3/23 1050	DATE/TIME: DATE/TIME:
Email Reports to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.com.au			
Email Invoice to (will default to PM if no other addresses are listed): dmoore@dpm-enviro.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	Cations & Anions: Major (Ca, Mg, Na, K, Cl, SO_4, Alkalinity) + Ionic Balance (Suite NT-1 & NT-2)								Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	R2	13/03/2023	W	P, N	2	✓								
2	R4	15/03/2023	W	P	1	✓								
3	R7	15/03/2023	W	P	1	✓								
4	R8	16/03/2023	W	P	1	✓								
5	R9	13/03/2023	W	P, N	2	✓								
6	R11	14/03/2023	W	P	1	✓								
7	R12	14/03/2023	W	P	1	✓								
8	HES1	16/03/2023	W	P	1	✓								
9	HES4	16/03/2023	W	P	1	✓								
10	HES5	16/03/2023	W	P	1	✓								
11	L1	13/03/2023	W	P, N	2	✓								
12	L2	13/03/2023	W	P, N	2	✓								
13	L3	13/03/2023	W	P, N	2	✓								
14	L4	13/03/2023	W	P, N	2	✓								
				TOTAL	14									

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.

Environmental Division
Brisbane
Work Order Reference
EB2308299

Telephone : + 61-7-3243 7222