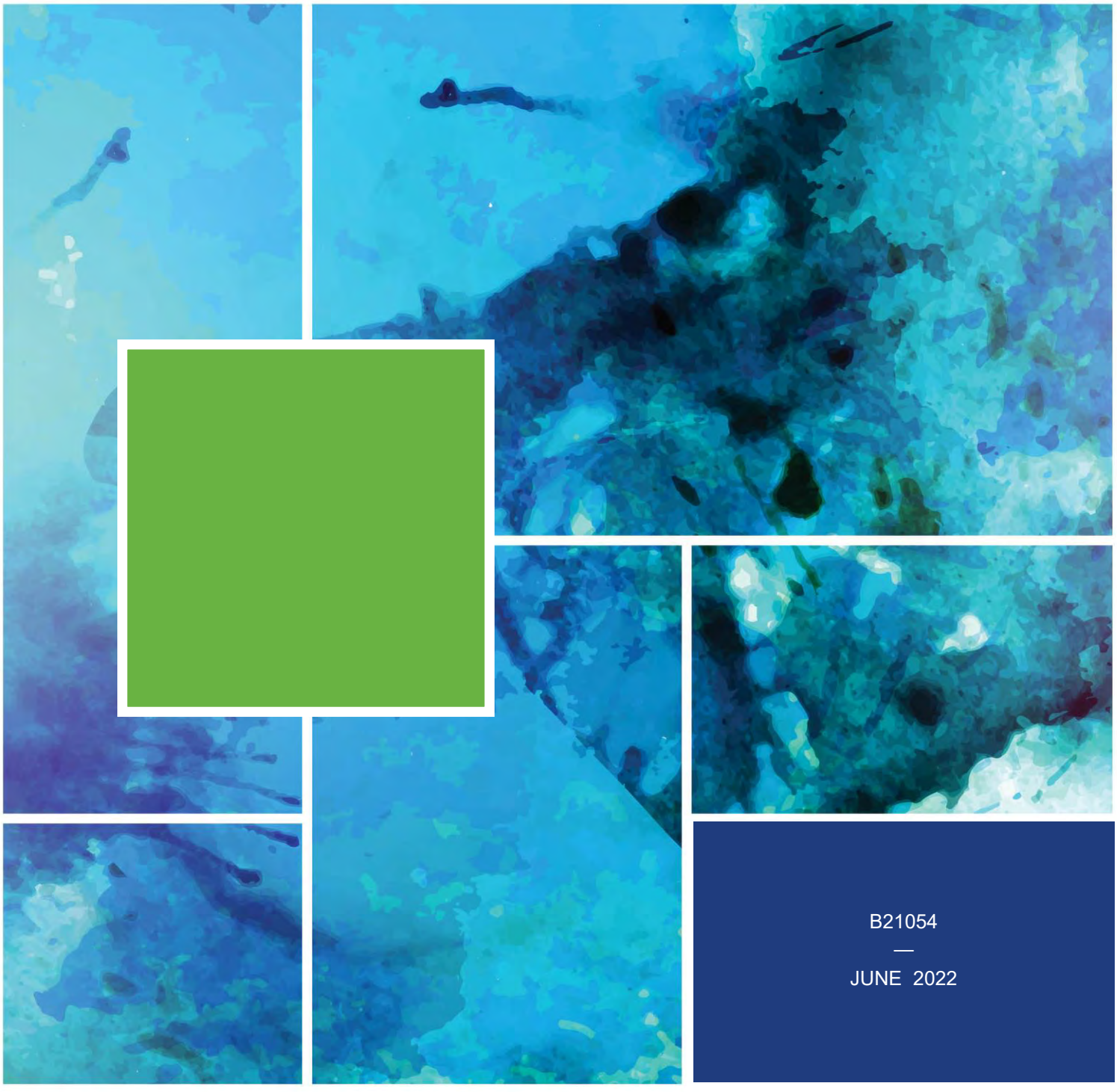
Hydrobiology

AQUATIC ECOLOGY BASELINE AND IMPACT ASSESSMENT

BRISBANE | PERTH | SINGAPORE | PAPUA NEW GUINEA

CAPE FLATTERY SILICA PROJECT



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THIS COMPANY IS REGISTERED FOR GST.

STREET
27 / 43 Lang Parade
Auchenflower 4066
QUEENSLAND

REGISTERED
c/- de Blonk Smith and
Young Accountants
GPO 119, Brisbane 4001
QUEENSLAND

POSTAL
PO Box 2151
Toowong 4066
QUEENSLAND

CONTACT
+61 (0)7 3721 0100 P
info@hydrobiology.biz

ABN 26 096 574 659

www.hydrobiology.biz

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EXECUTIVE SUMMARY

BACKGROUND

This report provides the results of the desktop assessment and aquatic (freshwater) sampling undertaken in November 2021 as part of the environmental assessment for the proposed development of the Cape Flattery Silica Project (the project). The project is in the Cape Bedford/Cape Flattery dunefield complex, north of Cooktown. This aquatic ecological study was able to draw on existing data from previous studies to initially define aquatic values, but also define field survey specifics for the identified knowledge gaps. The field survey involved twelve sampling sites across the mapped waterways (as defined in the *Vegetation Management Act 1999* and QLD Wetland Mapping) and wetlands. These sites were assessed for habitat (diversity and condition), groundwater dependency (presence and value), water quality (in-situ physicochemical priorities) and aquatic biota (macrophytes, macroinvertebrates, macrocrustaceans, fish and reptiles).

Based on the concept design of the project, construction and operational impacts are discussed, with appropriate management and mitigation measures detailed to protect aquatic ecosystem values.

AQUATIC ECOSYSTEM VALUES

The topography of the region dictates the nature of aquatic habitat within the Study area. The present aquatic habitat can be broadly group as follows:

- Palustrine wetlands located within the ML, which are mapped as high ecological significance wetlands. They are irregularly shaped wetlands and swamps and are considered low nutrient systems. They occupy the lower depressions between major dunes. Both wetlands contain high cover of macrophytes, including rushes and sedges. The baseline groundwater model conceptualisation is that these wetlands are not groundwater dependant; however this still requires

confirmation (GA&S, 2022). They provide dry seasonal refugia in an otherwise dry landscape. Though further investigations are required to confirm status.

- Lower order streams, including:
  - High slope streams which radiate from the hard rock exposure areas. These streams have limited connectivity to mid-upper catchment areas due to natural rock barriers and bed elevation changes present throughout.
  - Low order sand dominated creeks (drainage features) which discharge to Middle Beach. There is limited connectivity from these streams to the coastal tidal area
  - Low order creeks located in the supratidal extents of the catchments.

A number of mapped waterways (as identified under the *Vegetation Management Act 1999* and the Queensland Wetland Mapping (Wetland Info QLD)) through the ML (planned mining area) were not evident at the point of assessment, that is they lacked defined banks, a riparian zone and instream flow paths. The absence of such features occurs consistently along the natural drainage line as identified by current available aerial imagery. These waterways are also not defined as watercourses under the *Water Act 2000*. It is expected that they provided little if any aquatic ecosystem values. Dune lakes are also located downstream of the Cape Flattery Silica mining lease (ML), with the adjacent tenement. At the time of the survey most sites were dry, with only the palustrine wetlands, and three other creek sites containing aquatic habitat (present water).

Consistent with the noted habitat and nutrient status, diversity of aquatic biota was considered low. Surveyed macroinvertebrate, fish and aquatic reptile species captured in this survey have been documented to occur in the wider Cape York Basin. The Study area represents a small proportion of the native diversity of the basin. No threatened (endangered, vulnerable or near threatened)) or endemic species were recorded or are considered likely to occur based on knowledge of the range of aquatic habitats in the local watercourses. The migratory listed estuarine crocodile (*Crocodylus porosus*) was recorded in the Study area, while threatened sawfish species could possibly occur in the downstream extents of the Study area within the supratidal and coastal habitats.

PROJECT IMPACTS

With the implementation of the mitigation and management measures described and referred to throughout, and based on the current/likely impacts the construction and operation stages of the project are expected to have insignificant/negligible to low residual impact on the aquatic ecosystem values of the receiving environments.

The migratory listed estuarine crocodile (*Crocodylus porosus*) occurs at the noted palustrine wetlands and likely to occur in within the freshwater/supratidal extents of the project; Based on the current/likely impacts, the project will have insignificant/negligible impact on this species. The project will also have negligible impact on endemic and/or threatened aquatic species.

1. INTRODUCTION

1.1 PROJECT DESCRIPTION

1.1.1 OVERVIEW

The Cape Flattery Silica Sand Project (the Project) is a silica sand mining and processing operation located within the Mining Lease Application (MLA) 100284, covering an area of approximately 616 ha. Cape Flattery Silica Pty Ltd (CFS) is wholly owned by Metallica Minerals Limited (Metallica) and CFS is the proponent for the Project.

The Project is located on a greenfield site within the Cape Bedford/Cape Flattery dunefield complex and is characterised by large northwest trending transgressive elongated and parabolic sand dunes. The Project is located on Lot 35 SP232620 within the Hope Vale Shire Local Government Area (LGA), adjacent to the existing silica sand mining and shipping operation owned by Mitsubishi, approximately 42 km northeast of Hope Vale and 200 km north of Cairns, Queensland (Figure 1-1). Outside of MLA100284 on the western side of the site (but still connected to the site), a jetty / marine offloading facility is proposed to be constructed on land within the Hope Vale Aboriginal Shire Council local government area, and inside the tidal areas of Cook Shire Council and the Cape Flattery Port which is owned and operated by Ports North.

The Project involves mining and processing approximately 1.8 million tonnes per annum (Mtpa) of high-quality silica sand onsite over a 20 to 25-year life of mine (LOM), with approximately 1.35 Mtpa of saleable product to be shipped offsite.

Shipping frequency will be one ship every two weeks, accessing the Port via established shipping routes under REEFVTS pilotage. Estimated shipping size is Supramax (55,000 DWT) with a loading time per ship of around 3-4 days.

1.1.2 INFRASTRUCTURE

On-lease Project infrastructure will include a Mine Infrastructure Area (MIA) for general mine service facilities, mining panels, stockpile areas, laydown areas, processing plant, worker's accommodation for up to 80 persons, sediment basin, water storages, sewage treatment plant, conveyors, access tracks and a jetty infrastructure facility (JIF) to service the off-lease project infrastructure. A mine lease area (MLA) buffer (50 m wide) surrounding the MLA will retain vegetation, except where the boundary access track is proposed (Figure 1-2). The access track will be 5 m wide. Off-lease Project infrastructure includes a 350 metre (m) jetty, a 140 m material offloading facility, conveyors from the JIF to the jetty hopper, transhipment from the jetty to a swing basin for with mooring / anchorage capability.

The Marine Offloading Facility (MOF) is a purpose built structure to facilitate the delivery of equipment and goods to the Project during both construction and operations. From the JIF, an access road will lead down to the shoreline and a steel ramp which will be constructed and extended to the edge of the rocky shore area where it will meet a series of floating jack up barges (5). These barges are self-supporting on the seafloor via piles and will allow the barges to move up and down as needed, allowing tide and flow underneath. Seafloor disturbance is therefore constrained to the immediate location at each barge support. The last barge will be at a sufficient depth to allow for the loading and unloading of materials from appropriately sized barges and ships. During inclement weather, the barges can be relocated to deeper water if required to prevent damage.

1.1.3 CONSTRUCTION

Construction is expected to commence in 2023 and will run for approximately 6 months. A construction workforce of around 35 persons per swing will be required and will work on a roster basis with transport to the Project from Cooktown by fast passenger boat.

1.1.4 OPERATION

The mining method would involve sequential excavation using a front-end loader feeding a mobile tracked hopper-feeder which connects to the processing plant via a covered conveyor system. Water is added to the hopper-feeder to slurry the material from the pit to the plant.

Development of the active mine area would be staged with progressive rehabilitation occurring behind the advancing mine face. Clearing and grubbing activities will occur during daylight hours. Mining and processing will operate as a continuous process for 24 hours per day and 360 days per year.

Processing of silica will occur within the MIA which will consist of separation processes, and recovery/reuse of water used in the processing plant. Non product materials generated through processing such as organics, would be directed to storage for use in rehabilitation activities. Silica sand will be directly loaded from the product stockpile onto a conveyor, then transported to the jetty and loaded onto barges via a hopper. From there, silica sand will be transported offshore and transhipped onto bulk carrier ships within the Cape Flattery Port area and exported. An operational workforce of approximately 65 staff per roster will be required and will work on a roster basis with transport to the Project from Cooktown by fast passenger boat.

Figure 1-1 Associated mining leases and lot plan.

Figure 1-2 Mine layout and estimated sequence (source: Epic Environmental)

1.2 SCOPE AND OBJECTIVES

The proposed project requires the appropriate approvals to commence construction and operation. As defined by Epic Environmental, the preferred approval pathway is through an Environmental Authority (EA) Application.

The Project is also undergoing assessment against the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in parallel to the EA application. It is understood Epic Environmental as the lead consultant for the project have proactively engaged with the Commonwealth Department of Agriculture, Water and the Environment and will be referring the project for Commonwealth assessment.

As part of the proposed works, it is required that freshwater ecological assessments be undertaken for a range of ecological components to form the appropriate knowledge and approvals to commence construction activities. To address this requirement, Hydrobiology was commissioned to assist Epic Environmental to undertake a three-stage assessment process which includes the following:

- Stage 1 – Desktop assessment (literature review and gap analysis) of the freshwater ecosystem values within the region;
- Stage 2 – A single field survey to confirm the desktop findings and extend on the knowledge regarding the existing freshwater ecosystem values and their condition; and
- Stage 3 – An impact and mitigation assessment.

The report for this Project will involve an area of assessment for the infrastructure and mining works relating to the local freshwater ecosystems of the area which will be henceforth known as the "Study area". The Study area encapsulates the freshwater environments of the proposed mining lease, including freshwater habitats downstream of the ML and its immediate surrounds.

It is important to note that this report presents only freshwater ecosystem values for the relevant surface mining and infrastructure development. Marine ecosystem values relevant to the loading facility have been investigated by Hydrobiology in a separate report (Hydrobiology, 2022).

This report presents the findings of the initial desktop assessment, aquatic ecology field assessment and the subsequent impact and mitigation assessment.

1.3 PROJECT SETTING

1.3.1 BASIN AND CATCHMENTS

The freshwater systems of the Study area are located within the Jeannie Basin, specifically within the management area of the Landside of Port of Cape Flattery. The main river inputs of the area are the watercourse of the system is the Jeannie River, the headwaters of the river rise in the northern region of the Cape York Peninsula of the Great Dividing Range. The river flows in a north easterly direction and discharges into the coral sea adjacent to Howick Island.

No key river or tributary systems flow within the Study area, instead a series of small, unnamed, non-perennial first order tributary inputs discharge into the adjacent marine area. The Cape Flattery region also supports several high ecological significance (HES) palustrine wetlands and a series of high value ecosystem (HEV) lakes known as "Cape Flattery Dune Lakes".

The catchment has an area of 3,638 km^2 being composed of the Jeannie, Howick and Starke rivers with an area of 175 km^2 being estuarine wetlands. The freshwaters within the Study area itself are not HEV with the exception of Dune Lakes (those downstream of the ML), the remaining areas are all described as moderately disturbed.

1.3.2 CLIMATE

The Study area lies within the Australia Monsoon Zone, specifically within the Wet Tropics which exhibits a humid tropical maritime climate with distinctive wet and dry seasons. Cyclones regularly affect the Cape Flattery area during the wet season between December and April.

During the Wet Season, Cape Flattery typically experiences hot and humid summers with sea breezes and heavy rainfall. The dry season from May to November is generally cooler with less humidity, though unlike most of the tropical Australia, onshore winds still produce some light showers. The dry season is often characterised by continual 12-25 knots south easterly winds with an average wind speed of 5 knots for the remainder of the year.

Rainfall is highest during the wet season in the summer months, these months often account for the majority of the annual rainfall (80%) with peak rainfall often coinciding with cyclonic events. During typical summary periods, average maximum monthly temperatures can reach over 33°C while average monthly minimum temperatures can reach 19°C in winter (Figure 1-3).

Prior to the November 2021 survey, below average rainfall was experienced in the month preceding the event, while 64 mm of rainfall was recorded in the weeks preceding the November 2021 survey.

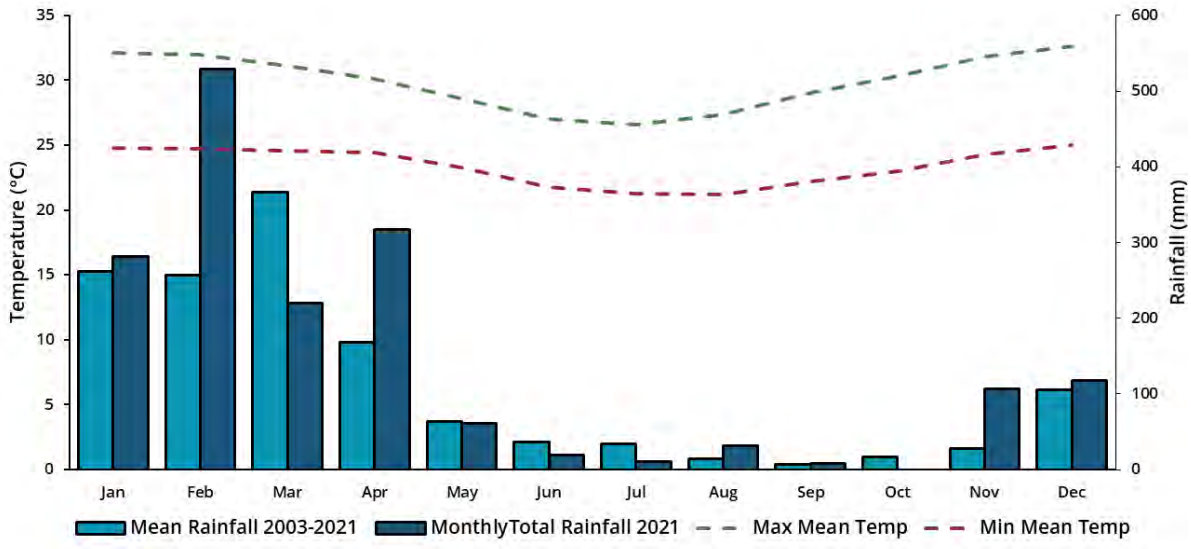

Figure 1-3 Average monthly climate statistics, sourced from Cape Flattery Station (#31213). Historical data inclusive from 2003 to present.

1.3.3 LANDUSE

Cape Flattery and its surrounds are located in mostly undeveloped landscapes, with access tracks forming the primary infrastructure in the ML. Initial developments at Cape Flattery (outside the current EPML) occurred in 1968 when the first silica sand mine was established. This silica mine (Cape Flattery Silica Mines – owned by Mitsubishi Corporation) occurs along the southwestern border of the proposed ML. The existing mine operates a 500m wharf consisting of 5 breasting dolphins and 3 mooring dolphins.

2. METHODOLGY

2.1 DESKTOP REVIEW

There have been limited recent ecological investigations for the region, this is likely due to the isolated location of Cape Flattery and still largely undeveloped landscape. The available literature often focused entirely on the Dune Lakes within the region, with watercourses and wetlands less commonly investigated. In terms of freshwater ecology, much of the ecological literature of the area has been produced by several key authors. The earliest utilised ecological study of the area was by Hawkins et al., (1988), which was a baseline study was undertaken on the limnology of 18 Dune Lakes in the Cape Flattery region. This study included baseline assessments of fish, macrophytes, phytoplankton, zooplankton, water quality, and basic observations of each Dune Lake. The greatest resource for fish in the area was undertaken by Pusey et al., (2000) in an area approximately 8km to the west of the Study area, bordering and intersecting the Projects exploration permit (EPM 25734). This study entails fish surveyed across Dune Lakes, streams, wetlands, and isolated pools near Blackwater creek and remains to be the only identified assessment of fish outside of the Dune Lakes. Smaller ecological reports by Herbert et al., (1995) on behalf of the Natural Resources Analysis Program, analysed the fish populations and environments of Cape York and the Cape Flattery region.

In terms of water quality and geomorphological features of the area and the Dune Lakes, studies by Wright & Burgin (2007) and Timms, (1982; 1986) were applied. A recent study on the water quality and habitat of streams within the area by Epic (2021) was also utilised to formulate a present understanding on the current conditions, habitat, and water quality of the area.

The following tasks were undertaken as part of the literature review:

- Identify Matters of State and National Environmental significance (MSES / MNES) and undertake Endangered, Vulnerable and Near Threatened (EVNT) searches;
- Identify and discuss relevant environmental baseline reports prepared and previous ecological surveys to assist in defining freshwater aquatic ecological values;
- Identify the presence of any protected areas or environmentally sensitive areas that exist within the Study area;
- Describe the regulatory framework relevant to freshwater aquatic ecological values;
- Undertake relevant database searches of any priority freshwater species or populations present within and surrounding the Study area;
- Analysis of aerial photograph, Lidar and other spatial data to assess for potential surface GDEs;
- Review relevant GDE database and analyse groundwater level data which will assist in the determination of surface GDEs (i.e. groundwater surface expression);
- Assess the pre-existing disturbance levels and the value of freshwater ecological processes in the Study area;
- Identify information and data that will be required to undertake the baseline freshwater ecological survey; and
- Describe the aquatic ecology and surface GDEs within local waterways, wetlands, and Dune Lakes surrounding the Study area and receiving environments, including habitat, groundwater dependent ecosystems, macrophyte composition, phytoplankton and zooplankton community composition, macroinvertebrate community composition, macrocrustacean and fish communities, and freshwater aquatic reptiles and mammals.

2.2 GAP ANALYSIS AND FIELD PLAN

Based on the desktop assessment, a field program was developed to confirm desktop findings and address identified knowledge gaps relevant to freshwater aquatic ecosystem values and aquatic GDEs. Table 2-1 defines the identified knowledge gaps based on the current literature review and proposes suitable investigations to address these gaps.

Table 2-1 Identified gaps and items of importance and associated forward plan.

Items	Comment	Action	Method and/or Reference
Knowledge Gaps			
Habitat	• Outdated and little information on macro and microhabitat features or condition aquatic habitats of the Study area.	• Undertake systematic habitat and condition assessments	• State of the Rivers • River Bioassessment • AUSRIVAS • Drone captured imagery
Water quality	• Little information on the water quality of wetlands and waterways • Outdated water quality data available on Dune Lakes.	• In situ physiochemical data to be collected during field surveys.	• QLD sampling manual • Australian and New Zealand water quality sampling standards.

Items	Comment	Action	Method and/or Reference
Aquatic flora	• Outdated information on macrophytes of Dune Lakes. • No information on aquatic macrophytes within other aquatic habitats of the area.	• Undertake systematic aquatic flora surveys	• Percentage cover and species identification surveys
Freshwater Fish, Turtles and Macrocrustaceans	• Outdated information on fish within Dune Lakes • No information concerning fish within other aquatic habitats of the Study area. • Little information regarding macrocrustaceans • No information on freshwater turtles within the Study area.	• Undertake systematic freshwater fish, turtle and macrocrustacean surveys	• Undertake passive and active freshwater fish, turtle and macrocrustacean surveys in accordance with the QLD sampling manual • Length and weight ratios of fish
Macroinvertebrates	• No information on Macroinvertebrates of Dune Lakes in the Study area.	• Undertake systematic surveys of present macroinvertebrates	• Single AUSRIVAS sampling • Undertake triplicate replicate sampling of both bed & edge habitats
GDEs	• The likelihood presence of GDEs have not previously been mapped for the region. • A review of aerial imagery indicates that the dune lakes of the systems may be influenced by the groundwater table. • Literature draws contrasting ideas across GDE presence.	• Undertake systematic surveys to indicate GDE	• Assessment for surface GDEs as per the IESC (2018) guideline checklist • Undertake groundwater levels and chemical groundwater analysis to determine GDEs (reliant on surface and groundwater investigations)
Items of Aquatic Conservation Significance			
Conservation Significant Fauna	• Vulnerable and migratory species are known or projected to occur on site.	Undertake systematic aquatic fauna surveys and likelihood of assessment surveys based on collected habitat information.	• State and National survey guidelines.

2.3 SURVEY DESIGN

To address the identified gaps and items of importance a field survey was undertaken at a representative number of sites, within the Study area, downstream, and further afield within the identified aquatic habitats (Table 2-2 and Figure 2-1). During the fieldwork planning phase, potential sites within representative habitats and relevant localities (i.e. within, upstream and downstream of the project footprint) were identified that appeared to be accessible. Specifically, the site locations were selected on the basis:

- They best represented identified habitat variation within the Study area (determined from aerial imagery and review, historical reports and State and Federal databases);
  - Riverine habitat, mapped waterways. Such habitats are located throughout the proposed ML and drain north, northwest and in southeast directions to the open coastal environment.
  - The major waterway (highest stream order) drain to the south-east and crosses to the adjacent ML 2965.
- They include protected areas;
  - Palustrine wetland, two mapped palustrine wetlands (both high ecological significance wetlands) occur on along the southern border of the proposed ML with the majority within ML 2965.
  - Dune Lakes, two mapped Dune Lakes (both high ecological value wetlands) receive discharge from the waterway within the mine footprint. These Dune Lakes are present within ML 2806 and ML 2965.
- They encompassed areas which could potentially be GDEs;
- They could be readily accessed through existing infrastructure; and
- The selected survey techniques could be safely carried out.

Some of these pre-selected potential sites were found to be inaccessible, unsafe to traverse to and/or access could not be granted (i.e. mapped Dune Lakes could not be accessed on ML 2806 and ML 2965). Site locations were iteratively rationalised in the field with due consideration to representativeness of habitat types in the area, potential impact and accessibility for any future monitoring. The Study area and selected sites can be viewed in Figure 2-1.

2.1 MONITORING ASPECTS

Aquatic ecological and GDE surveys were undertaken from the 22 to 27 November 2021. At each site, a range of parameters were assessed to provide an understanding of the aquatic and GDE values of the Study area (Table 2-2). Method implementation is detailed in Appendix A.

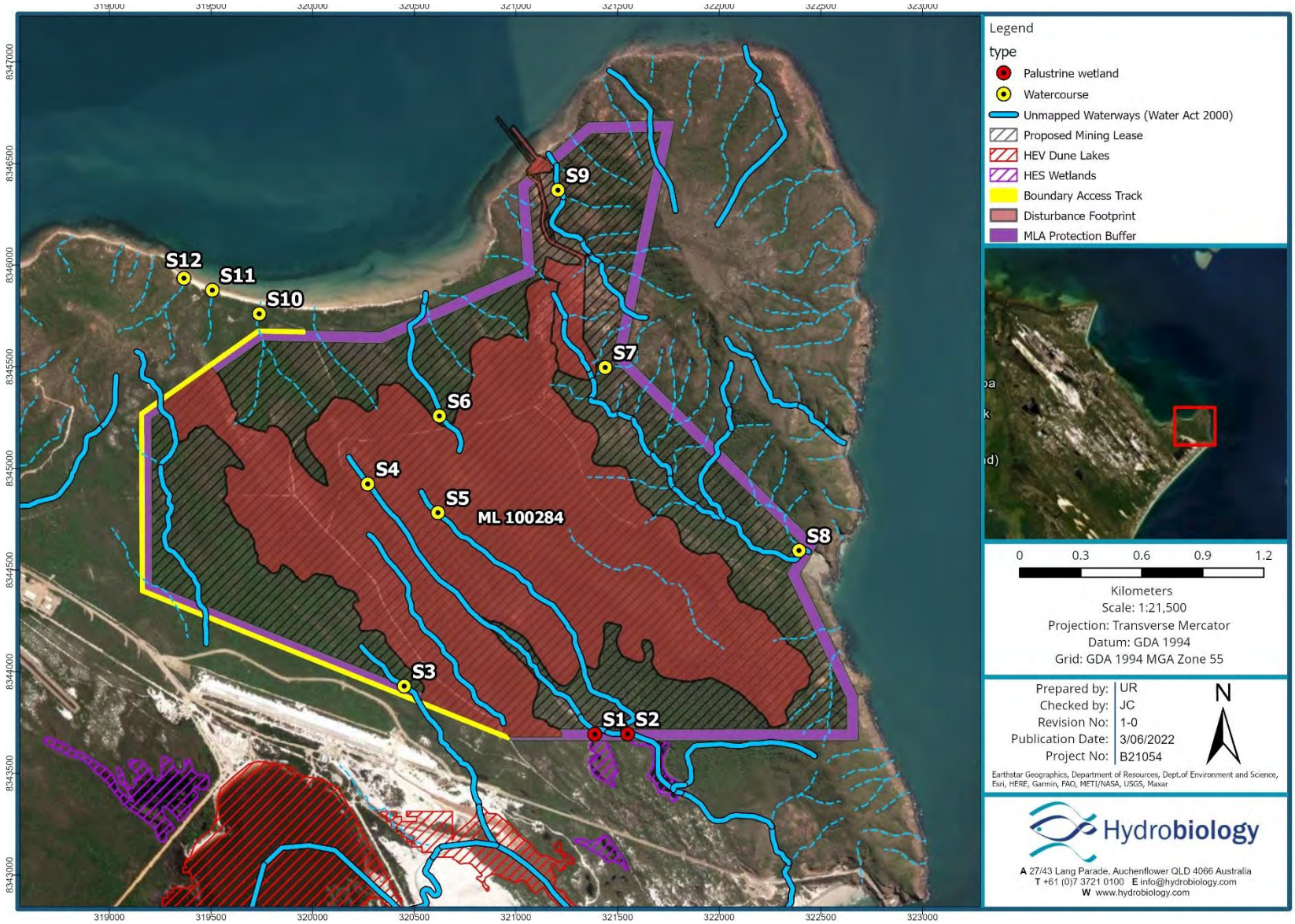

Figure 2-1 Surveyed sites

Table 2-2 Survey sites and assessed monitoring aspects.

Site	Wetland/waterway	Latitude	Longitude	Stream Order	Habitat	Drone	GDE	Water Quality	Macro-invertebrates	Fish
S1	Unnamed palustrine wetland	-14.9757	145.3390	n/a	✓	✓	✓	✓	✓	D
S2	Unnamed palustrine wetland	-14.9757	145.3405	n/a	✓	✓	✓	Could not safely traverse to site – croc risk		
S3	Unnamed waterway	-14.9735	145.3303	1	✓	✓	✓	dry		
S4	Unnamed waterway	-14.9645	145.3287	1	✓	✓	✓	dry		
S5	Unnamed waterway	-14.9658	145.3319	1	✓	✓	✓	dry		
S6	Unnamed waterway	-14.9615	145.3320	1	✓	✓	✓	dry		
S7	Unnamed waterway	-14.9594	145.3396	1	✓	✓	✓	✓	✓	F, E, D
S8	Unnamed waterway	-14.9676	145.3484	2	✓	✓	✓	✓	✓	F, E, D
S9	Unnamed waterway	-14.9515	145.3375	1	✓	✓	✓	✓	✓	F, E, D
S10	Unnamed waterway	-14.9569	145.3238	1	✓	✓	✓	dry		
S11	Unnamed waterway	-14.9559	145.3215	1	✓	✓	✓	dry		
S12	Unnamed waterway	-14.9555	145.3202	1	✓	✓	✓	dry		

F – Fyke nets; E – electrofishing; D; eDNA

2.2 IMPACT AND MITIGATION ASSESSMENT

The method used for this impact assessment conforms to guidelines provided by Cardno and takes a magnitude × duration × likelihood approach to the assessment with documentation of assumptions and the resulting impact significance in a matrix.

The assessment of impacts associated with the construction and operation of the Project involved:

- Identification of the potential impact;
- Categorising the impact including;
  - The phase (construction or operation).
- Whether it is a positive (i.e. beneficial) or negative impact;
- Screening of potential impacts: the potential (un-mitigated) impacts of the construction and operation was profiled and screened for inclusion in the impact assessment based on magnitude of threat, sensitivity of receptor and severity of potential impact;
- Identifying avoidance, mitigation and management measures that could reduce the effects of potential impacts;
- Assessing the residual risk posed by proposed activities and associated impacts, assuming that the mitigation measures adopted are successful. This involves assessing the likelihood and severity of risks associated with aquatic values and
- Recommended management and monitoring. Based on the results of the impact assessment, recommendations have been proposed for management and monitoring.

Further detail regarding the profiling and screening of potential impacts is provided in Appendix A.

3. DESKTOP REVIEW

3.1 AQUATIC PROTECTED AREAS

The Study area and surrounds are protected under both Commonwealth and State legislation as detailed in Table 3-1. Commonwealth and State database searches are provided in Appendix B.

3.2 ENVIRONMENTAL VALUES

There are a range of environmental values (EVs) applicable to waterways in Queensland. These include the value of the waterways to aquatic ecosystems, primary industries, recreation and aesthetics, drinking water, industrial uses as well as cultural and spiritual values. The Study area is located within the water management area deemed to be the Landside of Port of Cape Flattery (DES, 2020a). Table 3-2 defines EVs for the noted water management area.

Table 3-1 Aquatic protected areas within the Study area and surrounds

Legislation/Directory	Protection areas	Notes
Matters of National Environmental Significance		
Environmental Protection and Biodiversity Conservation Act 1999	National heritage places	The Great Barrier Reef National heritage place includes the low water mark surrounding Cape Flattery.
	World heritage properties	The Great Barrier Reef World heritage area includes the low water mark surrounding Cape Flattery.
	Wetlands of international significance	There are no mapped wetlands of international significance within the Study area and surrounds.
	Great Barrier Reef Marine Park	The GBRMP does not directly overlap with the Study area, yet the GBRMP is located within approximately 4 km off the coastline of the Study area (Figure 3-1).
	Commonwealth marine waters	The Study area and surrounds are not located within Commonwealth marine waters
	Listed Ecological Communities	There are no listed aquatic ecological communities mapped within the Study area.
	Listed Threatened Species	Threatened species or species habitat is known within the Study area and its surrounds (Table 3-7).
	Listed Migratory Communities	Possible migratory species or species habitat within the Study area and its surrounds (Table 3-7).
Wet Tropics World Heritage Protection and Management Act 1993	Wet tropics world heritage area	The Study area and surrounds are not located within any Wet Tropics World Heritage catchments. These are approximately 78 km south of the Study area
Directory of Important Wetlands in Australia	Wetland of national importance	There are two mapped wetlands of national importance within the Study area and surrounds. These wetlands include: The Cape Flattery Dune Lakes, which receive discharges from waterways within the ML and the GBRMPA which is located approximately 4 km off the coastline of the Study area however, the GBRMPA is irrelevant in the context of freshwater ecology.
Matters of State Environmental Significance		
Fisheries Regulation 2008	Fish habitat areas (A and B areas)	There are no protected fish habitat areas within the Study area and surrounds
Environmental Protection Act 1994	Referable wetlands	There are no mapped referrable wetlands within the Study area and surrounds.
	High ecological values (HEV)	There are mapped HEV wetlands present within the Study area (DES, 2020a). These are HEV wetlands attributing to Cape Flattery Dune Lakes which are a series of wetlands within and outside of the Study area. Waterways within the direct proposed mine footprint drain into some of these HEV wetlands (Figure 3-1).
	High ecological significance (HES) and Wetland Protection Area (WPA)	There are mapped HES wetlands present within the Study area. These are HES wetlands attributing to Cape Flattery Dune Lakes which are a series of wetlands within and outside of the Study area. Waterways within the direct proposed mine footprint drain into some of these HES wetlands (Figure 3-1)..
Regional Planning Interests Act 2014	Strategic environmental areas	The Study area and surrounds do not traverse any mapped strategic environmental areas (previously wild rivers).
Vegetation Management Act 1999	Regulated vegetation – category B, C and R	The Study area and its surrounds includes category B regulated vegetation along the riverbanks and a small patch of category R regulated vegetation (Figure 3-2).
	Regulated Vegetation – intersecting a watercourse	There are mapped areas of regulated vegetation – intersecting a waterways, throughout the Study area (Figure 3-2).
	Essential habitat	Essential habitat is mapped the along the far southwest, just outside 2.5 km radius of the Study area. Waterways from the Study area and the proposed mine footprint drain into the intersecting essential habitat area before discharging into the marine environment (Figure 3-2).
Nature Conservation Act 1992	Protected freshwater fauna and flora	Protected species or species habitat is known within the Study area and its surrounds (Table 3-7)
Water Act 2000	Defined watercourses	There are no defined watercourses in the Study area as defined under the *Water Act 2000*, these are currently unmapped (Figure 3-3)

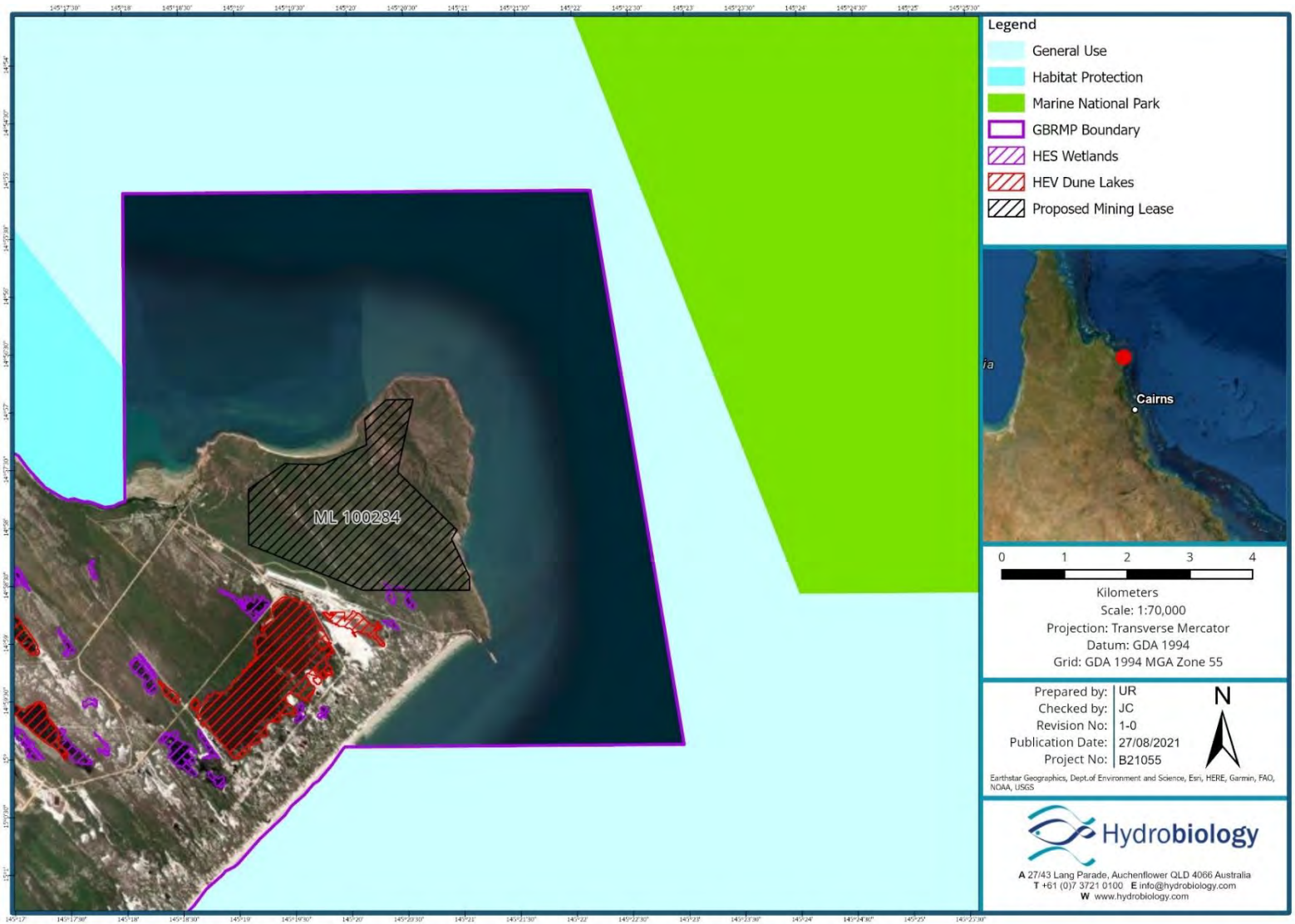

Figure 3-1 Great Barrier Reef Marine Park and Wetlands of HEV and HES status surrounding the Study area

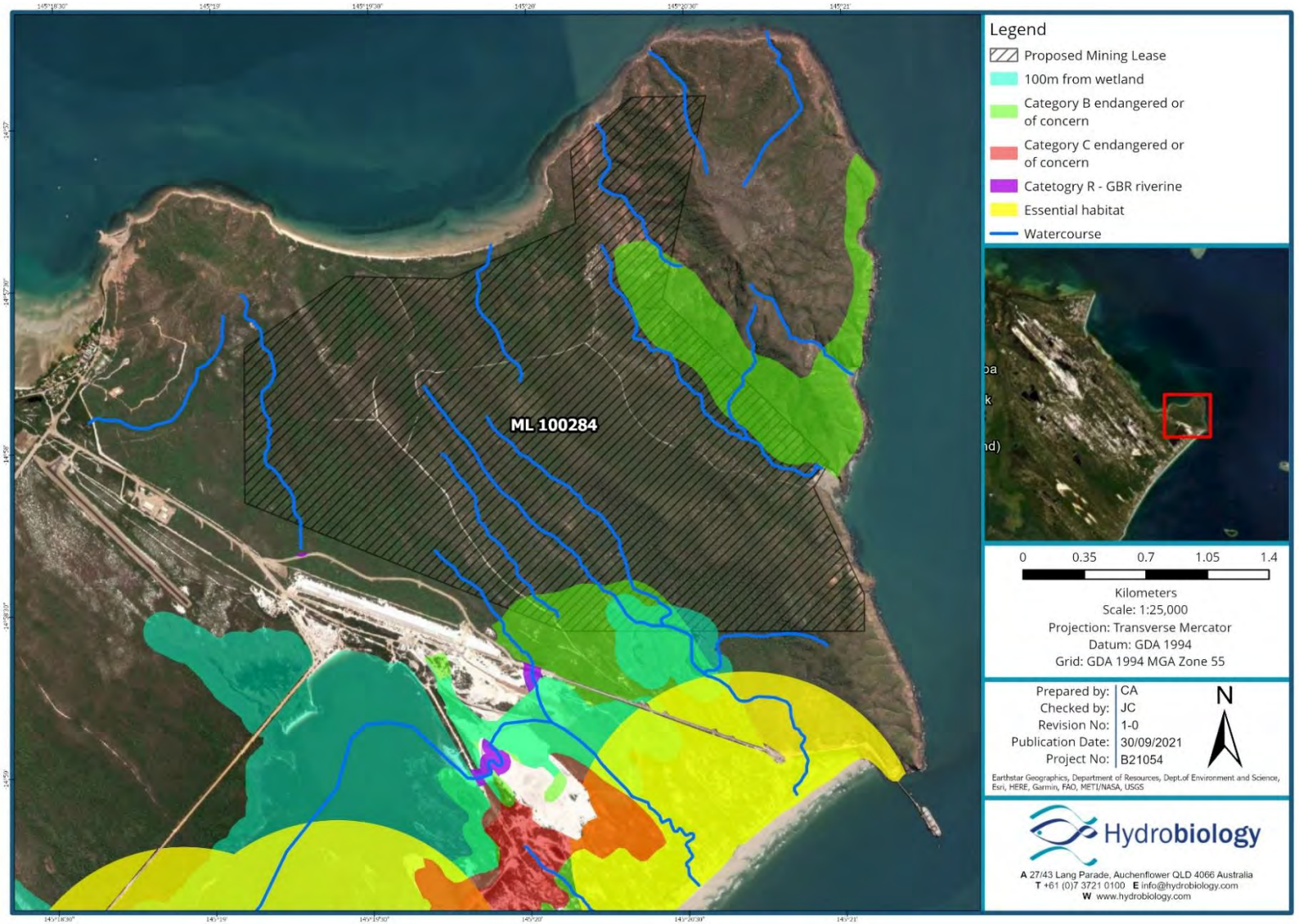

Figure 3-2 MSES Regulated Vegetation within and surrounding the Study area. Waterways defined under the *Vegetation Management Act 1999*.

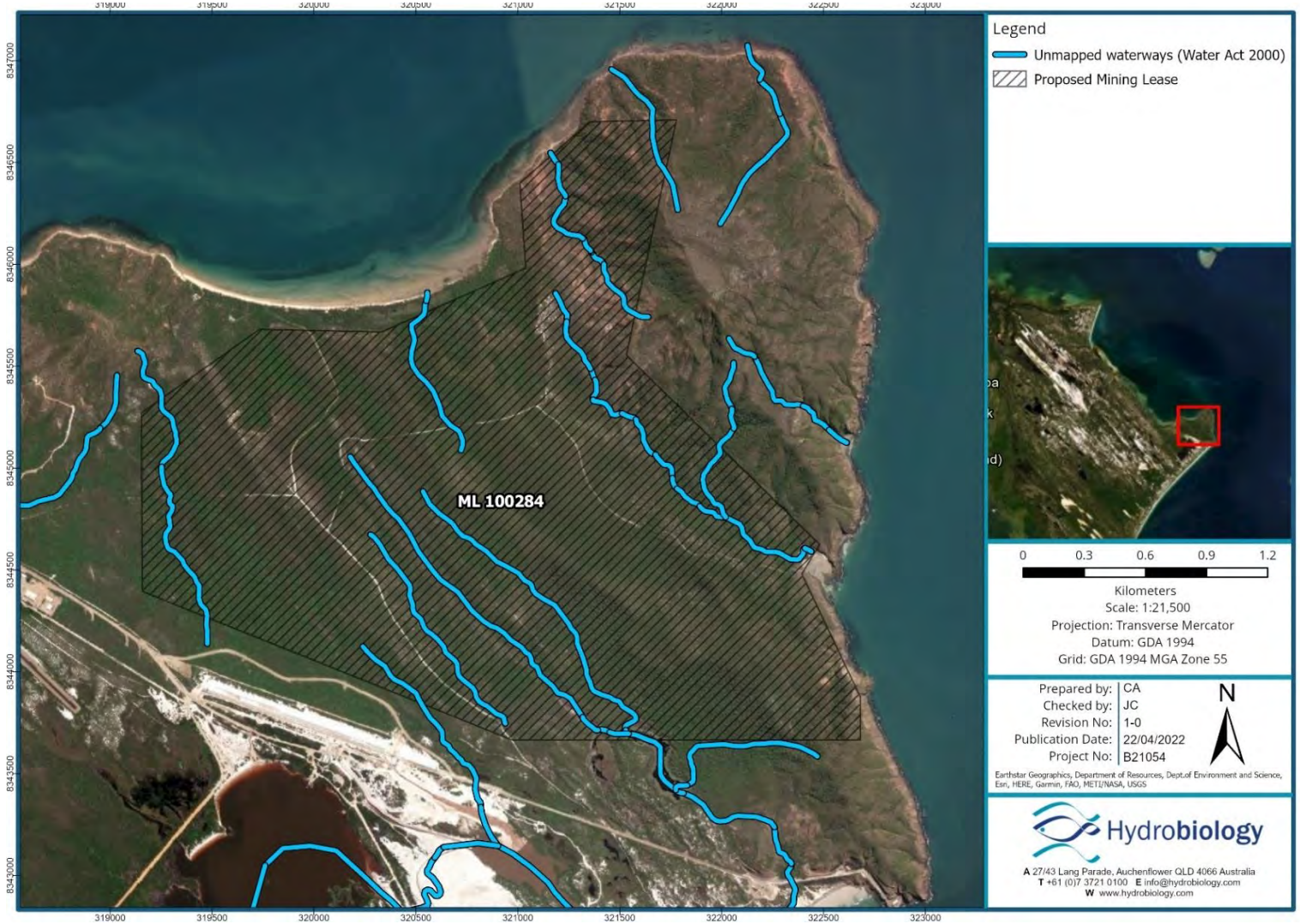

Figure 3-3 Unmapped waterways defined under the *Water Act 2000*

Table 3-2 EVs of the Study area (DES, 2020a)

Label	Environmental Value	Landside of Port of Cape Flattery
	Aquatic ecosystem	✓
	Irrigation	-
	Farm supply	-
	Stock watering	-
	Aquaculture	-
	Human consumption	✓
	Primary recreation	-
	Secondary recreation	-
	Visual appreciation	✓
	Drinking water (raw water supply)	-
	Industrial	✓
	Cultural and spiritual values	✓

3.3 HYDROLOGY

There are no State operated gauging stations within the Study area, furthermore, there are no State operated gauging stations present within the entire Jeannie River catchment. It is therefore difficult to determine or infer the hydrology of the aquatic systems of the Study area.

3.4 AQUATIC HABITAT

In accordance with the QLD wetland mapping categorisation and Jeannie and Endeavour River Basin EVs and WQOS (DES, 202a), there are three aquatic habitat types occurring within the Study area including:

- Numerous unnamed freshwater waterways throughout the Study area which drain north, northwest and in southeast directions to the open coastal environment.
- Two palustrine wetlands that receive water inputs through sub-surface flows, largely a result of the dominance of sand substrates in the catchment. Waters within the wetlands are sustained by waters seeping in from saturated sands. These are irregularly shaped inter-dune wetlands, with high aquatic vegetation cover.
- Two Dune Lake systems that receive water inputs through sub-surface flows, largely a result of the dominance of sand substrates in the catchment. Aerial photography shows that the two Dune Lakes are connected via a narrow inland channel.

These habitats can be viewed in Figure 3-4. A recent study (EPIC, 2021) observed the present habitat across three waterways draining northwest, and southeast within the Study area. These were found to be containing little water (Epic, 2021). The following site descriptions can be used to support knowledge of the available habitat for the waterways of the area. It is likely these habitat conditions will vary during flowing, wet season conditions throughout the Study area.

Creek banks along site were described to be stable with dense overhanging and trailing bank vegetation, microhabitat was represented predominately by leaf litter and some filamentous algae. Riparian canopy cover was closed with little bank cover, while substrate was generally described as being comprised of sandy/silt habitats with smaller coverage of pebbles, a site with water presence was described to be dominated by coarser sediments of rocks and pebbles with sand and silt increasing closer to shore (EPIC, 2021). Little is known on the current condition of the Dune Lakes, though there is evident erosion and increased turbidity at the Dune Lake (Dune Lake B in Figure 3-5) to the south-east of the proposed ML, which is also creating a plume into the larger Dune Lake to the east (Dune Lake A in Figure 3-5).

Hawkins et al., (1988) described the characteristics of a single Dune Lake (Dune Lake A in Figure 3-5) relevant to the Study area. This lake has been identified as a former barrier lagoon that has since become isolated from the sea with average depths of over 2 m. Vegetation within the barrier lagoon lake have been described to include dense fringing heaths and sedges (mostly *Leptocarpus*) alongside sparse *Leptocarpus* emergents (Hawkins et al., 1988).

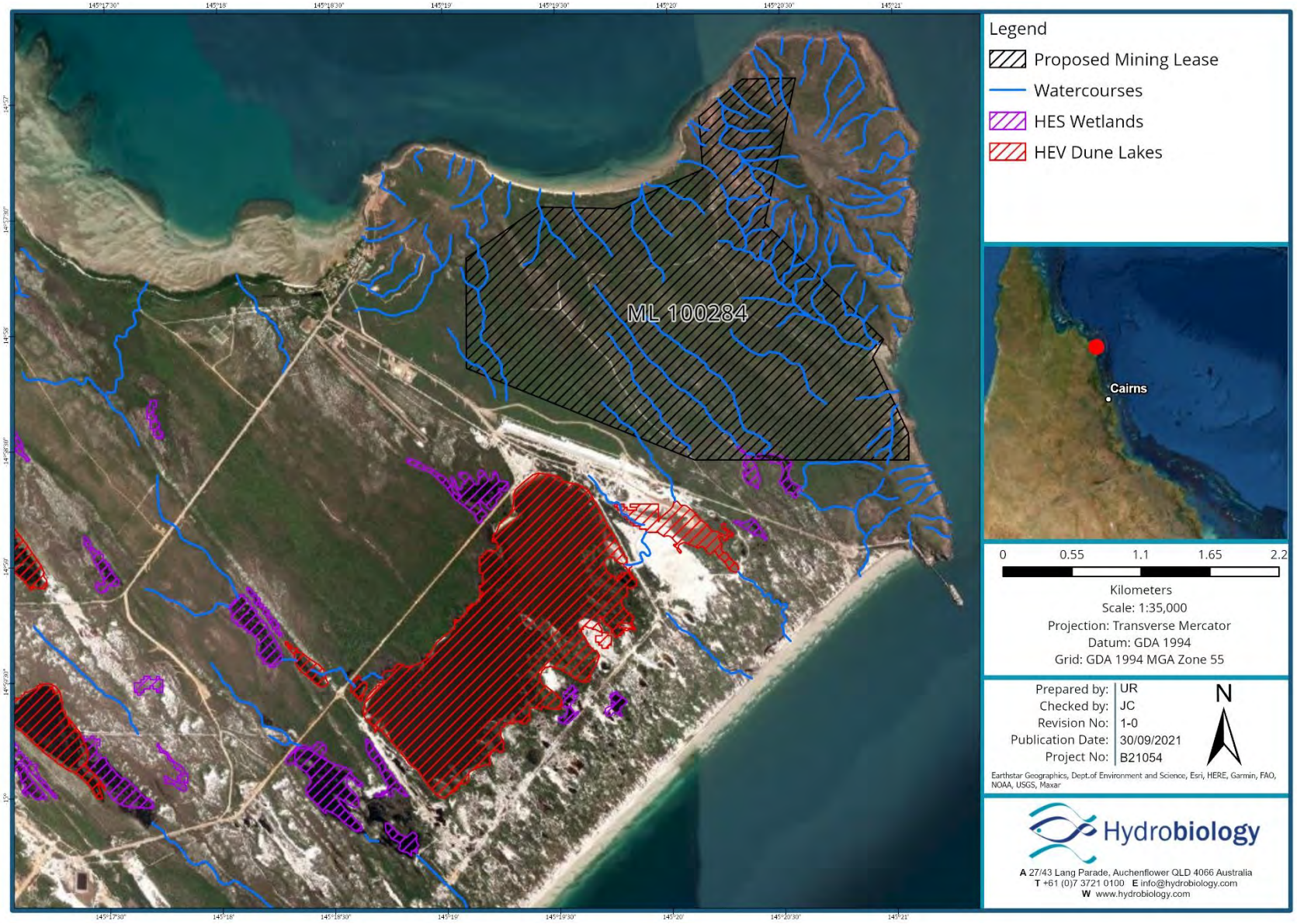

Figure 3-4 Aquatic habitats of the Study area.

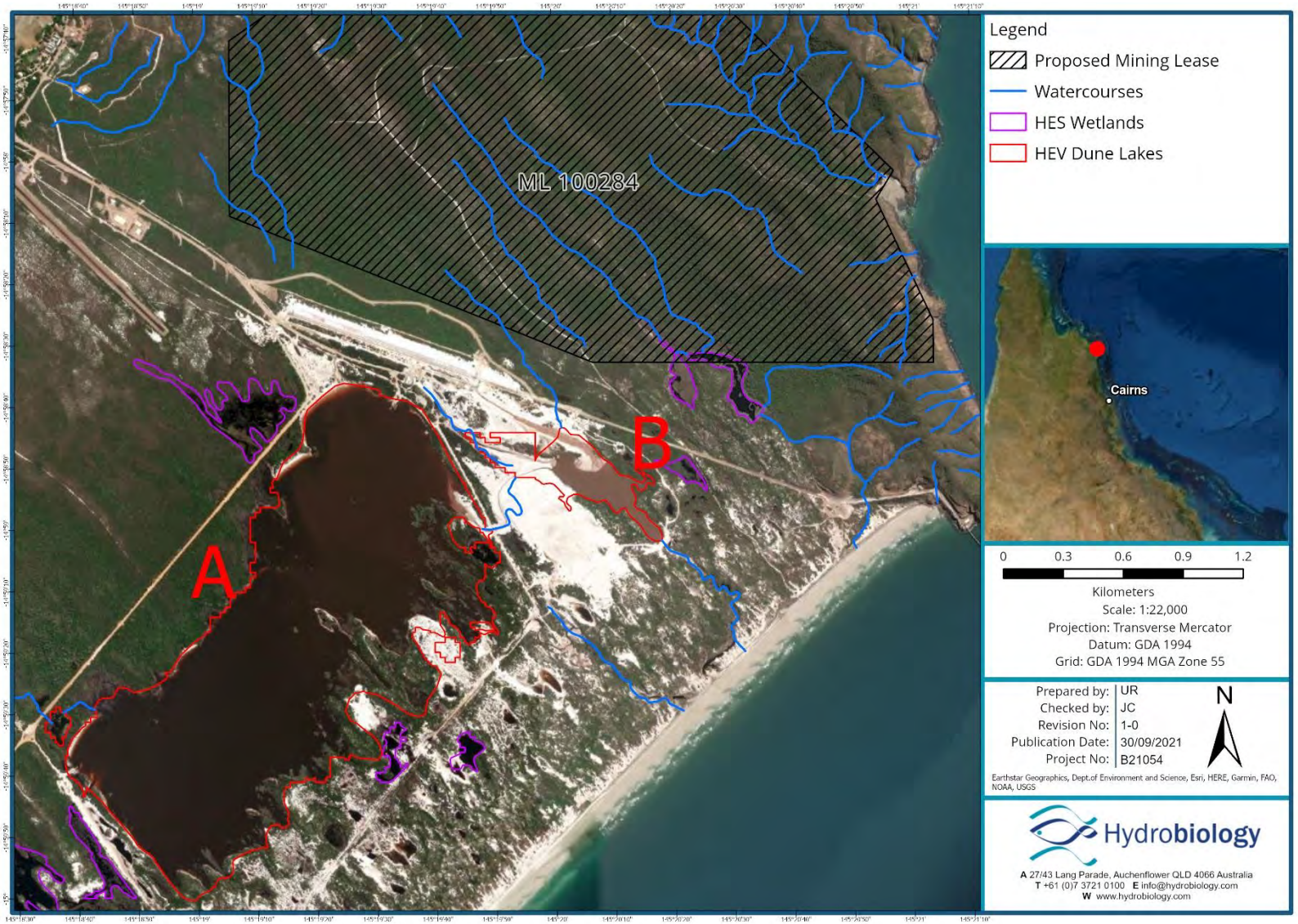

Figure 3-5 HEV wetlands displaying highly turbid (wetland B) and clearer (wetland A, though plume evident from wetland B) water column.

3.5 SURFACE WATER QUALITY

Water quality of the catchment is generally influenced by diffuse run-off and point source inputs (DES, 2021). Recent and detailed water quality data is sparse within the Study area however, information can be sourced from older published literature on the area. Unfortunately, the existing data largely excludes the tributary streams and HES palustrine wetlands of the region and instead focuses on the conservation significant Dune Lakes.

Data published by a variety of authors captures water quality in Dune Lakes within acceptable limits of their defined catchment WQOs (Hawkins et al., 1988; Pusey et al., 2000; Wright & Burgin, 2007). Published data generally corroborates findings throughout the years with initial findings published by Hawkins et al., (1988) determining that in-situ water quality characteristics generally maintained a low acidic pH of 4–6, and a very low to low conductivity ranging from 62–200 µS/cm^{-1}. The Ionic compositions of the Dune Lakes of the area were also found to be generally similar with very low concentrations of Ca, SO_4, K, and Mg, alongside an absence of Bicarbonate in most lakes however, large concentrations of NaCl were observed. (Hawkins et al., 1988). These attributes are comparable to dune fields in south-eastern Queensland yet, the lakes present in Cape Flattery are thought to not be perched above the local water table (Hawkins et al., 1988).

Later findings by Pusey et al., (2000) characterised water quality in streams, Dune Lakes, swamps, and isolated pools within the Blackwater Creek tributary to the north of the Study area between Lookout Point. Waterbodies within this study bordered or were within the Projects exploration permit (EPM 25734) with tributaries running through the EPM. The study correlated previous findings for Dune Lakes of the Study area itself with pH ranging from 5–5.1 and insights into the dissolved oxygen (DO) values of Dune Lakes with two sites recording values of 6.53 and 7.37 mg/L (Pusey et al., 2000). Isolated Pools of the area recorded acidic pH values and low conductivity while streams and the swamp habitat maintained acidic pH levels and higher DO content with very low conductivity (Pusey et al., 2000). A summary of the results from the study can be viewed in Table 3-3 these results can be used to infer water quality of the other waterbodies within the Study area itself.

Table 3-3 Pusey et al., (2000) Water Quality Results.

Parameter	Habitat Type							
	Lake	Lake	Pool	Pool	Pool	Swamp	Stream	Stream
pH	5.1	5.01	3.93	3.6	3.8	4.1	4.1	4.58
Dissolved Oxygen (mg/L)	6.53	7.38	7.12	6.4	7.37	7.73	7.73	7.5
Conductivity (µS/cm^{-1})	-	385	192	188	108	89	89	92

A more recent study by Wright & Burgin (2007) further supports the pH and electrical conductivity (EC) of the Dune Lakes within the area recording average pH values of 4.6 and electrical conductivity of 132 µS/cm^{-1}. Identifying the Dune Lakes of Cape Flattery as the most acidic in Australia while maintaining the lowest EC, similar to Fraser Island lakes while contrasting with significantly higher values to other Australian lakes in the south-eastern mainland and Tasmania (Wright & Burgin, 2007).

Recently, Epic, (2021) undertook water quality sampling within waterways of the Study area in June 2021. Limited data was captured due to a lack of present water with data being recorded from a single site, (Table 3-4). Jeannie River Basin WQOs are not available for the tributary rivers and wetlands of the Study area and thus ANZG 2000 trigger values for tropical freshwater systems were used for comparison. Parameters recorded at this one site were found to be outside of the default guideline

values for the following: pH (<6.0), DO %Saturation (<85%), and EC (>250 µS/cm^{-1}) (ANZG, 2000). The noted brackish water (EC of 1,009 µg/L) was likely linked to proximity to the coastal environment (i.e. tidal influence) and/or concentration of salts in drying pool habitat. This general non-conformance with ANZG default guidelines shows the importance of developing site-specific triggers for the management of water quality associated to the proposed mine.

Table 3-4 Epic Environmental June 2021 Water Quality Results

Parameter	Unit	Measurement
pH	pH Unit	5.71
Conductivity	µS/cm @ 25°C	1009
Dissolved Oxygen	% Saturation	73.7
	mg/L	6.02
Flow	m^3/s	0
Total Dissolved Solids	mg/L	650
Redox Potential	mV	75
Salinity	Ppt	0.49

3.6 GROUNDWATER DEPENDENT ECOSYSTEMS - AQUATIC

3.6.1 MAPPED LIKELIHOODS

The likelihood presence of GDEs (surface water expressions) have previously been mapped for the Cape Flattery region (DES, 2018). This desktop GIS study indicated that the palustrine wetlands are not groundwater dependant. GA&S (2022) also indicated that the conceptual understanding is the palustrine wetlands are disconnected from the water table and therefore are perched water bodies with an impermeable base. However, GA&S (2022) further states that conclusions regarding groundwater dependency of the palustrine wetlands is not necessarily accurate and further investigations are required.

The Dune Lake to the south (outside of the MLA, though downstream of it) is considered to be groundwater dependant (DES, 2018b). Two studies (Hawkins et al., 1988; Timms, 1986) also investigated groundwater dependence of the Dune Lakes and found conflicting results (either groundwater dependant or not).

3.6.2 ACTIVE SPRINGS

There are no mapped active springs within the site and surrounds.

3.7 AQUATIC CONSERVATION ASSESSMENT

The Aquatic Biodiversity Assessment and Mapping Method (AquaBAMM) is used to assess conservation values of wetlands in Queensland (DES, 2020). The Dune Lakes of the Cape Flattery system were designated as maintaining a very high aquatic biodiversity significance at a state significance level with distinct species assemblage and disjunct, relic populations of fish present. The Aquatic conservation significance for the majority the riverine wetlands of the Study area were rated to be at a very high level (73% of the Study area). The non-riverine, palustrine wetlands of the Study

area were additionally, all rated as very high. The method also identified the endemic *Cherax cartalacoolah* to be a Biodiversity planning assessment priority species that was present within site, with a back on track rank of high. Furthermore, Pennyfish (*Denariusa australis*), Jungle perch (*Kuhlia rupestris),* McCulloch's rainbowfish *(Melanotaenia macculloch*), Black catfish (*Neosilurus ater*), Poreless gudgeon (*Oxyeleotris nullipora*), Obbes' catfish (*Porochilus obbesi*), and Spotted blue eye (*Pseudomugil gertrudae*) were also identified as Biodiversity planning assessment priority species known to the area with back on track ranks of low. The previously listed species were all similarly identified as Aquatic conservation assessment priority species with the addition of the Estuarine crocodile (*Crocodylus porosus*) and the Shortfin eel (*Anguilla obscura*).

Overall, the area had a very high AquaBAMM scores for aquatic values, catchment values, diversity and richness, threatened species and ecosystems, priority species and ecosystems, and special features scores. This is the result of the high conservation values of the Dune Lakes systems and the threatened, endemic, relic, and disjunct communities within these habitats. The ratings of the riverine and non-riverine Aquatic conservation assessments can be viewed in Figure 3-6 and Figure 3-7.

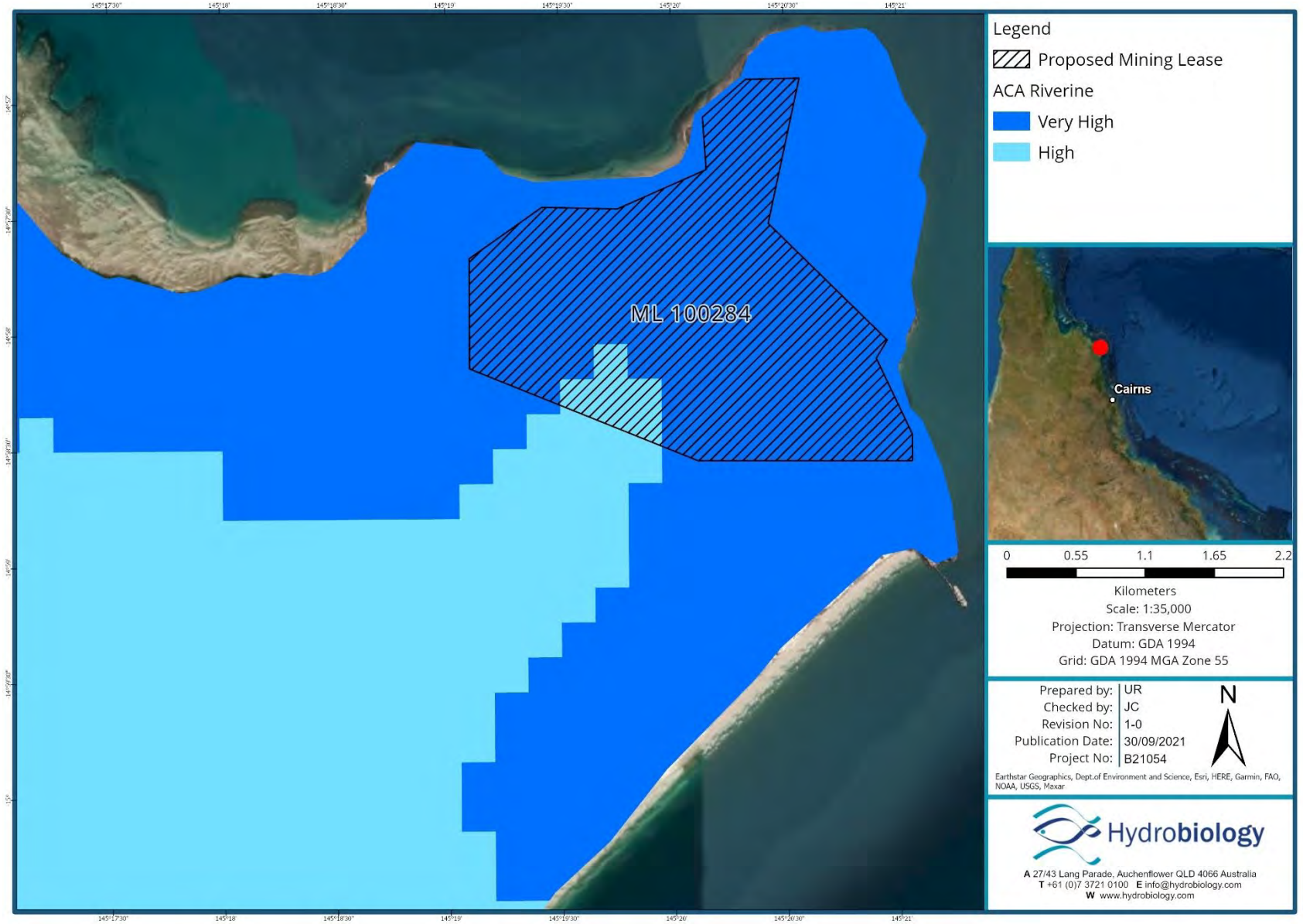

Figure 3-6 Riverine Aquatic Conservation Assessment

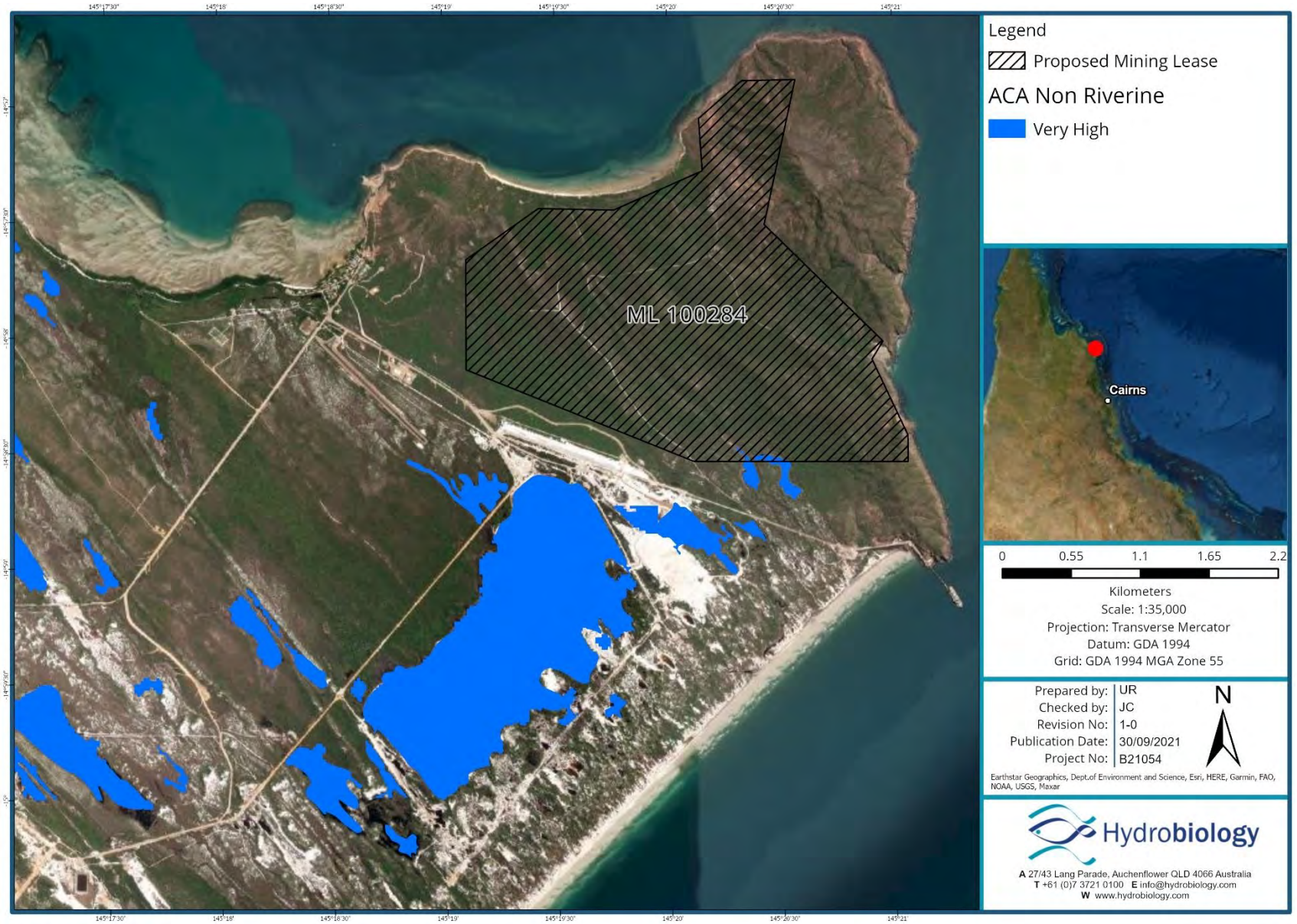

Figure 3-7 Non-Riverine Aquatic Conservation Assessment

3.8 AQUATIC FLORA

Hawkins et al., (1988) undertook a comprehensive assessment of Aquatic macrophyte communities within Dune Lakes of the Cape Flattery region. Community composition was found to similar to other Dune Lake systems within the Cape York Peninsula (Hawkins et al., 1988; Timms, 1986). At the time of sampling, *Leptocarpus spp*., *Baumea rubiginosa*, and *Lepironia articulata* were the most dominant macrophytes observed. This is typical of coastal Dune Lakes throughout northern New South Wales and southern Queensland with the three genera dominating these systems (Timms 1982; Arthington et al., 1986). However, of the 29 macrophyte species recorded within the Cape Flattery Dune Lakes, only four had previously been recorded in Dune Lake systems outside of Cape Flattery with commonly occurring submerged macrophytes of southern systems being noticeably absent from Cape Flattery. The lack of submerged macrophytes may be attributed to the strong light attenuation in many lakes and fluctuations in water levels (Hawkins et al., 1988).

Rudimentary macrophyte observations on aquatic habitats within Blackwater Creek and to the far end of the exploration permit (EPM 25734) by Pusey et al., (2000), corroborate the findings by Hawkins et al., (1988) observing abundant emergent vegetation of mostly *Lepironia articulata.*

A species list of macrophytes recorded by Hawkins et al., (1998) is available within Table 3-5, it is important to note that information on macrophytes to this study relates only to those within Dune Lakes, species compositions in other habitats of the Study area such as tributary waterways, pools, and wetlands is unknown.

Table 3-5 Macrophytes recorded within Dune Lakes in the Cape Flattery Dune Lakes region and the Study area.

Species	Common Name	Conservation	Within Study area	Within Wider Region
Machaerina rubiginosa	Soft twig rush	EPBC: Not listed - NCA: Not listed	✓	✓
Machaerina teretifolia	Twing rush	EPBC: Not listed - NCA: Not listed	-	✓
Centrolepis banksii	-	EPBC: Not listed - NCA: Not listed	-	✓
Cyperus sp.	-	EPBC: Not listed - NCA: Not listed	-	✓
Eleocharis spp.	-	EPBC: Not listed - NCA: Not listed	-	✓
Eleocharis dulcis	Water chestnut	EPBC: Not listed - NCA: Not listed	-	✓
Eleocharis geniculata	Bent spikerush	EPBC: Not listed - NCA: Not listed	-	✓
Eleocharis sp.	-	EPBC: Not listed - NCA: Not listed	-	✓
Eriocaulon australe	Austral pipewort	EPBC: Not listed - NCA: Not listed	-	✓
Eriocaulon depressum	Eriocaulon	EPBC: Not listed - NCA: Not listed	-	✓
Fimbristylis spp.	-	EPBC: Not listed - NCA: Not listed	-	✓
Fimbristylis modesta	-	EPBC: Not listed - NCA: Not listed	-	✓
Gahnia sieberiana	Red-fruit saw-sedge	EPBC: Not listed - NCA: Not listed	✓	✓
Lepironia articulata	Grey sedge	EPBC: Not listed - NCA: Not listed	✓	✓
Dapsilanthus spp.	-	EPBC: Not listed - NCA: Not listed	✓	✓
Dapsilanthus elatior	-	EPBC: Not listed - NCA: Not listed	✓	✓
Dapsilanthus ramoms	-	EPBC: Not listed - NCA: Not listed		✓
Dapsilanthus spathaceus	-	EPBC: Not listed - NCA: Not listed	✓	✓

Species	Common Name	Conservation	Within Study area	Within Wider Region
Nymphaea gigantea	Giant water lily	EPBC: Not listed - NCA: Not listed	-	✓
Coelachne pulchella	-	EPBC: Not listed - NCA: Not listed	-	✓
Philydrum lanuginosum	Frogsmouth	EPBC: Not listed - NCA: Not listed	-	✓
Pseudoraphis spinescens	Spiny mudgrass	EPBC: Not listed - NCA: Not listed	-	✓
Baloskion tetraphyllum	Tassel cord rush	EPBC: Not listed - NCA: Not listed	✓	✓
Schoenus calostachyus	Bogrush	EPBC: Not listed - NCA: Not listed	✓	✓
Scleria sp.	-	EPBC: Not listed - NCA: Not listed	✓	✓
Tricostularia undulata	-	EPBC: Not listed - NCA: Not listed	-	✓
Utricularia spp.	-	EPBC: Not listed - NCA: Not listed	-	✓
Utricularia chrysantha	Sun bladderwort	EPBC: Not listed - NCA: Not listed	-	✓
Utricularia limosa	-	EPBC: Not listed - NCA: Not listed	-	✓
Utricularia stellaris	-	EPBC: Not listed - NCA: Not listed	-	✓
Xyris complanata	Feathered yellow-eye	EPBC: Not listed - NCA: Not listed	-	✓
Xyris juncea	Dwarf yellow-eye	EPBC: Not listed - NCA: Not listed	-	✓

3.9 AQUATIC BIOTA

3.9.1 PHYTOPLANKTON AND ZOOPLANKTON

A study undertaken by Hawkins et al., (1988) investigated both phytoplankton and zooplankton taxa within the Cape Flattery Dune Lakes. Information regarding phytoplankton and zooplankton of the Study area outside of the Dune Lakes (palustrine wetlands and waterways) is unknown.

Phytoplankton was generally typical of compositions in Dune Lake systems globally, with a dominance of diatoms and desmids alongside a low chlorophycean index (Hawkins et al., 1988). The key feature of phytoplankton flora within this study was the diversity of desmids, which formed 83 of the 144 taxa identified within surveys. Chlorococcales and Diatoms contributed to the majority of the species. The diatoms identified were generally benthic and epiphytic species which their occurrence reflecting a lack of stratification, shallow depths (Hawkins et al., 1988).

The Dune Lakes of Cape Flattery were generally depauperate in true planktonic limnetic zooplankton with composition primarily composed of cladocerans and copepods with *Calamoecia ultima* being sampled in nearly all lakes. This is a typical characteristic of Dune Lakes located to the south of the tropic of Capricorn, with the exception of the usual *Calamoecia tasmanica* of Australia's southern Dune Lakes being replaced by *C. ultima* (Hawkins et al., 1988; Timms, 1986). Generally, the majority of zooplankton was derived from littoral species which were characteristic to the shallow depths and turbulence of the Dune Lakes (Hawkins et al., 1988).

3.9.2 MACROINVERTEBRATES AND MACROCRUSTACEANS

Macroinvertebrates play a vital role in food web dynamics as they provide the link between primary production and high trophic organisms. Literature detailing the macroinvertebrate communities of Dune Lakes within Cape Flattery was detailed by Wright, (2005) however, this study limits its range to only Chironomid species, and furthermore combines data with multiple dune systems throughout tropical north Queensland. Due to this, the Chironomid composition of Cape Flattery Dune Lakes cannot be determined, this is exacerbated by the distinct environmental differences within Cape Flattery Dune Lakes listed throughout this report in contrast to other lakes.

Little is known on macrocrustaceans of the Study area with no known available studies having been previously undertaken to fill this knowledge gap. A study by Hawkins et al., (1988) did however, record a crayfish (*Cherax sp*.) in Dune Lakes of the region near the McIvor River (approximately 20 km south-west of the Study area) alongside shrimps (*Caridina sp.*) and several unidentified species of *Macrobrachium in* streams draining from lakes. Furthermore no molluscs were located in any of the Dune Lakes (Hawkins et al., 1988). An additional study by Timms, (1986) also corroborated findings by Hawkins et al., (1998) with *Caridinides wilkensi* being detected within the same Dune Lake. While the waterbodies studied were not connected to those within the Study area, the information can be used to infer a possible macrocrustacean presence within waterbodies in the Study area.

Cherax cartalacoolah is endemic to Cape Flattery region having been known to occur only within a restricted range, found only in Dune Lakes and coastal creek habitats of the Study area. It is believed that the species range possibly further extends between Cape Lookout and Cape Bedford (Short, 1993). None of the macrocrustaceans discussed are listed under the EPBC or NC Acts.

3.9.3 FRESHWATER FISH

A fish list was compiled for the Study area from the four following literature sources. The first was a report compiled by Pusey et al., (2000) in an area approximately 8 km to the west of the Study area, bordering and intersecting the Projects exploration permit (EPM 25734). This study entails fish

surveyed across Dune Lakes, streams, wetlands, and isolated pools near Blackwater creek. The second report is a study by Hawkins et al., (1988) undertaking an assessment on the limnology of Dune Lakes with surveys encompassing 18 Dune Lakes in the Cape Flattery region, including the largest Dune Lake within the Study area. The Third study was undertaken by Herbert et al., (1995) on behalf of the Natural Resources Analysis Program, this report analysed the fish populations of Cape York, providing Museum accession records of fish species obtained from Cape Flattery Dune Lakes. The final, source by Pusey et al., (2004) is a compiled guide on freshwater fish of north-eastern Australia, this guide draws upon a variety of unpublished fish data undertaken on behalf of existing mining operations in the region.

Based upon past surveys, a total of 22 species of fish are known to occur within the Study area, of these species none are listed under the EPBC act (Environment Protection and Biodiversity Conservation Act 1999) or the NC act (Nature Conservation Act 1992) (Table 3-6). However, three species (*M. maccullochi, D. australis*, and *P. gertrudae*) all occur in small, very disjunct, and isolated populations, these species are often syntopic and require similar habitat requirements (Pusey et al., 2000). It is important to note that no known surveys have been undertaken in the smaller tributary waterways and palustrine wetlands of the Study area. This leaves a knowledge gap regarding the fish community composition of those waterways. However, the report by Pusey et al., (2000) included sites within blackwater creek to the west of the Study area, this data showed little difference with most species being found in both habitats and can be used to infer species composition within the Study area.

Data collated from previous studies indicated that the abundant species within the Study area are *Melanotaenia maccullochi, Melanotaenia splendida inornata, Ambassis agrammus,* and *Denariusa australis* with species assemblage often appearing to form assemblage characteristics of darkly tannin-stained acidic waters (Pusey et al., 2000). These species generally have life cycle attributes that predispose them towards success in highly seasonal and largely non-perennial freshwater habitats available within the Study area. Furthermore, the *Melanotaenia splendida inornata* of the area have been suggested to be a further subspecific differentiation with other species of the area such as *Denariusa australis*, also thought to be genetically distinct (Pusey et al., 2000, Pusey et al., 2004). Larger pelagic and piscivorous species such as *Lates calcarifer* and *Megalops cyprinoides* are expected to be in higher abundances within the Dune Lakes however, these have only been caught seldomly due to spiritual concerns by traditional owners of the area (Pusey et al., 2000).

The EPBC listed Opal cling goby (*Stiphodon semoni*) has been listed as possibly present in the Study area (section 3.9.5). However, the species has not previously been observed within the Study area or surrounds (Wildnet Search and ALA), nor does their habitat occur within the site. The Opal cling goby has been found south of the Study area with the nearest sighting being approximately 130 km south, just north of the Daintree. Its known range at present is known to extend from the Daintree to the south of Cairns. The species general distribution in Australia is confined to a limited number of rainforest streams within the Wet Tropics World Heritage Area and the Wet Tropics Interim Biogeographic Regionalisation of Australia Bioregion (Ebner & Thuesen, 2010; TSSC, 2011). Thuesen et al., (2009) has estimated a population of 10-30 individuals from numbers recorded during surveys of streams within the Wet Tropics. These individuals were generally found within habitats described as pristine rainforest streams with significant flow and direct access to marine habitats (Thuesen et al., 2009).

Table 3-6 Freshwater fish recorded in the Cape Flattery region.

Species	Common name	NCA	EPBC	(Pusey et al., 2000) (Dune Lakes, Waterways, Wetlands)	(Hawkins et al., 1988) (Dune Lakes)	(Herbert et al., 1995) (Dune Lakes)	(Pusey et al., 2004) (Dune Lakes)
Ambassidae							
Ambassis agrammus	Sailfin glassfish	-	-	✓	✓	-	✓
Denariusa australis	Pennyfish	-	-	✓	-	✓	✓
Anguillidae							
Anguilla obscura	Shortfinned eel	-	-	✓	-	-	-
Anguilla reinhardtii	Longfin eel	-	-	✓	✓	-	-
Apogonidae							
Glossamia aprion	Mouth almighty	-	-	✓	✓	✓	✓
Butidae							
Oxyeleotris nullipora	Poreless gudgeon	-	-	✓	-	✓	-
Latidae							
Lates calcarifer	Barramundi	-	-	✓	-	-	✓
Eleotridae							
Giuris margaritacea	Snakehead gudgeon	-	-	✓	-	-	✓
Hypseleotris compressa	Empire gudgeon	-	-	✓	✓	✓	✓
Mogurnda adspersa	Southern purplespotted gudgeon	-	-	✓	✓	-	-
Mogurnda morgunda	Northern purplespotted gudgeon	-	-	✓	-	✓	✓

Species	Common name	NCA	EPBC	(Pusey et al., 2000) (Dune Lakes, Waterways, Wetlands)	(Hawkins et al., 1988) (Dune Lakes)	(Herbert et al., 1995) (Dune Lakes)	(Pusey et al., 2004) (Dune Lakes)
Kuhliidae							
Kuhlia rupestris	Jungle perch	-	-	✓	-	-	✓
Megalopidae							
Megaalops cyprinodies	Tarpon	-	-	-	-	✓	✓
Melanotaeniidae							
Melanotaenia maccullochi	McCulloch's rainbowfish	-	-	✓	✓	✓	✓
Melanotaenia splendida	Eastern rainbowfish	-	-	✓	✓	-	-
Melanotaenia splendida inornata	Chequered rainbowfish	-	-	✓	-	✓	✓
Plotosidae							
Neosilurus ater	Black catfish	-	-	✓	✓	✓	✓
Neosilurus hyrtlii	Hyrtl's catfish	-	-	✓	-	-	-
Porochilus obbesi	Obbes' catfish	-	-	✓	-	✓	-
Porochilus rendahli	Rendahl's catfish	-	-	✓	-	-	✓
Pseudomugilidae							
Pseudomugil gertrudae	Spotted blue eye	-	-	✓	✓	✓	✓
Synbranchidae							
Ophisternon bengalense	Swamp eels	-	-	✓	-	-	✓

3.9.4 FRESHWATER REPTILES

Generally, few studies have been undertaken on freshwater reptiles of the area. However, recordings of *Crocodylus porosus* (estuarine crocodile) have been consistent amongst the majority of available literature. The estuarine crocodile has been reported in many of the Dune Lakes of the system, including shallow, clear water lakes isolated from estuarine waters (Hawkins et al., 1988). It is known to the area, often inhabiting swamps, inland rivers, estuary mouths, and the open sea. The estuarine crocodile is an EPBC listed migratory species, in addition to being listed as Vulnerable under the NC Act.

Freshwater turtle information is scarce with only Hawkins et at., (1988) noting two shells of *Chelodina rugosa* (Northern snake-necked turtle) being found during surveys and descriptions from residents and traditional owners suggesting the presence of *Emydura krefftii* (Krefts river turtle). Both these species are not threatened or conservation significant and considering no live specimens have been collected, the presence of freshwater turtles within the Study area is considered to be unknown.

3.9.5 EVNT SPECIES POTENTIALLY OCCURING IN STUDY AREA

Resources such as the EPBC Act Protected Matters Search Tool, the Queensland Matters of State Environmental Significance Search Tool, were used to identify conservation significant species that occur or could occur in the Study area. The habitat and distribution of threatened freshwater species known or likely to occur in the Study area and surrounds were identified below in Table 3-7. To summarise, the following was identified:

- Threatened freshwater fish: 1 species
- Threatened freshwater reptiles: 1 species
- Threatened sharks and rays: 3 species
- Threatened mammals: 1 species

The listed mammal (Water mouse) will be covered by EPIC Environmental in the corresponding terrestrial fauna survey. The likelihood of species occurring was considered under four categories; (i) unlikely; (ii) possible; (iii) likely; and (iv) Known (see Section Conservation Significant Species4.7). We note that occurrences of saltwater crocodiles within the Study area (Ayling et al., 1997; Hawkins et al., 1988).

Table 3-7 Threatened Species – Likelihood of Occurrence.

Species	Status (EPBC / NC Act)	Distribution / Habitat	Nearest known record
Freshwater Fish			
Stiphodon semoni Opal cling goby	EPBC: Critically Endangered NCA: Not listed	Recorded from north of the Daintree River to the south of Cairns, Queensland. Generally, inhabits pristine rainforests streams with high flow and access to marine habitats. Can be found clinging to rocky substrates. (Thuesen et al., 2009)	The nearest sighting is approximately 130 km south
Freshwater Reptiles			
Crocodylus porosus Salt-water crocodile	EPBC: Migratory, NCA: Vulnerable	Inhabits swamps, coastal rivers, estuary mouths, inland rivers and open sea (Wilson & Swan, 2003) Species has been observed in the Study area (Ayling et al., 1997).	Species has been observed in the Study area (Ayling et al., 1997; Hawkins et al., 1988).
Sharks and Rays			
Pristis pristis Largetooth Sawfish	EPBC: Vulnerable, Migratory NCA: Not listed	The species are generally restricted to shallow estuarine fresh and coastal waters (Thorburn et al., 2007). Juvenile individuals inhabit estuarine and freshwater watercourses, while adults are generally marine (Whitty et al., 2008). Within northern Australia, the Sawfish can be located inland as far 400 km from the sea (Whitty et al., 2008).	Closest recorded freshwater sighting is approximately 100 km west.
Pristis zijsron Green Sawfish	EPBC: Vulnerable, Migratory NCA: Not listed	Species is known to occur in shallow and coastal and estuarine areas. Occurrence in much of its range is unknown due to a lack of data, It most abundant in the tropics (Simpfendorfer, 2019).	Closest sighting is Port Douglas, roughly 160 km south.
Anoxypristis cuspidate Narrow Sawfish	EPBC: Migratory NCA: Not listed	The species is bentho-pelagic, inhabiting estuarine and coastal habitats (Last & Stevens, 2009). Adults generally inhabit offshore environments while juveniles and mothers require coastal and estuarine habitats (Peverell, 2005).	Closest sighting to the Study area being in Townsville, roughly 370 km south.

4. FIELD SURVEY RESULTS

4.1 HABITAT

Detailed site profiles and drone imagery capture can be viewed in Appendix B. Site profiles are provided for those sites which contained watercourse features (as defined in the *Water Act 2000)*. That is one cannot detail aquatic habitat features if they are not present. Drone imagery and site photos were collected at all sites, except S11 and S12 due to drone failure.

4.1.1 CREEK SYSTEMS

At S9, S7, and S12 high slope streams radiate from the hard rock exposure areas. S12 was dry at the time of the survey, while S9 contained a rock pool of sufficient depth to maintain fish populations. Consistent depth at the rock pool was approximately 1m, though a max of 1.7 m was noted at some points. The rock pool was downstream of the small waterfall, which maintained a trickle baseflow during the time of the survey. It is likely that this rock pool serves as dry seasonal refugia. A meandering narrow stream was noted at S7, with high riparian and rock substrate cover. Other than the defined wetland habitats described below, the high slope stream provide the greatest aquatic values across the ML. Though the longitudinal extent of these values, particularly for fish and macroinvertebrates is expected to be limited due to the noted rock outcrops and natural instream barriers which would limit connectivity through the catchment.

S8 was located on the downstream extent of the catchment, in the supratidal zone. The creek was sand dominated and lined with both fresh and marine plant species. There is an evident sand bar that separated the waterway from discharging to the beach. It is expected that connectivity between the waterways and coastal environment would be provided during king tides and high flow events.

S10 and S11 are minor or streams dominated by sand substrates, which discharge to Middle Beach. There is limited connectivity from these streams to the coastal tidal area. At S10 minimal main channel features were noted, while S11 contained an incised compacted main channel. Mapped waterways (as identified under the *Vegetation Management Act 1999* and the Queensland Wetland Mapping (Wetland Info QLD)) at S3, S4, S5 and S6 were not evident, that is the absence of defined banks, instream flow paths and a defined riparian zone at these locations. The absence of such features occurs consistently along the natural drainage line as identified by current available aerial imagery. These waterways are also unmapped and not defined as watercourses under the *Water Act 2000*. It is expected that they provided little if any aquatic ecosystem values.

It is expected that water inputs (rainfall) are immediately drained by the sand substrates and flow through the vadose zone (i.e. sub-surface flows) following elevations contours. These would express at lower bed elevations through the drainage lines and at the mapped palustrine wetlands and further downstream dune lakes.

4.1.2 WETLAND SYSTEMS

The mapped palustrine wetlands (S1 and S2) are considered to be irregularly-shaped wetlands and swamps consistent with those described in Pye (1982). They occupy the lower depressions between major dunes. They owe their origin to deflation below the average position of the groundwater table during exceptionally dry years, although the possibility that some were formed during a period of slightly drier climate or lower sea level (and thus lower groundwater levels) cannot be ruled out (Pye, 1982). These lakes have a wet season depth of more than 2 m, but 1-1.5 m is more common (Pye, 1982). S1 contained high cover of macrophytes, dominated by *Lepironia* articulata, and *Leptocarpus* spp., while S2 only had fringing macrophyte areas, likely of these two species (interpreted from captured drone imagery). These species typically outcompete other macrophyte species, while the lack of nutrients in such wetlands systems would also limit diversity. There is evident connectivity between the two wetlands, though flows are only likely to occur during wet seasonal conditions.

Access to the dune lake mapped downstream of the Study area was not granted as this was within another proponents ML.

4.1.3 HABITAT CONDITION

Habitat condition scores based on river bioassessment methods ranged from fair to good condition (Figure 4-1). Those which scored a condition of fair typically contained higher sedimentation (fine to coarse sands). At the sites which radiate from hard rock exposure areas, bed stability was typically ranked in fair condition (though overall habitat condition score of good) due to bed scouring. Such features are considered consistent with the noted high bed slope of these waterways.

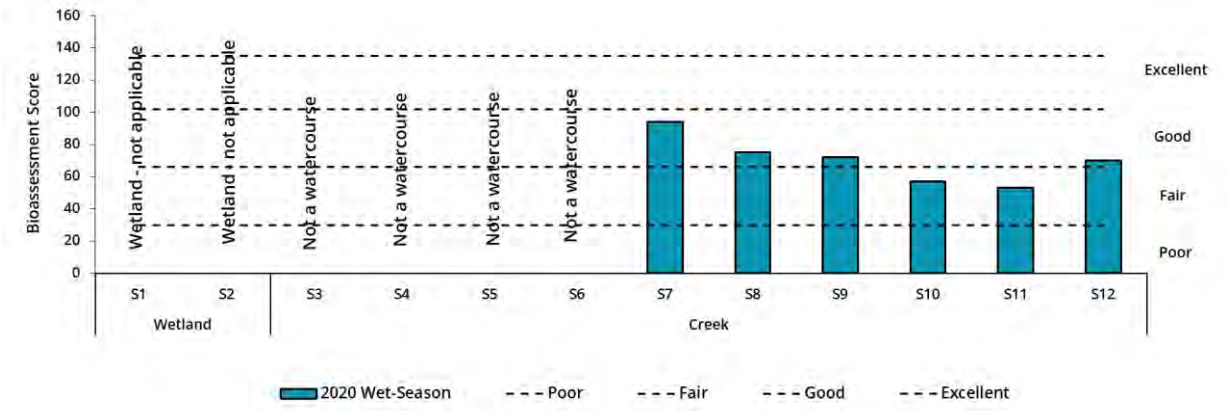

Figure 4-1 Habitat condition scores – river bioassessment

4.1.4 MACROHABITAT

The Study area consists of low macrohabitat diversity across the wetland and creek system (Figure 4-2). The significance of this low diversity is difficult to interpret without further understanding of the morphological aspects within each waterway. This analysis is rooted in the concept that reduced macrohabitat diversity reduces the functionality of the overall habitat. Limited presence of large substrate such as cobbles and boulders suggest that when flowing riffle habitat is unlikely to occur. A majority of the sites assessed were found to be predominantly dry presenting limited to no aquatic habitat, whilst the remaining sites were pools consisting of rocky or sandy/silt substrate. A lack of riffle and run reduces the habitat diversity due to declines in varied particle size and indicates the loss of what is often the most suitable habitat when found in high-gradient streams. A dominance of sandy/silt macrohabitat is expected in wetland as areas exemplified at S1.

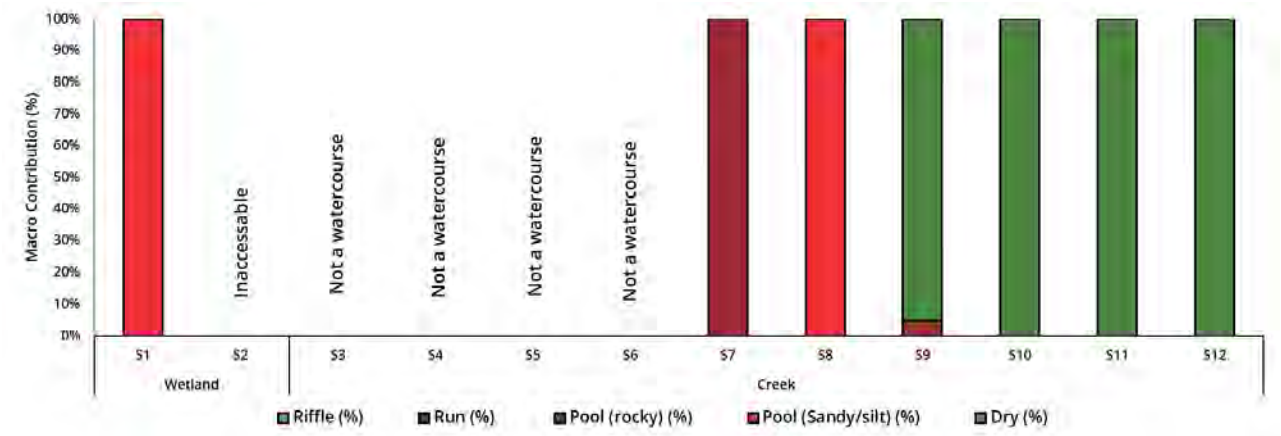

Figure 4-2 Macrohabitat variability recorded at each site.

4.1.5 MICROHABITAT

Microhabitat was variable across each site, with wetlands dominated by small woody debris followed by detritus; creek and river sites dominated by detritus and large woody debris (Figure 4-3). There is limited diversity across the project area with no presence blanketing silt and small contributions of undercut banks and periphyton occurring only at S7 and S9. Low variety in microhabitat availability results in monotonous habitat structure, decreased diversity and a decline in potential to recover following disturbance events. The high contribution of large woody debris across S8-12 aids in providing increased macroinvertebrate habitat and refugia for fish as it is often the most productive

habitat within low gradient streams. Increased availability of available rock surfaces at S9 drove extensive periphyton growth at this location.

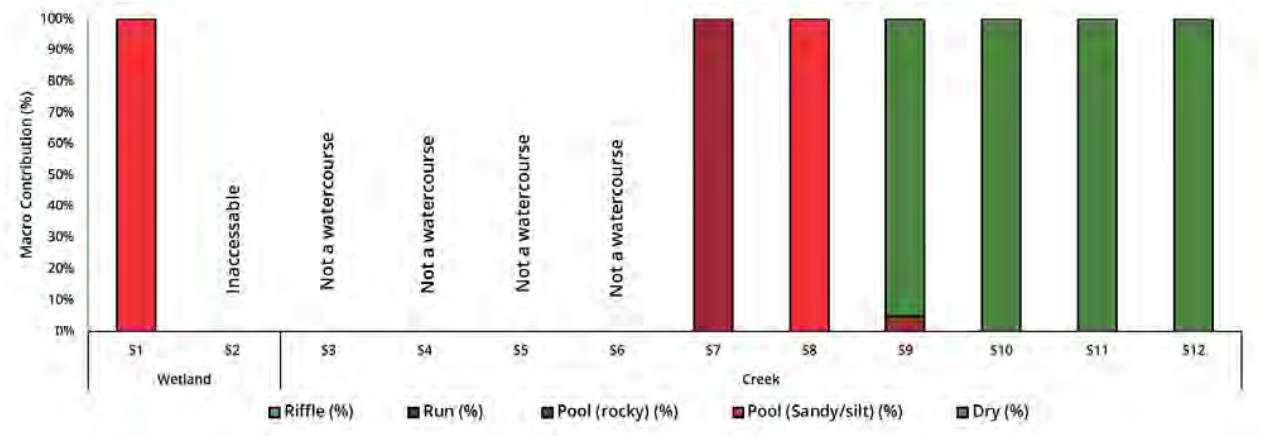

Figure 4-3 Microhabitat features recorded at each site

4.1.6 AQUATIC FLORA

Aquatic flora cover was considered low at all waterway sites, with overall cover assessed in each reach, including:

- S7 – 25%;
- S8 – 65%;
- S9 – 30%
- S12 – 30%

Low cover and diversity are likely associated to the ephemeral nature and low water availability throughout the year. This is exemplified by the dominance of emergent species. At S8 and S12 marine species were noted, further indicating the supratidal nature of these sites. As mentioned above, the wetland sites contained high cover of sedge and rush species, with S1 recording over 80% cover of macrophytes. Identified species are not considered threatened or endemic and are common to the wider Cape York region.

Table 4-1 Percent proportions of aquatic flora recorded at each site. Sites without aquatic flora are not included in the below table.

			Wetland	Waterway			
Species	Common name	Form	S1	S7	S8	S9	S12
Lepironia articulata	grey sedge	Emergent	60				
***Leptocarpus* spp.**	rush	Emergent	30				
***Xyris* sp.**	yellow eye	Emergent	5				
***Drosera* sp.**	sundew	Emergent	5				
***Gahnia* sp.**	saw-sedge	Emergent		100		40	
Eleocharis sp.	spike rush	Emergent				35	

Species	Common name	Form	Wetland	Waterway			
			S1	S7	S8	S9	S12
Cyperus spp.	sedge	Emergent				35	
Rhizophora stylosa	stilt mangrove	Marine – mangrove			80		
Ceriops spp.	yellow mangrove	Marine – mangrove			10		
Avicennia marina	grey mangrove	Marine - mangrove			10		
Sporobolus virginicus	marine couch	Marine – saltmarsh					100

4.1.7 SUBSTRATE COMPOSITION

No variability in substrate composition was found across sites 1, 8, 10 and 11; all of which were composed of 100% sandy substrate as is expected due to their proximity to the adjacent beaches (Figure 4-4). The remaining sites assessed did have some increased variability with a dominance of coarse substrates such as boulders, followed by bedrock and cobble in the creek and river locals. These coarser materials are likely sourced from the surrounding elevated ranges found adjacent to each of these three sites.

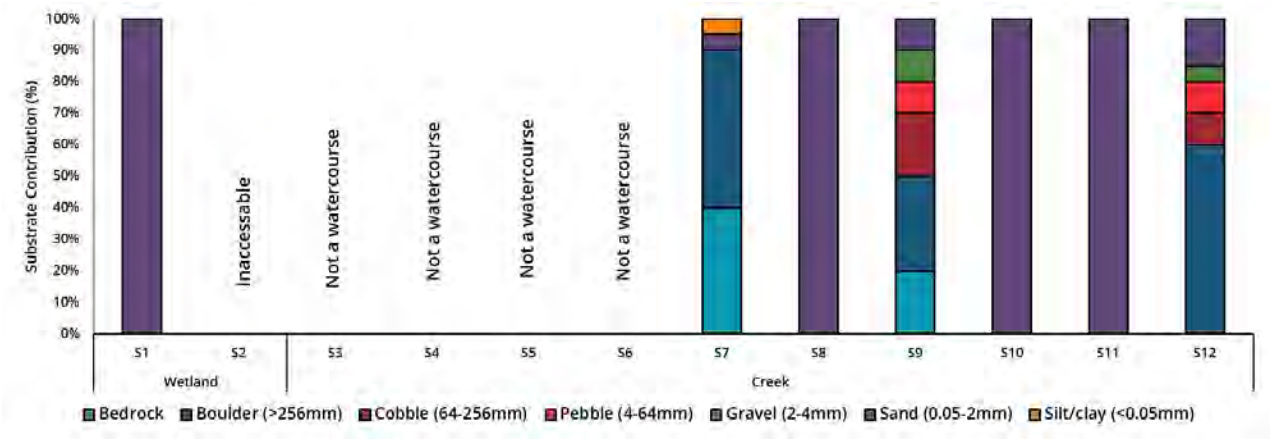

Figure 4-4 Microhabitat feature recorded at each site

4.1.8 RIPARIAN ZONE STRUCTURE

No exotic species were recorded across any of the sites assessed, native species present ranged in structure from trees greater than 10 m in height (canopy) to grasses creating a diverse riparian zone at most locations (Figure 4-5). This diversity and density of vegetation with limited bare spaces aids in bank stabilisation, controlling instream scouring and stream shading to provide increased protection for fish and macroinvertebrate populations. Site 10 was dominated by small trees with little other vegetative structure.

The wetland site consisted predominantly of grasses with low contributions of shrub species as is expected within most freshwater wetland environments.

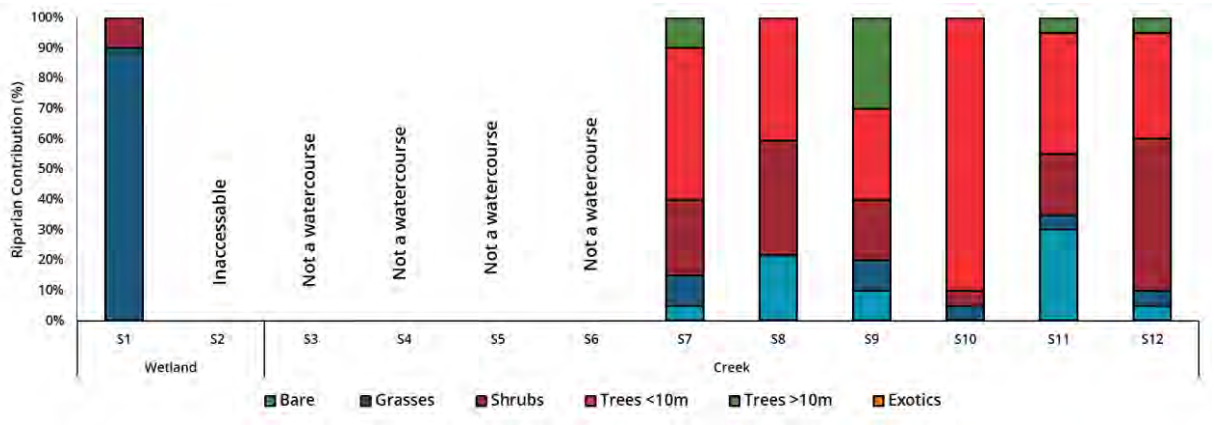

Figure 4-5 Riparian zone structure recorded at each site

4.1.9 GROUNDWATER DEPENDANT ECOSYSTEMS

PRESENCE

Based on the desktop and field assessments for surface water GDEs presented by Eamus (2006) and Doody et al. (2018), both the palustrine wetlands (S1 and S2) are possibly groundwater dependant (Table 4-3). It is noted that the baseline groundwater conceptualisation is that these wetlands are not groundwater dependant (GA&S, 2022). Further investigations are required to confirm this conceptualisation. This could include an assessment of groundwater levels at areas where water persists throughout the year and isotope investigations identifying signatures between surface and groundwaters. The current groundwater assessment also concluded that the further investigations area required (GA&S, 2022).

It is important to note that the GDE presence assessment was undertaken specifically for surface water GDEs and the series of questions relevant to Queensland and freshwater systems in Eamus (2006) and Doody et al (2018). Questions relevant to terrestrial GDEs (i.e. groundwater dependence of trees) and subterranean fauna have not been assessed by Hydrobiology.

Table 4-2 Potential for groundwater dependent ecosystems to be present (Eamus et al. 2006; Doody et al. 2018).

Attribute	Wetland		Creeks								
	S1	S2	S4	S5	S6	S7	S8	S9	S10	S11	S12
Does a stream/river continue to flow all year, despite prolonged periods of zero or very low rainfall?	N	N	N	N	N	N	N	N	N	N	N
Does the volume of flow in a stream/river increase downstream in the absence of inflow from a tributary?	N	N	N	N	N	N	N	N	N	N	N
Is the level of water in a wetland/swamp maintained during extended dry periods?[3]	Y	Y	N	N	N	N	N	N	N	N	N
Are cracking clays present? Cracking clays representing a lower likelihood of GDE presence	N	N	N	N	N	N	N	N	N	N	N

VALUE

Based on the method defined by Serov et al (2012) (repeated in Appendix A) to identify GDE value, should the palustrine wetlands be considered GDEs, then they are of high value due to the following:

- They are in pristine condition;

- They are conservation significant areas (i.e. high ecological significance);
- They represent dry seasonal refugia in an otherwise dry landscape; and
- They support conservation significant species (i.e. the migratory estuarine crocodile).

4.2 WATER QUALITY

Water temperature ranged from between 28-31°C (Figure 4-6) with warmer temperatures recorded in the afternoon and at sites with minimal shading.

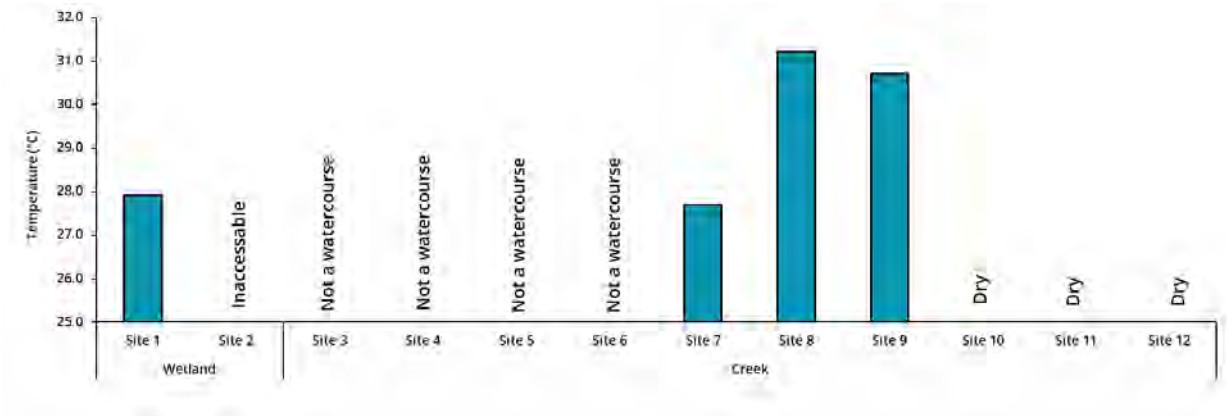

Figure 4-6 Water temperature recorded at each site

S8 and S9 recorded electrical conductivity values far greater than the default guideline values for this area, whilst S7 was slightly over these guidelines (Figure 4-7). The values for S8 are likely due to its location in the catchment (supratidal extent) which can experience marine water influx. Brackish water sampled at S9 is likely also due to the concentration of salts in drying pool habitats. S1 was well within the defined guideline for wetland areas in northern Queensland.

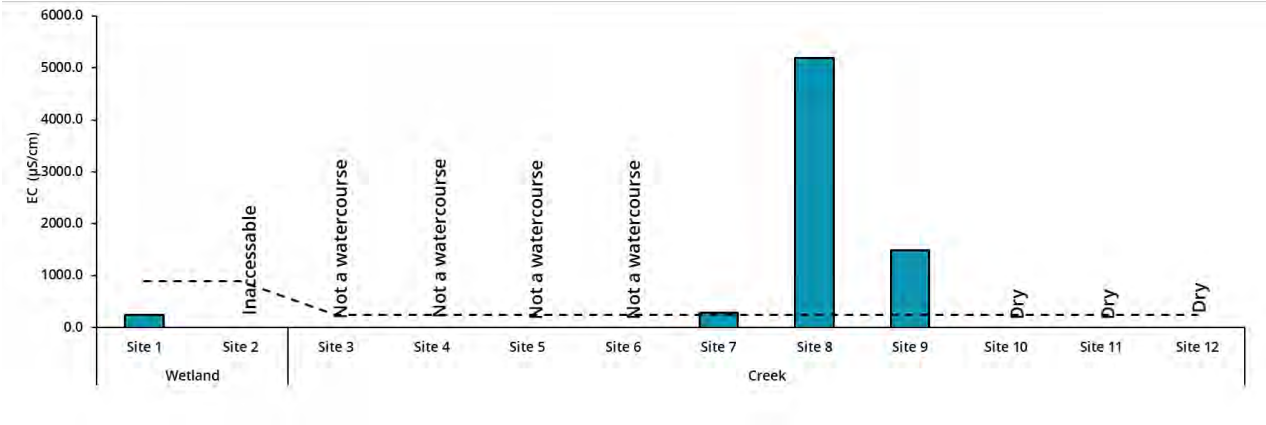

Figure 4-7 Conductivity recorded at each site

Turbidity levels were generally below the defined guidelines values with the exception of S7 (80.1 NTU). Turbidity measurements at this site were collected after rainfall, possibly resulting in increased turbidity from diffuse run-off (Figure 4-8).

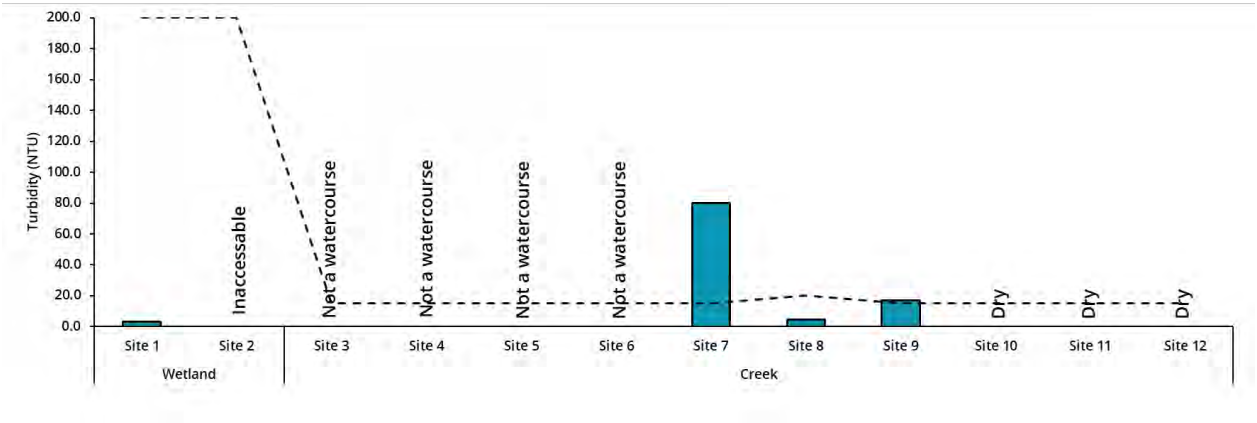

Figure 4-8 Turbidity recorded at each site

S1 and S7 contained relatively acidic (pH=5.8 and 5) waters (Figure 4-9). Wetlands in the area have previously recorded low acidic pH values (pH=4-6), and these acidic waters have further been recorded within the bordering Blackwater Creek tributary (Pusey et al. 2000; Wright & Burgin 2007). Low pH levels at S1 may be further exacerbated by decomposition (breakdown of organic material, largely macrophytes in these systems) occurring in the presence of dissolved oxygen via oxygen reduction which results in increases in carbon dioxide levels in the water.

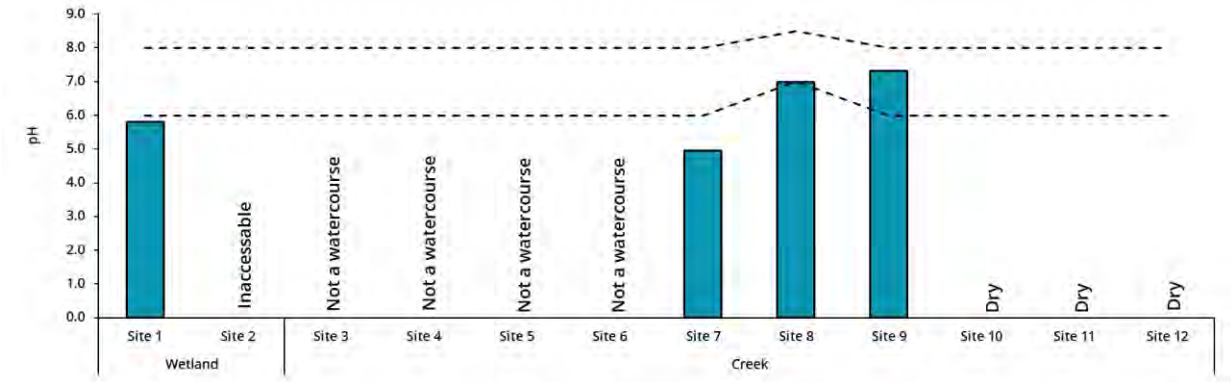

Figure 4-9 pH recorded at each site

Dissolved oxygen levels were variable among sites with S1 and S9 measuring defined guidelines and the remaining two sites beneath recommended values. (Figure 4-10) All waterways within the Study area contained pool habitat, this may be contributing towards low dissolved oxygen values as there is minimal mixing between atmospheric oxygen and creek water.

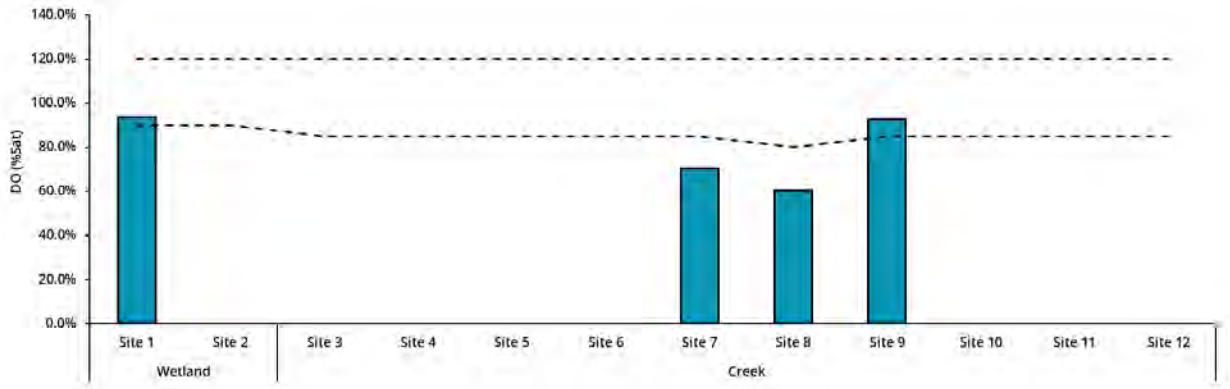

Figure 4-10 Dissolved oxygen recorded at each site

4.3 MACROINVERTEBRATES

4.3.1 UNIVARIATE ANALYSIS

EDGE

SIGNAL2 scores were significantly higher ($P<0.05$) at creek sites compared to the wetland sites (Figure 4-14). Additionally, the percentage of tolerant taxa was significantly lower ($P<0.05$) at creek sites compared to the wetland site (Figure 4-15). These results indicated that macroinvertebrate communities at creek sites tended to comprise of species that are less tolerant of disturbance than the wetland site.

There were no significant differences in taxonomic richness (Figure 4-11), abundance (Figure 4-12) or PET richness (Figure 4-13) detected between creek and wetland sites. Overall, taxa richness, PET scores were considered low and reflect the lack of:

- Trailing bank vegetation at all sites;
- Macrohabitat variability at all sites;
- Nutrient supply, as is typical in sand systems (S1), where runoff is minimal; and/or
- Position in the catchment (high elevation at S7).

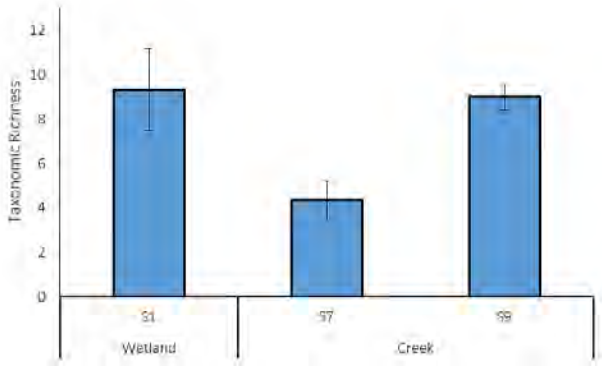

Figure 4-11 Mean edge macroinvertebrate taxonomic richness. Error bars represent standard error.

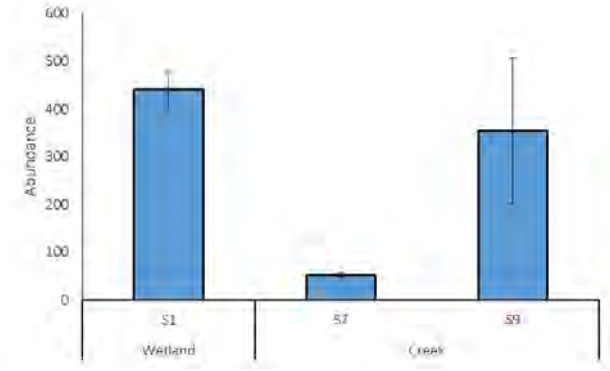

Figure 4-12 Mean edge macroinvertebrate abundance. Error bars represent standard error.

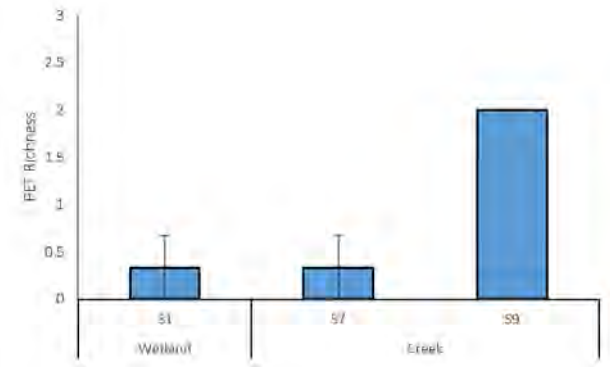

Figure 4-13 Mean edge macroinvertebrate PET richness. Error bars represent standard error.

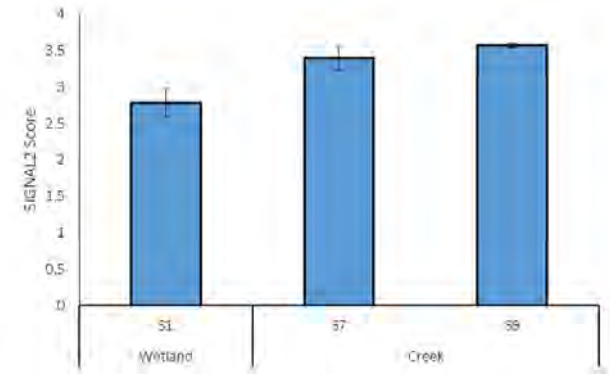

Figure 4-14 Mean edge macroinvertebrate SIGNAL2 score. Error bars represent standard error.

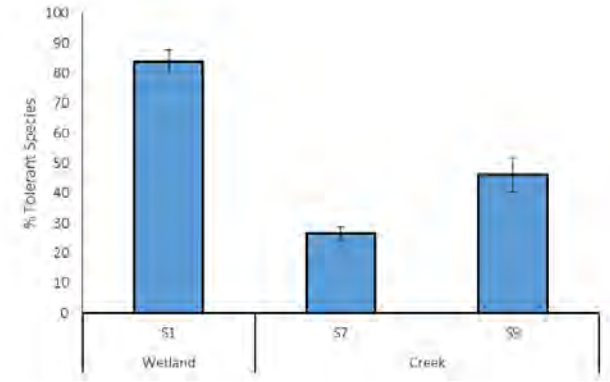

Figure 4-15 Mean edge macroinvertebrate % tolerant species. Error bars represent standard error.

BED

There were no significant differences (P>0.05) in taxonomic richness (Figure 4-16), abundance (Figure 4-17), PET richness (Figure 4-18), SIGNAL2 score (Figure 4-19) or percentage of tolerant species (Figure 4-20) between creek and wetland sites. Given the location of S8 (supratidal extent), the absence of PET species is expected, as PET taxa can be sensitive to higher conductivities. Overall, diversity index values suggest low diversity and the presence of more tolerant taxa. Given the minimal disturbances noted at these sites, the low values are associated with the lack of

- Bed substrate variability (mostly fine sands at S1 and S8);
- High conductivity at S8;
- Low macrohabitat variability at all sites;
- Nutrient supply, as is typical in sand systems (S1), where runoff and subsequent nutrient input is minimal; and/or
- Position in the catchment (high elevation at S7).

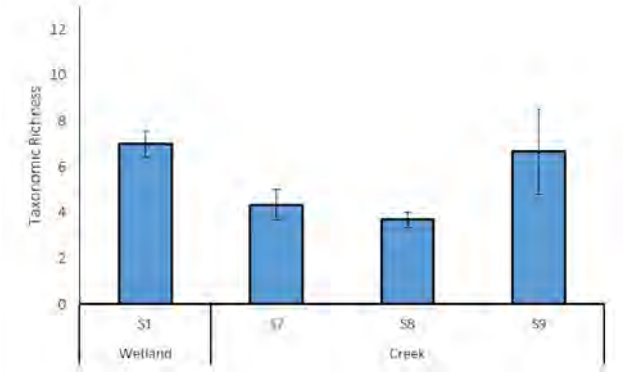

Figure 4-16 Mean bed macroinvertebrate taxonomic richness. Error bars represent standard error.

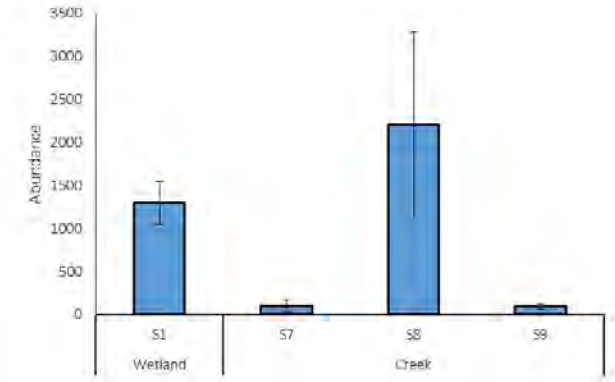

Figure 4-17 Mean bed macroinvertebrate abundance. Error bars represent standard error.

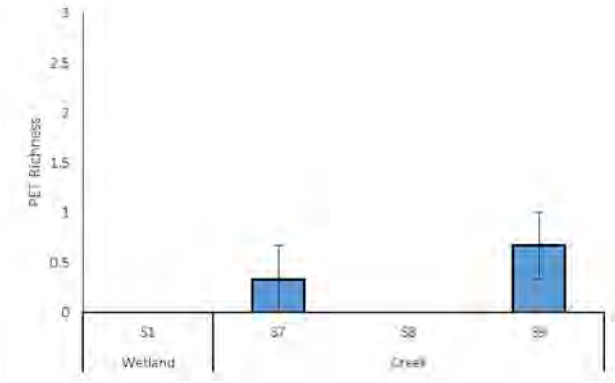

Figure 4-18 Mean bed macroinvertebrate PET richness. Error bars represent standard error.

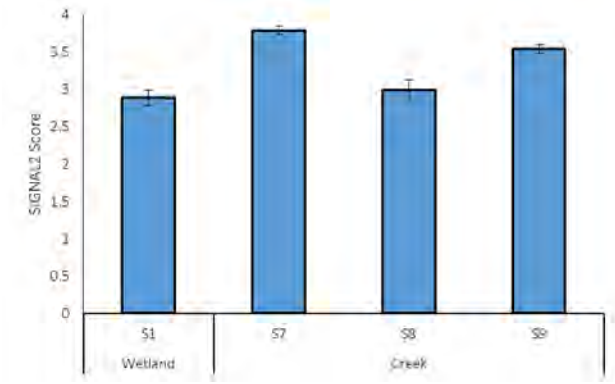

Figure 4-19 Mean bed macroinvertebrate SIGNAL2 score. Error bars represent standard error.

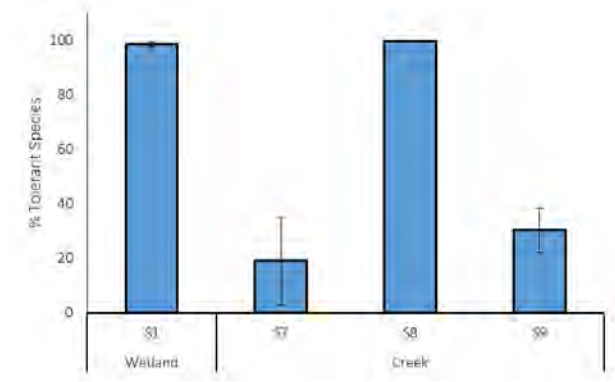

Figure 4-20 Mean bed macroinvertebrate % tolerant species. Error bars represent standard error.

4.3.2 MULTIVARIATE ANALYSIS

EDGE

All sites differed (P<0.05) in macroinvertebrate community assemblages between (Figure 4-21). S7 and S9 were dominated by taxa with very dispersive adults (fly larvae, Ceratopogonidae), able to colonise areas which many macroinvertebrates would be able to take advantage of, particularly in stream where disconnected pool habitat remains (Figure 4-22). Despite this S9 contained greater diversity, than S7, though were represented by other fly larvae taxa. Within the wetland systems (S9), microcrustaceans dominated community assemblages. Their dominance of microcrustaceans is likely attributed to their more adequate light availability (exhibited by lowest turbidity levels) which

enhances phytoplankton growth and production of phytoplankton This in turn, serves as microcrustacean food sources (Domingues et al. 2011).

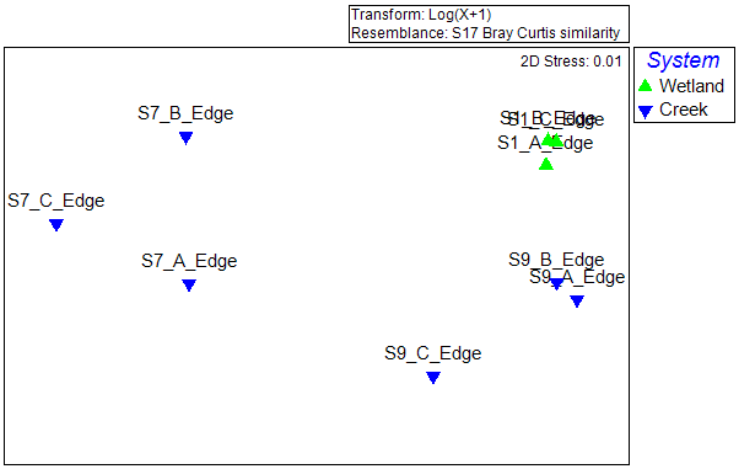

Figure 4-21MDS plot of edge macroinvertebrate communities.

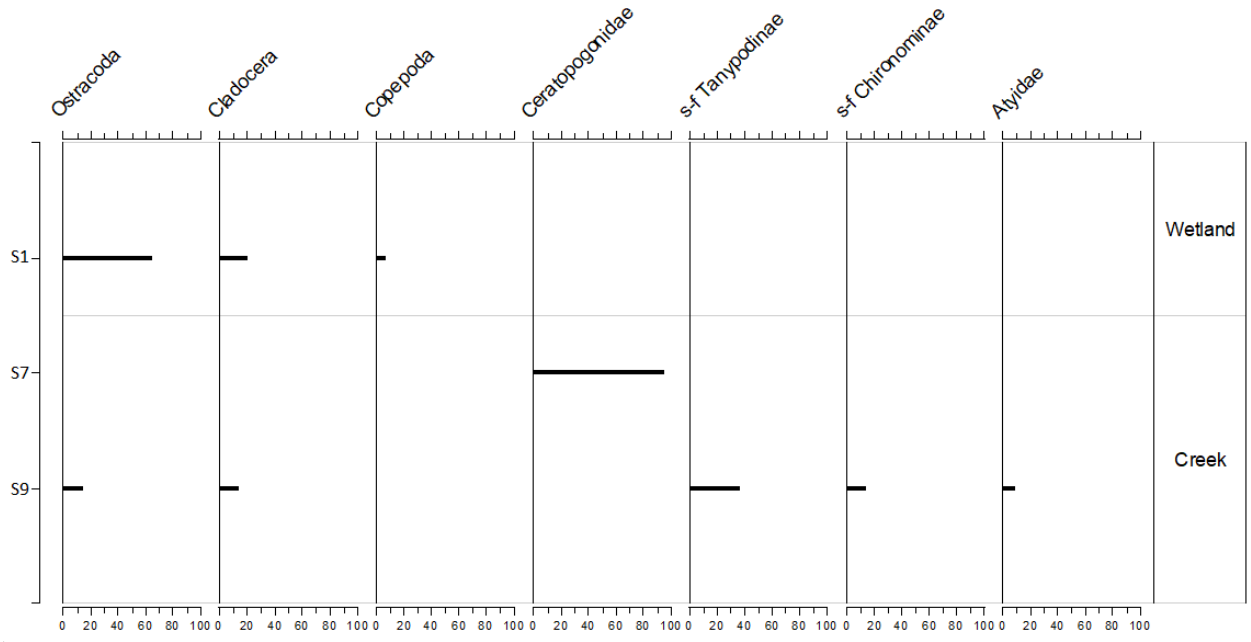

Figure 4-22 Percentage contribution of macroinvertebrate taxa in edge samples. Taxa represent those contributing 90%.

BED

Macroinvertebrate assemblages were significantly different (P<0.05) between creek and wetland sites (Figure 4-23). Dominate species were similar to those demonstrated within edge habitat, with creek sites S1 and S9 dominated by fly larvae and the wetland S1 dominated by microcrustaceans (Figure 4-24). S8 located in the supratidal extent of the catchment was dominated by nematodes, most likely the result of the higher conductivities noted at this site.

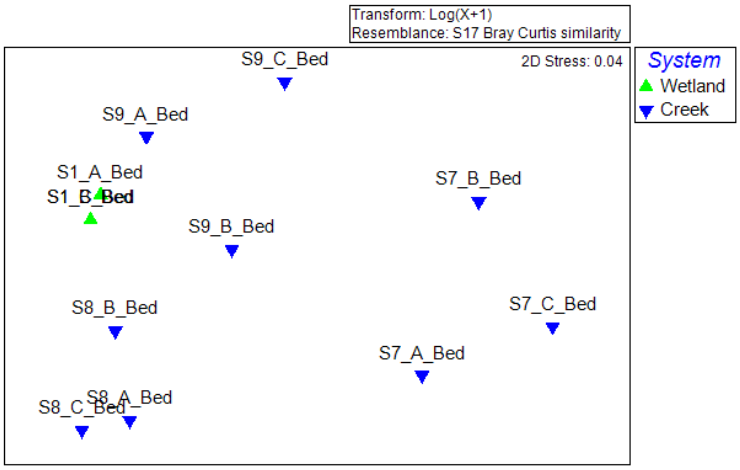

Figure 4-23 MDS plot of bed macroinvertebrate communities.

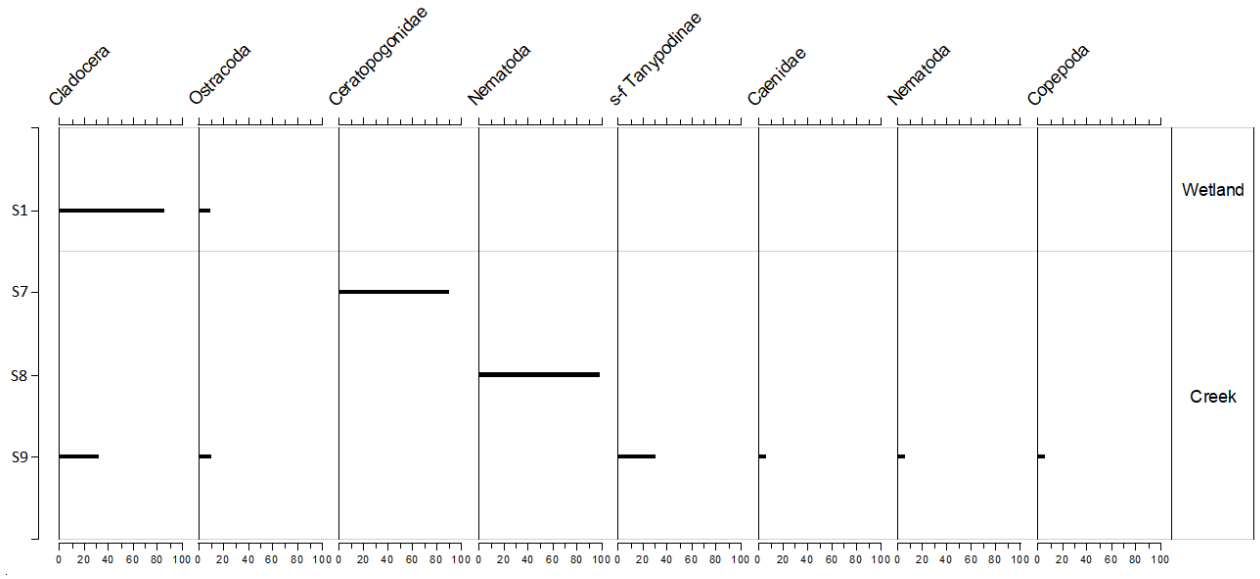

Figure 4-24 Percentage contribution of macroinvertebrate taxa in bed samples. Taxa represent those contributing 90%.

4.4 MACROCRUSTACEANS

4.4.1 COMPOSITION

Six native macrocrustacean species, representing four families, were recorded from fyke fishing efforts (Table 4-3). Only one example of each species was captured, with two freshwater prawn species and one crab species occurring at site 8 and the same at site 9. Overall, macrocrustacean catches were relatively small in quantity suggesting low abundance within these locals.

4.5 FISH

4.5.1 COMPOSITION

17 native fish and no introduced fish species, representing 11 families, were recorded in the most recent survey (Table 4-4). The most represented families (most abundant) were mullet (Mugilidae) and glassfish (Ambassidae) followed by cresent grunters (Terapontidae). Only three of the twelve sites

were suitable for fishing using traditional techniques (e-fisher, traps and nets); S7, S8 and S9. S8 yielded the most species (n=182) whilst at site 9 lower abundance and diversity was recorded (n=5). No fish were caught at S7, likely representing the position in the catchment, where multiple natural barriers would limit fish passage to this area. S8 is located in the supratidal extent where connectivity to the adjacent bay is evident. This was further supported by the recorded species which included anadromous species which migrate up freshwater extents from coastal areas to spawn.

At the palustrine wetland S1, eDNA surveys were carried out. Four species were identified, all of which are considered to be small bodied fish. Given that there appears to be connectivity between S1 and the adjacent palustrine wetland (S2), it is expected that the species assemblages would be similar between the two palustrine wetlands.

Comparison to previous survey defined in Section 3.9.3, indicated that most of the identified species in this survey have not been recorded historically in the area; however we note that the previous surveys were primarily undertaken in Dune Lake systems, dissimilar to the current survey. Despite this, the habitat for which fish were collected from in the Study area was considered typical of current known habitat requirements and within the ranges of previously recorded distributions across northern Australia, including the Cape York Basin (Pusey et al. 2017). The Study area represents a small proportion of the fish native diversity for the wider Cape York Basin.

Variation in size classes were noted for species captured (Table 4-5). This indicates that successive generations occur within the Study area, for which suitable nesting and spawning areas reside, where such fish were captured.

Table 4-3 Macrocrustacean abundances at each site crustacean surveys could be undertaken

Species name	Common name	Creeks		
		S7	S8	S9
Atyidae				
Caridea sp.	Freshwater Prawn		1	
Caridina wilkinsi	Freshwater Prawn			1
Palaemonidae				
Macrobrachium lar	Tahitian Prawn			1
Macrobrachium rosenbergii	Giant River Prawn		1	
Portunidae				
Scylla serrata	Mud Crab		1	
Varunidae				
Varuna litterata	River swimming crab			1

Table 4-4 Recorded species at each site fish survey could be undertaken

Species Name	Common Name	Wetland	Waterway		
		S1	**S7**	**S8**	**S9**
Ambassidae					
Ambassis interrupta	longspine glassfish			82	
Butidae					
Oxyeleotris lineolata	sleepy cod				1
Oxyeleotris nullipora	poreless gudgeon	X			
Eleotridae					
Ophiocara porocephala	spangled Gudgeon			16	
Gobiidae					
Redigobius balteatus	rhinohorn goby			3	
Kuhliidae					
Kuhlia mugil	barred flagtail				X
Kuhlia rupestris	jungle perch				3
Latidae					
Lates calcarifer	barramundi			1	
Melanotaeniidae					
Melanotaenia splendida inornata	chequered rainbow	X			
Melanotaenia splendida	eastern rainbow	X			
Mugilidae					
Crenimugil crenilabis	wartylip mullet			X	
Liza subviridis	greenback mullet			X	
Moolgarda Seheli	bluespot mullet			X	
Mugil cephalus	flathead grey mullet			55	
Pseudomugilidae					
Pseudomugil gertrudae	spotted blue eyes	X			

Species Name	Common Name	Wetland	Waterway		
		S1	**S7**	**S8**	**S9**
Serranidae					
Epinephelus lanceolatus	old grouper			1	
Terapontidae					
Terapon jarbua	crescent grunter			20	

X represents species detected via eDNA methods

Table 4-5 Length (mm) statistics of captured species via e-fishing and fyke netting methods.

Species	**Common name**	**S8**			**S9**		
		Min	**Max**	**Avg**	**Min**	**Max**	**Avg**
Ambassidae							
Ambassis interrupta	Longspine glassfish	27	63	44.76			
Butidae							
Oxyeleotris lineolata	Sleepy Cod				140	140	140
Eleotridae							
Ophiocara porocephala	Spangled Gudgeon	122	242	190.13			
Gobiidae							
Redigobius balteatus	Rhinohorn goby	30	35	32			
Kuhliidae							
Kuhlia rupestris	Jungle Perch				73	111	87.33
Mugilidae							
Mugil cephalus	Flathead Grey Mullet	25	71	43.35			
Terapontidae							
Terapon jarbua	Crescent grunter	16	25	19.95			

4.5.2 HABITAT AND DIET

The majority of the fish species recorded across the two sites are found to not typically penetrate further then moderately upstream reaches of riverine and estuarine environments (Pusey et al. 2017). Many of the species identified migrate to freshwater extents for spawning. The majority of fish species caught share similar habitat preferences and reside in gently flowing or still waters and are usually found amongst edge habitat. They inhabit lakes, dams, marshes, billabongs, aqueducts and slow-flowing streams (Pusey et al. 2004). As a result, the habitat for which fish were collected from in the Study area were considered typical of current known habitat requirements. Furthermore, many of the tabulated species can tolerate high temperatures and variations in salinity, allowing them to survive in small remnant pools, (Pusey et al. 2004) similar to those identified in the creek systems.

Most identified fish within the Study area share a similar diet consisting of small aquatic and terrestrial insects, larvae, macroinvertebrates, crustations and small fish. Recorded species belonging to the family Mugilidae is an exception to this as they predominantly feed on filamentous algae, forams, diatoms and detritus associated with sand and mud (Pusey et al. 2017; Pusey at al. 2004).

4.6 OTHER AQUATIC VERTEBRATES

No turtles were caught during the current survey. Crocodile (*Crocodylus porous*) were noted at the following locations:

- S1 - slides were noted at the S1 palustrine wetland. Other evidence of estuarine crocodiles included their scats at this location.
- S9 – Downstream of the S9 within the coastal fringing area;
- S8 – One nets deployed at S8 was moved by a crocodile. The collected fishing this net also contained puncture wounds consistent with crocodile.

4.7 CONSERVATION SIGNIFICANT SPECIES

OPAL CLING GOBY

Based on the lack of key habitat variables (i.e. rainforest communities and yearly discharging creeks) (Table 4-6) and the nearest record of the Opal Cling Goby occurring over 150 km from the Study area, it is unlikely that this species occurs within the Study area.

ESTUARINE CROCODILE

Estuarine crocodiles are usually found in coastal waters, estuaries, lakes, in-land swamps and marshes although they can persist in freshwaters further upstream (DES, 2022), Within the Study area suitable habitat for the migratory estuarine crocodile was noted at S1, S2, S8 and further downstream extents of S9, where the creek widens and discharges to the open coastal area. Crocodile sightings and evidence of the occurrence were noted at S1, S8 and downstream of S9 in the adjacent coastal area. Given the evident connectivity between S1 and S2, estuarine crocodiles are also expected to occur at S2.

SAWFISH

Only largetooth sawfish are known to penetrate completely freshwater reaches. Whitty (2017) found that juvenile freshwater sawfish can travel over 150 km upstream into freshwater reaches of the Fitzroy River, a dynamic and large river system in Western Australia. In the dry season juveniles become trapped in large, deep, isolated pools (>3km in length) when water levels recede. The creeks within the Study area are comparatively very small, ephemeral systems that largely dry out during the

dry season. The requirement of freshwater sawfish for large pools as refuge during the dry season indicates that this species is highly unlikely to occur within the Study area. Connectivity from coastal areas to freshwater extents of the Study area is also limited given the noted high elevation and bed slope, and noted natural barriers. This means that the palustrine wetlands (S1 and S2) are also unlikely to contain such species.

The surveyed freshwater creeks and wetlands in the Study area contain minimal habitat features for the noted sawfish species (Table 4-6). Suitable habitat features for all listed sawfish below is evident in downstream extents of S8 and S9. Given that there nearest record for these species is over 100 km from the Study area, it is considered possible that the noted sawfish species occur within the downstream reaches of S8 and S9 in the supratidal and coastal extents.

Table 4-6 Conservation significant fauna habitat assessments

Attribute	Ref.	Wetland		Creek					
		1	2	7	8	9	10	11	12
Opal cling goby									
Significant flows	9	N	N	N	N	N	N	N	N
Direct access to marine habitat	9	N	N	N	Y	Y	N	N	N
Rocky substrates	9	N	N	Y	N	Y	N	N	Y
Rainforest stream habitat	9	N	N	N	N	N	N	N	N
green sawfish									
Coastal shoreline and inshore	3	N	N	N	Y	N	N	N	N
Muddy bottom habitats	4	N	N	N	N	N	N	N	N
Waters of 1.2 to 3 m deep	3	Y	Y	N	N	N	N	N	N
Marine waters, estuaries, river mouths, embankments or along sandy muddy beaches	5	N	N	N	Y	N	N	N	N
Shallow waters	6	N	N	N	Y	N	N	N	N
narrow sawfish									
In-shore coastal waters, estuarine environment, river deltas or upstream rivers	7	N	N	N	Y	N	N	N	N
Depth range 0-40 m	7	Y	Y	N	Y	Y	N	N	N
Estuarine and shallow coastal areas	7	N	N	N	Y	N	N	N	N
Sand, mud and seagrass	8	N	N	N	N	N	N	N	N
Mangroves	8	N	N	N	Y	N	N	N	N
largetooth sawfish									
Deep pools and runs	1	N	N	N	Y	N	N	N	N
Large woody debris	1	N	Y	Y	N	Y	Y	Y	Y

Shallow glides (shallow water running into pools)	1	N	N	N	Y	N	N	N	N
Shallow runs (shallow water running out of pools)	1	N	N	N	Y	N	N	N	N
Floodplain waterholes	2	N	N	N	N	N	N	N	N
Sandy/muddy substrate	2	Y	Y	N	Y	N	Y	Y	Y
Riparian heavily wooded/tree lined	2	Y	Y	Y	Y	Y	Y	Y	Y

1: Whitty et al. 2017; 2: Kyne et al. 2014; 3: Stevens et al. 2005; 4: Allen 1997; Peverell 2004; 5:Stead 1963; 7: Last and Stevens (2009); 8: Peverell (2005); 9: Thuesen et al. 2009

5. POTENTIAL IMPACTS

5.1 CONTEXT

Impacts of sand mining on aquatic ecosystems may be direct or indirect (Figure 5-1). Direct impacts are those in which the extraction of material is directly responsible for the ecosystem impact, such as the removal of habitat. Indirect impacts are related to ecosystem changes that are propagated through the system due to physical changes resulting from sand extraction. For example, the removal of sand can alter the channel, river hydraulics, or sediment budget which in turn can alter the distribution of habitats and ecosystem functioning. These types of impacts can be difficult to attribute to sand mining, as they may require long time frames to emerge. The situation is further complicated by the existence of geomorphic thresholds in such systems (Schumm, 1979). Alterations linked to removal of sand may not be gradual and/or linear, and only limited changes may be observed for an extended period and could be irreversible.

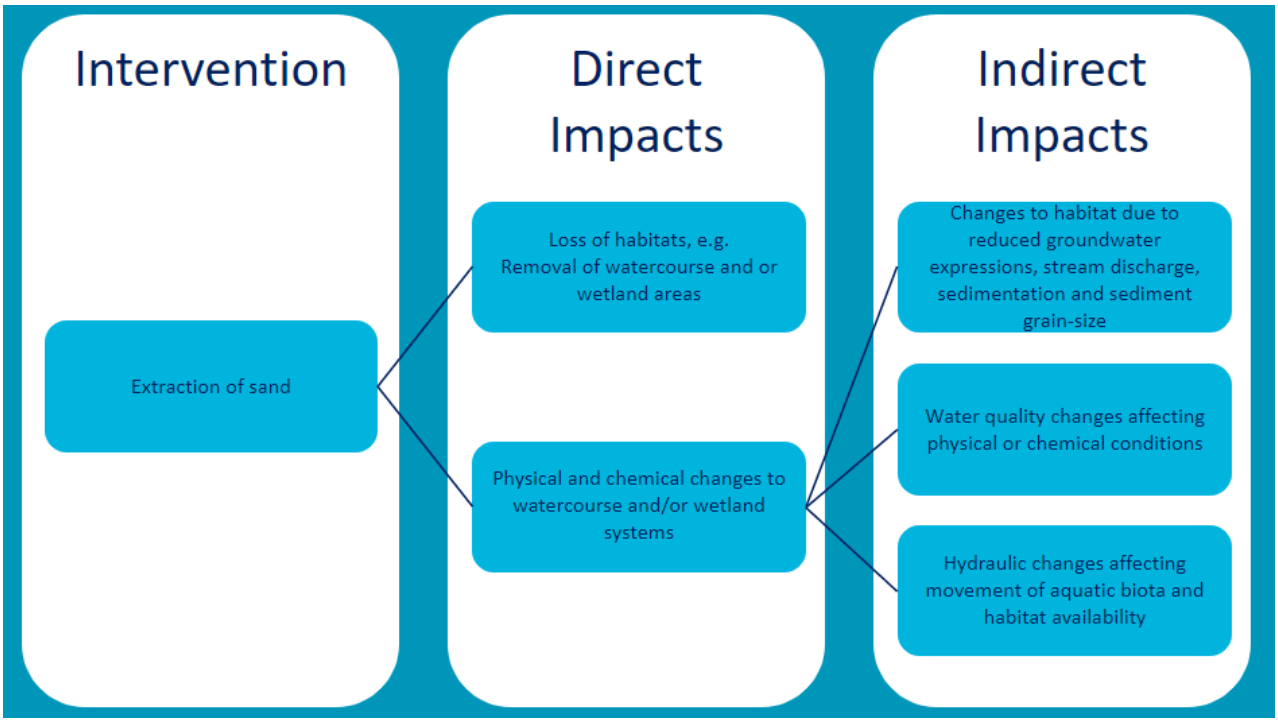

Figure 5-1 Schematic of the impact assessment approach.

5.2 LIMITATIONS

The aquatic impact assessment contains the following limitations:

- Presented impacts are based on data collection from a single seasonal survey in the Study area. Further survey effort may identify additional species that may differ in their habitat and water quality requirements than those identified. Potential impacts to any unknown aquatic values will be informed by future REMP monitoring, which will incorporate an adaptive management strategy;
- The aquatic impact assessment does not consider subterranean fauna;
- Detailed regarding the treated STP water management are yet to be finalised;
- There remains a knowledge gap concerning the palustrine wetlands and it's groundwater dependence. This is also noted in the current groundwater and impact assessment report (GA&S, 2022). Suggested studies in GA&S (2022), include groundwater level investigations to confirm the current baseline groundwater conceptualisation that the wetlands are not groundwater dependant. Further to this we recommended stable isotope investigations as limited seasonal information concerning groundwater levels may prove inadequate in determining long-term groundwater dependence.

5.3 CONSTRUCTION PHASE

Construction phase impacts[1] on aquatic ecological values of the project relate mainly to aquatic habitat, biota, flow (habitat connectivity), water quality and the spread and introduction of exotic species. Consideration has also been given in this assessment to the presence and general condition of riparian vegetation that provides habitat values as well as important stabilisation and water quality

1 Construction phase involves the mine access road, mine infrastructure area, mine lease area buffer (50 m wide) including aq 5 m access track on the western boundary limit, accommodation village, process plant, process water pond, stockpile area, sediment basin and embankment

functions. Impacts are considered with regards to the aquatic values or sensitivity of the affected waterways. Provided that the proposed mitigation measures are implemented successfully, the construction phase of the project are largely minor in nature and present a negligible to low residual risk to the aquatic ecosystem values.

These impacts are discussed below with brief detail of mitigation measures (where appropriate) also mentioned to understand any residual risks. Detailed mitigation measures can be viewed in Section 6 and the overall residual impact assessment can be viewed in Appendix D.

For the most part the construction footprint does not extend, nor does it drain to the two palustrine wetlands.

5.3.1 LOSS OF MACROHABITAT

Direct impact posed by the construction footprint for the accommodation village, mine infrastructure area, process plant etc, includes approximately 0.55 km of waterway. The directly impacted reaches are considered to be of low aquatic value, supporting colonising macroinvertebrate assemblages. These reaches are unlikely to support fish communities (as demonstrated by the current survey) due to the spatial position (high elevation) in the catchment, high slope bed and outcrop barriers, that would limit connectivity to these areas.

Clearing and grubbing can increase sediment supply into local waterways which could smother riffle habitat[2] and reduce pools depths in receiving creeks and wetlands. Sedimentation of waterways can impact aquatic ecology by smothering stream beds and infilling wetlands. Decreases in available habitat for aquatic fauna due to sedimentation could reduce breeding opportunities and increase predation (e.g. by birds), potentially causing a localised decline in abundance and diversity of aquatic species. Stockpiles of sediment and soil may also cause increased sedimentation of waterways where rainfall and run-off washes material to waterways. Relevant to the Project, areas at most risk which provide aquatic habitat values include downstream freshwater extents for which the proposed infrastructure is located.

Any sediment movement from unsealed areas will largely be trapped by the cover afforded by the remnant terrestrial vegetation buffers, though inputs to receiving waters are possible where the unsealed areas are close to waterways. These inputs will largely be mitigated via appropriate erosion and sediment control measures, which will be defined in accordance with Best Practice Erosion and Sediment Control (IECA, 2008) and achieve the pollutant load reduction requirements defined in DES (2021). At the palustrine wetlands a 50 m buffer is to be instated to protect both mapped wetlands. Buffer size is based on the logic presented in the Fisheries' guidelines for Fish Habitat Buffer Zones (DPI, 2000)

The construction footprint for the mine access road and mine infrastructure will occupy both riparian and instream habitat extents. This infrastructure footprint is considered minor in the context of the creeks affected and will occupy habitat features which are ubiquitous to the Study area. It can however pose impacts to macrohabitat where erosion and sedimentation eventuate from cleared areas.

5.3.2 LOSS OF MICROHABITAT DIVERSITY

The dominant microhabitat in the Study area was found to be detritus, followed by LWD and SWD. The riparian zone is expected to provide the greatest material input relevant to microhabitat. Riparian buffers will be instated at the palustrine wetlands. Clearing within the riparian zone is mostly

2 During wet seasonal conditions, riffle habitat would be present at the waterways which radiate from the hard rock exposure areas.

associated to the conveyor and mine access road, those these areas represent a very small portion of riparian zone within the affected waterways. As such, the impact on microhabitat (logs, snags, detritus, etc.), which support aquatic biota in terms of habitat (foraging, protection, etc.), nutrient cycling and water quality, resulting from the project are expected to be insignificant/negligible.

Sedimentation can affect the growth and species composition of submerged macrophyte communities. Within creek systems, identified macrophytes were all emergent forms and are far less susceptible to sedimentation impacts. Additionally, emergent forms were identified along the mid to upper bank margins where they will also be less susceptible to sedimentation.

5.3.3 LOSS OR REDUCED ACCESS TO FEEDING, NESTING AND SPAWNING RESOURCES

Given the locations of proposed infrastructure there are few waterways crossing points to impact fish movement to feeding, nesting and spawning resources. Most of the infrastructure are in the upper catchments of these systems, where multiple natural barriers (waterfalls, drops in bed elevation (cascades), etc.) and high slopes would impede access. The identified fish assemblage also does not disperse typically beyond the mid catchment area. This is also recognised in the current Queensland Waterways for waterway barrier works (Figure 5-2), where there are no major, high, moderate or low impact designations relevant to fish passage and waterway barrier works intersected by the project footprint (Figure 5-2). The proposed Mine Lease Area buffer will contain a 5m wide boundary access track along the western boundary of the MLA. The mapped waterways which the access track intersects contain no defined banks, channel morphology and riparian vegetation. These mapped waterways which the proposed boundary access track intersects are not anticipated to provide values relevant to fish movement.

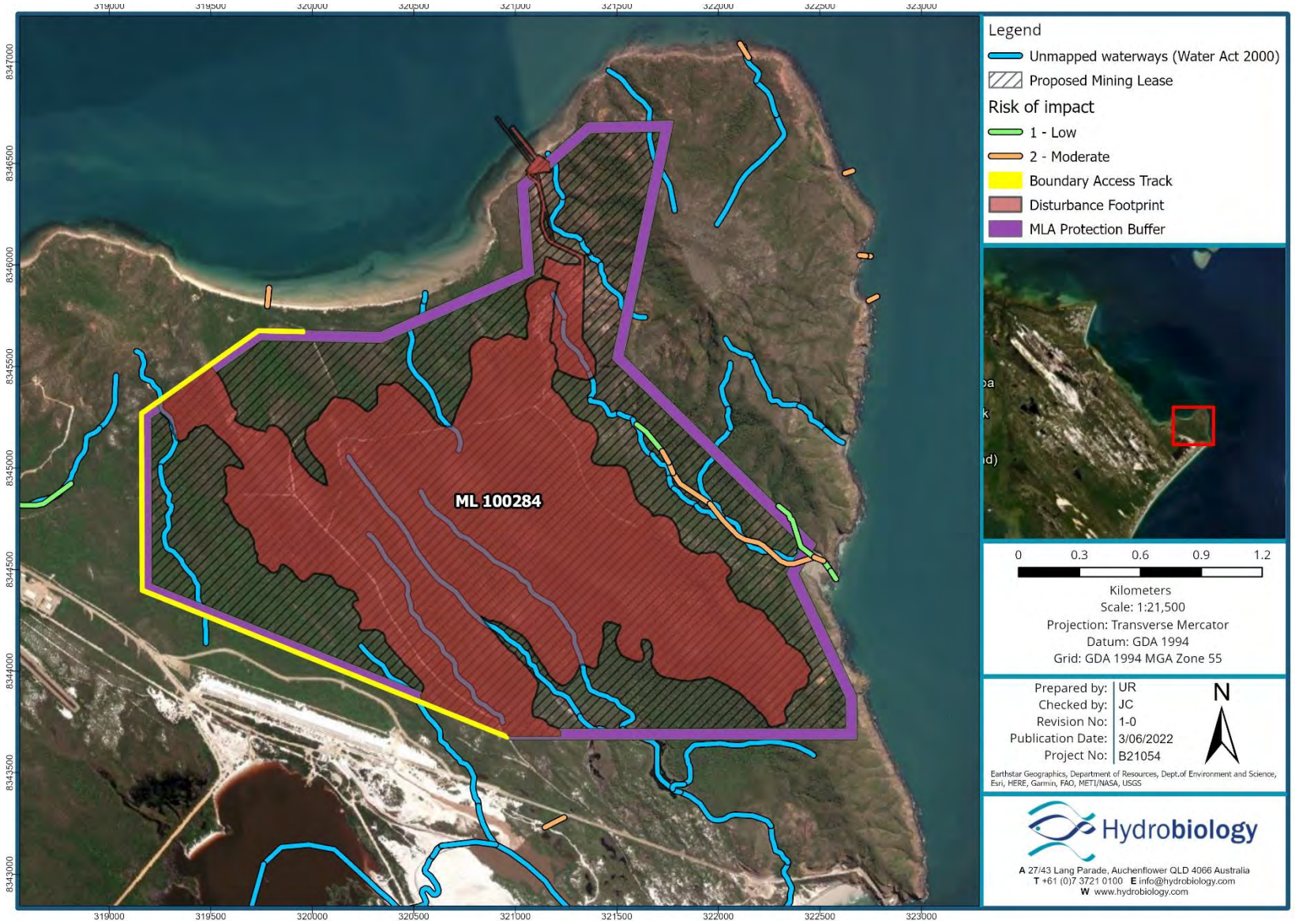

Figure 5-2 Waterway barrier works mapping

5.3.4 CHANGES TO HYDROLOGY AND HYDRAULICS

DEWATERING

Dewatering can potentially impact the hydrology and/or hydraulics of aquatic ecosystems, where any portion of the surface water balance within the local waterways is attributed to groundwater (i.e. groundwater surface expressions). Regarding the Study area it is possible that the palustrine wetlands are groundwater dependant, while the further downstream Dune Lake is considered likely to be groundwater dependant. Any required dewatering activities should be minimised to not reduce water availability within these sensitive receptors. In the event that dewatering is required during the construction phase, the duration of impacts to groundwater would likely be temporary in nature (6 months). We note that dewatering is only discussed for the operational phase of the project (GA&S, 2022)

CONSTRUCTION WATER SUPPLY

Construction water will be required to facilitate activities such as earthworks, dust suppression and concrete production. The project should minimise take from local ground or surface waters to reduce the risk of impacts to aquatic ecosystem values.

SEDIMENT BASIN RELEASES

Other potential impacts to hydrology and hydraulics of the local waterways include changes to peak discharges from stormwater releases. WRM (2020), predicted that the forecasted stored inventory of the sediment basin is projected to exceed the preliminary full storage volume (FSV) during 1%ile climatic conditions. Should the FSV be exceeded, then releases are to be managed in a way which will not increase peak discharge rates to local waterways.

5.3.5 CHANGES TO WATER QUALITY

SUSPENDED SEDIMENTS AND NUTRIENTS

The introduction of sediments from unsealed and cleared areas could also increase suspended sediments, nutrients and algal growth. Increased turbidity may negatively impact fish and macroinvertebrates, because highly turbid water reduces respiratory and feeding efficiency (Russell & Hales, 1993). Increases in turbidity may also adversely affect submerged aquatic plants as light penetration (required for photosynthesis) is reduced. Reduced light penetration can also lead to a reduction in temperature throughout the water column (DNR, 1998).

Sediment inputs will largely be mitigated via appropriate erosion and sediment control measures which will be defined in the Stormwater Management (SWMP) and/or Construction Environment Management Plan (CEMP). The described riparian buffers will also provide sediment filter/control. It is expected that any defined erosion and sediment control measures will be in accordance with Best Practice Erosion and Sediment Control (IECA, 2008) and achieve the pollutant load reduction requirements defined in DES (2021).

There are unlikely to be any releases from the proposed sediment basin during the construction phase of the project (WRM, 2020). WRM (2020), predicted that the forecasted stored inventory of the sediment basin is projected to exceed the preliminary full storage volume during 1%ile climatic conditions. Should the FSV be exceeded, then releases are to be managed in a way which will not impact water quality in the receiving environment. This includes conformance with local water quality objectives (WQOs) for nutrient and physicochemical parameters and ANZG (2018) default guideline values for contaminants. Contaminant release concentrations are to conform with 95% protection levels for freshwater systems, as defined in the DES (2020a).

PHYSICOCHEMICAL PARAMETERS

The project for the most part does not involve the removal of any riparian vegetation. Therefore, potential riparian weed ingress, reduced habitat complexity, reduced shading (impact to water quality) and increased evaporative losses are unlikely.

HAZARDOUS SUBSTANCES AND CONTAMINANTS

During the construction phase, potential contamination of surface waters and therefore to aquatic ecosystem values may result from:

- Accidental spills and leaks of hydrocarbons (oils, fuels and hydraulic fluids) and other contaminants associated with mobile plant and heavy equipment (BTEXN, TRH, PAHs);
- Accidental discharge of chemicals and detergents associated with washdown areas (i.e. potassium, phosphates, ammonia, surfactants);
- Stored bulk chemicals used during construction;
- Leakage or spills from temporary diesel fuel storage areas (BTEXN, TRH, PAHs); and
- Use of contaminated water onsite (i.e. water extracted from groundwater sources or brought to site; is of suitable quality to protect defined environmental values).

Potential impacts as a result of spills of hazardous substances will be managed in accordance with relevant legislation, guidelines and standards. All hazardous materials will be contained in appropriately engineered and fully lined/bunded storage areas, appropriate management measures for emergency response, etc.

The risk of imported materials creating potential contaminated land issues are considered low as the project is likely to only import materials classified as 'clean earth' under the *QLD Environmental Protection Regulation 2019*

5.3.6 DAMAGE AND OR FISH DEATH

Damage and or fish death is unlikely where the proposed boundary access track intersects the mapped waterways. Again these areas are unlikely to provide habitat for fish.

5.3.7 INTRODUCTION AND SPREAD OF AQUATIC WEEDS

The introduction and inadvertent spread of aquatic weeds could pose a significant biodiversity risk. Many aquatic weeds choke waterways and shade out submerged plant life. This in turn impedes oxygen exchange, making the habitat unsuitable for fish and other aquatic life. While no aquatic weeds were identified in the Project area, there is an increased risk of introduction of aquatic weeds (salvinia, water hyacinth, etc.) through transient populations, plant and equipment associated with the construction. To mitigate the introduction of aquatic weeds a weed management plan (WMP) will also be required and will include (but not be limited to):

- Monitoring and control frequencies at palustrine wetlands (areas at most risk); and
- Decontamination procedures for vehicles, machinery and other construction equipment.

5.3.8 INTRODUCTION AND SPREAD OF AQUATIC FAUNA

The introduction and inadvertent spread of other exotic fish species could pose a significant biodiversity risk. The current survey identified no exotic aquatic fauna. Construction phase activities will not require the introduction of any pest aquatic fauna and therefore the risk associated with the introduction and spread of exotics is considered negligible.

5.3.9 INCREASED FISHING PRESSURE

The risk of adverse impacts to fish populations due to increased fishing pressure from the project workforce is considered to be insignificant/negligible. Employees of the project will not engage in recreational fishing in the freshwater extents of the project area.

5.4 OPERATIONAL PHASE

Minor impacts to sedimentation within channels, as seen in other sand mining operations with less stringent environmental regulations, would be expected to some degree in those most heavily mined areas as a by-product of reduced velocities, mine runoff, changes to hydrological regime and resulting alterations to the sediment transport regime.

The mine plan intersects four unmapped waterways (i.e. not defined as a watercourse under the *Water Act 2000*, with current status indicating unmapped). Ground truthing of these unmapped waterways during the most recent field survey indicated the absence of defined banks, a riparian zone and lack of channel flow paths at the points of assessment. The absence of such features occurs consistently along the natural drainage line as identified by current available aerial imagery. It is expected that these unmapped waterways provide little if any aquatic ecosystem values. Therefore, these waterways are not considered any further.

5.4.1 LOSS OF MACROHABITAT

There is a high potential for soil erosion and sedimentation of waterways following vegetation clearing as the mine footprint progresses, especially during the wet season when rainfall and run-off intensity is greatest. In addition to runoff, sedimentation from fine sands can occur where winds transport fine sands.

Inputs from runoff will be mitigated via appropriate erosion and sediment control measures, which will be defined in accordance with Best Practice Erosion and Sediment Control (IECA, 2008) and achieve the pollutant load reduction requirements defined in DES (2021). The active mine area would be staged with progressive rehabilitation occurring behind the advancing mine face. The described buffers will also assist in sediment filtering/control.

Loss of macrohabitat as a result of changes to the hydrology and hydraulics of waterways and wetlands are defined in Section 5.4.3.

5.4.2 LOSS OF MICROHABITAT DIVERSITY

Sedimentation can affect the growth and species composition of submerged macrophyte communities. At the palustrine wetland systems high cover of *Lepironia articulata*. *Leptocarpus* sp. were identified. These species trap sediment in wetland areas which allows them to grow aggressively and cover large areas of a landscape (Marshall and McGregor, 2011). Should sedimentation within the wetlands occur (though unlikely) it is expected that this would have a positive impact on these species in terms of cover. However, changes to macrophyte distribution could have consequences for wetland ecosystem structure and integrity, where species of fish require free water habitat.

At S1 palustrine wetland, the current *Lepironia articulata*. *Leptocarpus* sp cover as identified by the drone imagery capture is above 95%, therefore any changes are expected to be minimal. At S2 palustrine wetland macrophyte cover, as identified by the drone imagery captured, was far less. Increase in cover will likely provide further organic input to these wetland (positive change to typical nutrient deficient systems). Based on the fish species identified at S1 (sampling could not be undertaken at S2), there are no species of fish which require largely open water habitat. Regardless,

instated riparian buffers (50 m buffer surrounding the palustrine wetlands) will assist in sediment filtering/control.

5.4.3 CHANGES TO HYDROLOGY AND HYDRAULICS

DEWATERING

The physical effect on the groundwater system by the proposed mine is limited to the extraction of 751 ML/year of groundwater. This equates to 6% of discharge under the groundwater regime as reported for 2021 (GA&S, 2022). The period of reporting (March to November 2021) is preceded by five years of below average rainfall and all indications are that the aquifer remains at capacity and likely to experience significantly increased discharge during periods of high rainfall. The extraction of groundwater will likely have short term localised effects adjacent to the extraction location (Cone of depression) which would not likely cause any significant effects on the wider aquifer or to aquifer discharge (GA&S, 2022). Any drawdowns which occur would likely be accounted for within the current rainfall regime and certainly during periods of higher rainfall. Additionally, extraction locations are to be placed so that any cone of depression does not occur at the palustrine wetlands and downstream Dune Lake.

LANDUSE CHANGE

Mining areas

The mining method would involve sequential excavation using a front-end loader feeding a mobile tracked hopper-feeder which connects to the processing plant via a covered conveyor system. Development of the active mine area would be staged with progressive rehabilitation occurring behind the advancing mine face.

During the period where sand is being actively extracted from a mining area, the mining area would be kept dry. It is expected that the majority of rainfall runoff draining to the mining area would be lost through evaporation and infiltration into the soil (WRM, 2022). In addition, the catchment excision is only temporary, and the catchment will be reinstated as part of the final landform. To minimise impacts on downstream surface flows on the active mining areas:

- The active mining area disturbance will be minimised as much as possible;
- Upslope drainage would be constructed to divert clean catchment away from the active mining areas; and
- Following active mining, the area would be rehabilitated and graded to freely drain.

Based on the above, it is expected that the downstream flow impacts caused by the active mining areas would be negligible (WRM, 2022).

Mine infrastructure

The only long-term excised areas is where the mine infrastructure is proposed, and this represents (Figure 5-3):

- 8% in catchment 1; and
- <1% in catchment 2.

While this represent some reduction in the natural waterway catchments, it is unlikely that there will be a detectable impact on flows (WRM, 2022). Importantly, the palustrine wetlands are located in catchment 2, where minimal long-term catchment excise is planned.

SEDIMENT BASIN RELEASES

Other potential impacts to hydrology and hydraulics of the local waterways include changes to peak discharges from stormwater releases. The water balance model was used to assess the risk of uncontrolled offsite spills from the stormwater/sediment basin that can potentially overflow directly to the receiving environment. WRM (2020), predicted that the forecasted stored inventory of the Sediment Basin is projected to exceed the preliminary full storage volume during 1%ile climatic conditions. Should the FSV be exceeded, then releases are to be managed in a way which will not increase peak discharge rates to local waterways.

5.4.4 CHANGES TO WATER QUALITY

LANDUSE CHANGE

Mining areas

During the period where ore is being actively extracted from a mining area, the mining area would be kept dry (WRM, 2022). It is expected that the majority of rainfall runoff draining to the mining area would be lost through evaporation and infiltration into the soil (WRM, 2022). The downstream edge of the mining area will also be bunded, to prevent ponded water spilling into the receiving environment for any conceivable event (WRM, 2022).

Mine Infrastructure

Runoff from the infrastructure area, process plant and stockpile area will drain via gravity to the stormwater/sediment basin (WRM, 2022). The sediment basin will be the primary storage of mine water for use in meeting mine demands on site. There will be no releases from the sediment basin (WRM, 2022). During extreme weather events, any remaining water in the mining area that is not lost through evaporation or infiltration would either be:

- Dewatered to the Sediment Basin (if the storage capacity is below the minimum operating volume (MOV)) and subsequently controlled released or used to meet site water demands; and
- Allow ponded water to infiltrate into the soil over a longer period. The downstream edge of the mining area would be bunded, to prevent ponded water spilling into the receiving environment for any conceivable event.

SEDIMENT BASIN RELEASES

WRM (2020), predicted that the forecasted stored inventory of the Sediment Basin is projected to exceed the preliminary full storage volume during 1%ile climatic conditions. Should the FSV be exceeded, then releases are to be managed in a way which will not impact water quality in the receiving environment. This includes conformance with local water quality objectives (WQOs) for nutrient and physicochemical parameters and ANZG (2018) for contaminants. Contaminant release concentrations are to conform with 95% protection levels for freshwater systems, as defined in the DES (2020a).

HAZARDOUS SUBSTANCES AND CONTAMINANTS

The risk of impact from to storage and handling of hazardous substances is considered low, and consistent with that described for the Construction phase.

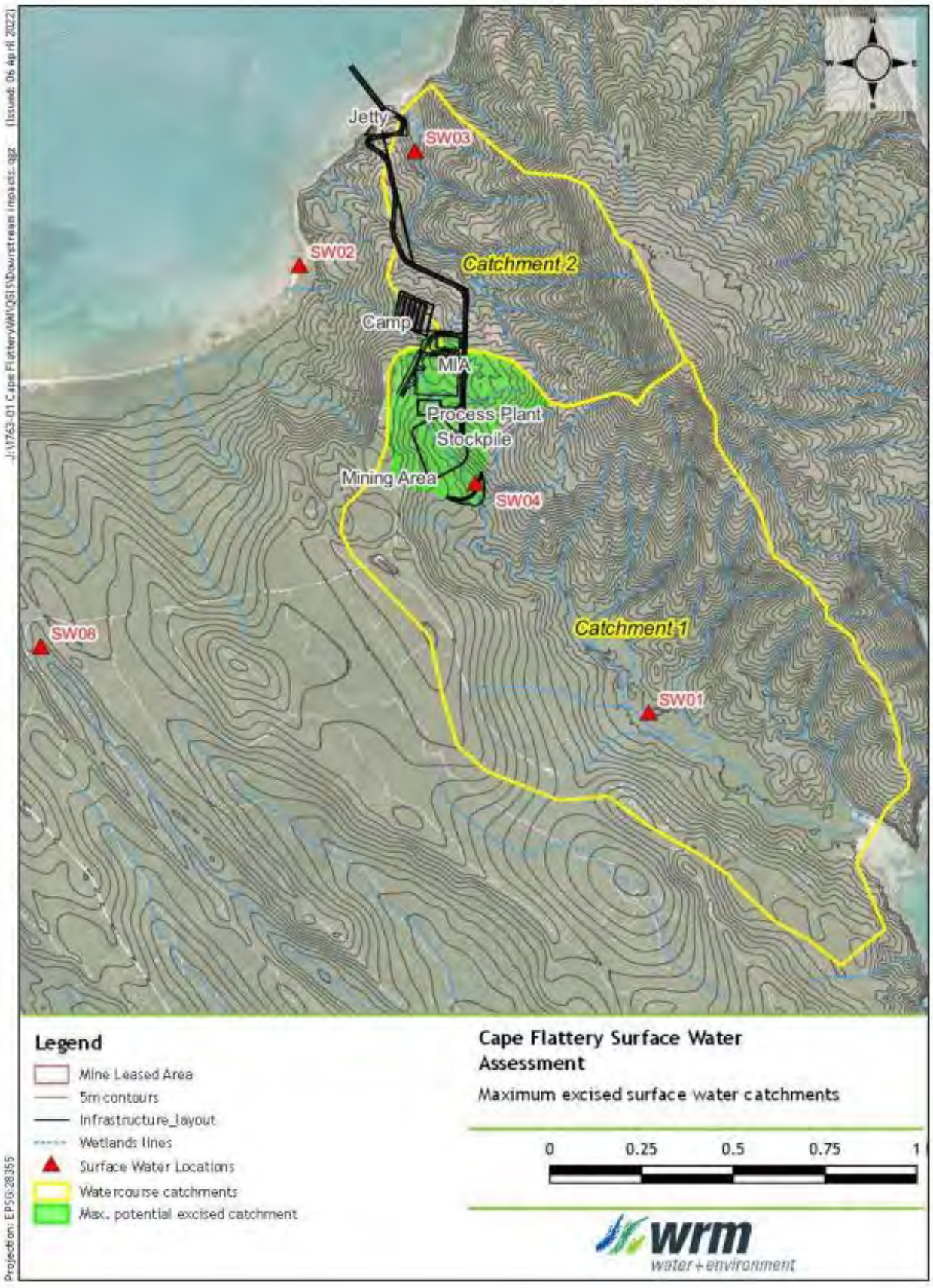

Figure 5-3 Maximum excised surface water catchments (WRM, 2022).

5.4.5 INTRODUCTION AND SPREAD OF AQUATIC WEEDS

During operation the risk of the introduction and spread of aquatic weeds are considered negligible due to the limited works within the local waterways.

5.4.6 INTRODUCTION AND SPREAD OF AQUATIC FAUNA

The risk of adverse impacts to fish populations due to the introduction and proliferation of exotic aquatic fauna are considered negligible and consistent with the construction phase.

5.4.7 INCREASED FISHING PRESSURE

The risk of adverse impacts to fish populations due to increased fishing pressure are considered negligible and consistent with the construction phase.

6. MANAGEMENT, MITIGATION, AND MONITORING

Identified avoidance, mitigation and management measures for the identified construction and operational and closure phases impacts of the project are detailed in Table 6-1. Monitoring of each environmental aspect will be conducted for the various project phases to ensure the identified mitigation measures are implemented and are successful.

Table 6-1 Potential impacts and proposed avoidance, mitigation, and management measures.

Potential Impact to Aquatic Ecosystem Values	Recommended Avoidance, Mitigation or Management Measure
Construction Phase	
Loss of macrohabitat diversity	• The clearing footprint will clearly be delineated and minimised as far as practicable • Existing access roads and tracks will be used where practicable • Where the mine road and conveyor intersect the riparian zone, mature trees will be retained, where possible, and shall be trimmed in preference to removal. • The use of excavators or other suitable machinery will be no greater than the capacity required for the purpose. • Vehicle access to and across the waterways will be by the designated access way only. • New access ways will be designed to accommodate intended traffic types and volumes. • Vegetative material will be stockpiled away from the waterways. • Runoff, erosion and sediment control measures will be installed and maintained, as per the requirements outlined in the developed and Erosion and Sediment Control Plan (ESCP) and/or SWMP. The implemented erosion and sediment controls will be inspected regularly, including after rainfall or significant flow events, and maintained to ensure their ongoing functionality. • A minimum 50 m buffer is to be instated around the palustrine wetlands where the proposed mine lease area buffer intersects these mapped wetlands.
Loss of microhabitat diversity	• The clearing footprint will clearly be delineated and minimised as far as practicable • Vegetative material will be stockpiled away from the waterways.
Changes to hydrology and hydraulics	• Construction water supply will minimise as far as practicable dewatering of groundwater or extraction of local waterways. Should water be sourced from any potential freshwater sources (surface or groundwater, where GDEs occur), then separate assessment are required to address potential impacts to aquatic ecosystem values. • There will unlikely be any releases from the proposed sediment basin (WRM, 2022). Should the FSC be exceeded then releases are to be managed in a way which will not increase peak discharge rates to local waterways.
Changes to water quality	• The clearing footprint will clearly delineated and minimised as far as practicable • Runoff, erosion and sediment control measures will be installed and maintained, as per the requirements outlined in the developed and Erosion and Sediment Control Plan (ESCP) and/or SWMP. Quality targets will achieve minimum gross pollutant reductions outlined in DES (2021c). • There will unlikely be any releases from the proposed sediment basin (WRM, 2022). Should the FSV be exceeded, then releases are to be managed in a way which will not impact water quality in the receiving environment. This includes conformance with local water quality objectives (WQOs) for nutrient and physicochemical parameters and ANZG (2018) for

Potential Impact to Aquatic Ecosystem Values	Recommended Avoidance, Mitigation or Management Measure
	contaminants. Contaminant release concentrations are to conform with 95% protection levels for freshwater systems, as defined in the DES (2020a). • All vehicles, plant and equipment required on-site will be in good condition, and will be regularly maintained and inspected for leakages, in order to minimise the risk of contaminant spill • Bulk chemicals and fuels will be stored within the project area at locations away from surface water bodies and will be managed in accordance with: – the WHS Act and regulation – AS 1940:2017 Storage and Flammable or Combustible Substances – AS 3780:2008 The storage and Handling of Corrosive Substances • Refuelling of mobile plant and vehicles will occur at designated areas within the Project. These areas will be suitably distanced from surface water bodies and drainage lines. Spill kits for chemical and hydrocarbon spills will be available at refuelling points. • In the event of an accidental spill or release of contaminants, works will cease immediately, and preventative actions implemented as per the Construction Environment Management Plan (CEMP) • Spill kits will be located at appropriate points during construction and staff instructed in their use • Development of a waste/refuse management plan. • Development of a spills emergency response plan including appropriate spills containment and training that is consistent with good practice. • Vegetative material will be stockpiled away from the waterways.
Introduction and spread of aquatic weeds	• Education and awareness training regarding the impacts of aquatic weeds to aquatic ecosystem values to be held with contractors as detailed in the CEMP. • A Weed Management Plan (WMP) will be required and should include (but not limited to): – Monitoring and control frequencies (treatment methods and number of treatments required). – Appropriate decontamination procedures for vehicles, machinery and other construction equipment internal to and those vehicles and equipment leaving the site.
Introduction and spread of exotic aquatic fauna	• n/a
Increased fishing pressure	• Employees and contractors of the project will not engage in recreational fishing in freshwater extents
Operational Phase	

Potential Impact to Aquatic Ecosystem Values	Recommended Avoidance, Mitigation or Management Measure
Loss of macrohabitat diversity	• The active mine area would be staged with progressive rehabilitation occurring behind the advancing mine face. • Runoff, erosion and sediment control measures will be installed and maintained, as per the requirements outlined in the developed and Erosion and Sediment Control Plan (ESCP) and/or SWMP.
Loss of microhabitat diversity	• The mining area clearing footprint will clearly be delineated, staged and minimised as far as practicable • Vegetative material will be stockpiled away from the waterways. • Runoff, erosion and sediment control measures will be installed and maintained, as per the requirements outlined in the developed and Erosion and Sediment Control Plan (ESCP) and/or SWMP.
Changes to hydrology and hydraulics	• To minimise impacts on downstream surface flows on the active mining areas: – The active mining area disturbance will be minimised as much as possible; – Upslope drainage would be constructed to divert clean catchment away from the active mining areas; and – Following active mining, the area would be rehabilitated and graded to freely drain. • Extraction locations for the proposed 751 ML/year are to be placed so that any predicted cone of depression (GA&S, 2022) does not occur at the palustrine wetlands (should these be groundwater dependant) or the downstream Dune Lake. Should the palustrine wetlands be not identified as a GDE then this mitigation measure is not required. • There will unlikely be any releases from the proposed sediment basin (WRM, 2022). Should the FSC be exceeded then releases are to be managed in a way which will not increase peak discharge rates to local waterways.
Changes to water quality	• The active mine area would be staged with progressive rehabilitation occurring behind the advancing mine face • Runoff, erosion and sediment control measures will be installed and maintained, as per the requirements outlined in the developed and Erosion and Sediment Control Plan (ESCP) and/or SWMP. • There will unlikely be any releases from the proposed sediment basin (WRM, 2022). Should the FSV be exceeded, then releases are to be managed in a way which will not impact water quality in the receiving environment. This includes conformance with local water quality objectives (WQOs) for nutrient and physicochemical parameters and ANZG (2018) for contaminants. Contaminant release concentrations are to conform with 95% protection levels for freshwater systems, as defined in the DES (2020a). • During extreme weather events any water in the mining area will be: – Dewatered to the Sediment Basin (if the storage capacity is below the minimum operating volume (MOV)) and subsequently controlled released or used to meet site water demands; – Allowed to pond to infiltrate into the soil over a longer period. The downstream edge of the mining area would be bunded, to prevent ponded water spilling into the receiving environment for any conceivable event. • All vehicles, plant and equipment required on-site will be in good condition, and will be regularly maintained and inspected for leakages, in order to minimise the risk of contaminant spill • Bulk chemicals and fuels will be stored within the project area at locations away from surface water bodies and will be managed in accordance with:

Potential Impact to Aquatic Ecosystem Values	Recommended Avoidance, Mitigation or Management Measure
	– the WHS Act and regulation – AS 1940:2017 Storage and Flammable or Combustible Substances – AS 3780:2008 The storage and Handling of Corrosive Substances • Refuelling of mobile plant and vehicles will occur at designated areas within the Project footprint. These areas will be suitably distanced from surface water bodies and drainage lines. Spill kits for chemical and hydrocarbon spills will be available at refuelling points. • In the event of an accidental spill or release of contaminants, works will cease immediately, and preventative actions implemented as per the Operational Environment Management Plan (OEMP) • Development of a waste/refuse management plan. • Development of a spills emergency response plan including appropriate spills containment and training that is consistent with good practice. • Runoff from stockpiles will be captured via the planned stormwater management system. • Planned releases from stormwater infrastructure are to conform to for the wider catchment (DSITI, 2017) and default guideline values in ANZG (2018) for the protection of 95% of species.
Introduction and spread of aquatic weeds	• Education and awareness training regarding the impacts of aquatic weeds to aquatic ecosystem values to be held with contractors as detailed in the OEMP. • A WMP will be required and should include (but not limited to): – Monitoring and control frequencies (treatment methods and number of treatments required). – Appropriate decontamination procedures for vehicles, machinery and other construction equipment internal to and those vehicles and equipment leaving the site.
Introduction and spread of exotic aquatic fauna	• n/a
Increased fishing pressure	• Employees and contractors of the project will not engage in recreational fishing

6.1 INSPECTIONS AND MONITORING

The below points provide monitoring context for both the construction and operational phases, which will be further detailed in the respective construction environment management plan (CEMP) and operation environment management plan (OEMP). Planned monitoring includes:

- Environmental monitoring, involving the collection of quantitative data to establish whether aquatic values are being impacted as a result of project activities;
- Monitoring implementation of specific environmental management plans and programs; and
- Reporting and analysis of regulated discharges, emissions and waste disposal any other prescribed monitoring in accordance with relevant conditions and management plans.

6.1.1 CONSTRUCTION PHASE

The effectiveness of construction impact mitigation and management measures will be verified during the development and implementation of the CEMP. These will include, but not limited to:

- Visual inspection of hazardous substance storage areas and erosion and sediment control measures. Visual inspections are to be carried out during works and following rainfall events to identify any issues and remedy actions;
- Routine audits to ensure appropriately provisioned spill containment controls and spill response kits are in place during construction;
- Routine monitoring, in accordance with a developed Weed Management Plan (WMP);
- Monitoring flow, physicochemical and contaminant parameters upstream and downstream of any releases from stormwater infrastructure.
- Implementation of response mechanisms for any upstream to downstream variance in water quality greater than 10%.
- Monitoring groundwater levels to ensure that any drawdowns are not impacting the potentially groundwater dependant palustrine wetlands; and
- Development of site-specific guideline values for the protection of aquatic ecosystem values, including those for surface and groundwater (quality and quantity).

6.1.2 OPERATIONAL PHASE

The effectiveness of operational impact mitigation and management measures be verified during the development and implementation of the OEMP. These will include, but not limited to:

- Development and implementation of a receiving environment monitoring program (REMP) which assesses the effectiveness of defined mitigation and management measures. The REMP is to include appropriate bioindicators relevant to the defined impacts, as well as the monitoring of aquatic habitat variables and their condition. The developed program is to contain sufficient statistical rigour to ensure that impacts to aquatic ecosystem values can be identified both within the identified creeks and palustrine wetlands;
- Monitoring flow, physicochemical and contaminant parameters upstream and downstream of any uncontrolled releases from the sediment basin;
- Monitoring groundwater levels and quality; and
- Routine monitoring of any sediment basin release infrastructure to identify and correct any scour, erosion and/or sedimentation. Identified issues are to be investigated and remedied.

6.2 RESPONSE MECHANISMS

Should aquatic habitat, water quality and/or aquatic bota impacts be detected from project activities, a response mechanism will be followed. This will include:

- Reporting of the incident according to internal incident reporting procedures;
- Assessment of activities, including stop work for significant events;
- Photo records of impacts and corrective works;
- Review of existing erosion and sediment controls and management plans; and
- Implementation of corrective actions and rehabilitation.

7. CONCLUSION

The topography of the region dictates the nature of aquatic habitat within the Study area. The present aquatic habitat can be broadly group as follows:

- Palustrine wetlands located within the ML, which are mapped as high ecological significance wetlands. They are irregularly shaped wetlands and swamps and are considered low nutrient systems. They occupy the lower depressions between major dunes. Both wetlands contain high cover of macrophytes, including rushes and sedges. The baseline groundwater model conceptualisation is that these wetlands are not groundwater dependant; however this still requires confirmation (GA&S, 2022). They provide dry seasonal refugia in an otherwise dry landscape. Though further investigations are required to confirm status.
- Lower order streams, including:
  - High slope streams which radiate from the hard rock exposure areas. These streams have limited connectivity to mid-upper catchment areas due to natural rock barriers and bed elevation changes present throughout.
  - Low order sand dominated creeks (drainage features) which discharge to Middle Beach. There is limited connectivity from these streams to the coastal tidal area
  - Low order creeks located in the supratidal extents of the catchments.

A number of mapped waterways (as identified under the *Vegetation Management Act 1999* and the Queensland Wetland Mapping (Wetland Info QLD)) through the ML (planned mining area) were not evident at the point of assessment, that is they lacked defined banks, a riparian zone and instream flow paths. The absence of such features occurs consistently along the natural drainage line as identified by current available aerial imagery. These waterways are also not defined as watercourses under the *Water Act 2000*. It is expected that they provided little if any aquatic ecosystem values. Dune

lakes are also located downstream of the Cape Flattery Silica mining lease (ML), with the adjacent tenement. At the time of the survey most sites were dry, with only the palustrine wetlands, and three other creek sites containing aquatic habitat (present water).

Consistent with the noted habitat and nutrient status, diversity of aquatic biota was considered low. Surveyed macroinvertebrate, fish and aquatic reptile species captured in this survey have been documented to occur in the wider Cape York Basin. The Study area represents a small proportion of the native diversity of the basin. No threatened (endangered, vulnerable or near threatened)) or endemic species were recorded or are considered likely to occur based on knowledge of the range of aquatic habitats in the local watercourses. The migratory listed estuarine crocodile (*Crocodylus porosus*) was recorded in the Study area, while threatened sawfish species could possibly occur in the downstream extents of the Study area within the supratidal and coastal habitats.

With the implementation of the mitigation and management measures described and referred to throughout, and based on the current/likely impacts the construction and operation stages of the project are expected to have insignificant/negligible to low residual impact on the aquatic ecosystem values of the receiving environments.

8. REFERENCES

Allen GR. (1997). Marine fishes of tropical Australia and South-East Asia. A field guide for anglers and divers. Third Revised Edition. Perth, Western Australia: Western Australian Museum.

ANZG. (2018), Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines.

Ayling A, Roelofs A, McKenzie, Lee LW. (1997). Port of Cape Flattery Benthic Monitoring, Baseline Survey – Wet Season (February) 1996. Ecoports Monograph Series No.5. Ports Corporation of Queensland, Brisbane, 67pp.

Department of Agriculture and Fisheries (2018). Accepted development requirements for operational work that is constructing or raising waterway barrier works.

Department of Environment and Science (DES) Queensland. (2020a). Environmental Protection Water Policy 2019. Jeannie and Endeavour River Basins environmental values and water quality objectives.

Department of Environment and Science, Queensland. (2020b). Aquatic Conservation Assessments (ACA) and AquaBAMM. Retrieved from WetlandInfo: https://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca/

Department of Environment and Science, Queensland. (2021). Jeannie Catchment Story, Wetland*Info* website, accessed 31 August 2021. Available at: https://wetlandinfo.des.qld.gov.au/wetlands/ecology/processes-systems/water/catchment-stories/transcript-jeannie.html

Department of Environment and Science, DES (2022). *Crocodylus porosus* — Salt-water Crocodile, Estuarine Crocodile', Department of Environment and Science. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1774.

Department of Environment and Science, DES (2018). Cape York Water Plan, Environment Assessment Report.

Department of the Environment and Resource Management (DERM) (2010), National Recovery plan for the water mouse (false water rat) Xeromys myoides. Report to Department of Sustainability, Environment, Water, Population and Communities, Canberra. Department of the Environment and Resource Management, Brisbane. Available from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/nationalrecovery-plan-water-mouse-false-water-rat-xeromys-myoides. In effect under the EPBC Act from 21-Apr-2011.

Department of Environment and Science (DES) (2018a). Monitoring and Sampling Manual: Environmental Protection (Water) Policy. Brisbane: Department of Environment and Science Government. Available at: https://environment.des.qld.gov.au/water/monitoring/sampling-manual/pdf/monitoringsampling-manual-2018.pdf

Department of Environment and Science (DES) (2018b). Cape York Water Plan: Environmental Assessment Report

Department of Environment and Science (DES) (2021). Stormwater and environmentally relevant activities guideline. ESR/2015/1653 Version 1.03.

Department of Natural Resources (1998). Fitzroy Basin Water Allocation and Management Planning, Technical Reports. A Summary of information and analyses conducted for the WAMP process to date in the Fitzroy Basin, report prepared for Department of Natural Resources.

Department of Primary Industries (DPI) (2000). Fisheries Guidelines for Fish Habitat Buffer Zones.

Doody TM, Hancock PJ, Pritchard JL (2018). Assessing Groundwater-Dependent Ecosystems: IESC Information Guidelines Explanatory Note. A report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy.

Domingues RB, Anselmo TP, Barbosa AB, Sommer U, Galvão HM. (2011). Light as a driver of phytoplankton growth and production in the freshwater tidal zone of a turbid estuary. Estuar. Coast. Shelf Sci. 91: 526-535.

Eamus D, Froend R, Loomes R, Hose G, Murray B. (2006). A functional methodology for determining the groundwater regime needed to maintain the health of groundwater-dependent vegetation. Australian Journal of Botany, 54, 91-114.

Ebner, B. & P. Thuesen (2010). Discovery of stream-cling-goby assemblages in the Australian Wet Tropics. *Australian Journal of Zoology*. 58(6):331-340.

EPIC Environmental, (2021). *Surface Water Scoping*

Groundwater Assessment and Solutions (GAS) (2022). Cape Flattery Silica Mine. Report prepared for Metallica Minerals.

Hawkins, P, Taplin, L, Duivenvoorden, L & Scott, F (1988), 'Limnology of oligotrophic Dune Lakes at Cape Flattery, North Queensland', Marine and freshwater research, vol. 39, no. 4, pp. 535–553.

Herbert B, Peters P, Graham P, Hogan, A. (1995). Freshwater Fish and Aquatic Habitat Survey of Cape York Peninsula. Report prepared for the Cape York Peninsula Land Use Strategy. Queensland Department of Primary Industries.

Hinlo R, Gleeson D, Lintermans M, Furlan E (2017). Methods to maximise recovery of DNA from water samples. PLoS ONE. 12 (6): http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0179251

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International Erosion Control Association (IECA) (2008). Best Practice Erosion and Sediment Control.

Kyne PM, Pillam RD. (2014). Protocols for surveying and tagging sawfishes and river sharks. National Environmental Research Program Marine Biodiversity Hub.

Last P, Stevens JD. (2009). Sharks and rays of Australia, 2nd edn, CSIRO Publishing, Collingwood

Marshall JC, McGregor GB. (2011). The Influence of water depth on the distribution of the emergent sedge Lepironia articulata (Cyperaceae) in two dune lakes of southern Queensland Wallum wetlands. Proceedings of the Royal Society of Queensland. 1:193-199.

McColl-Gausden EF, Weeks AR., Coleman RA. (2020) Multispecies models reveal that eDNA metabarcoding is more sensitive than backpack electrofishing for conducting fish surveys in freshwater streams. Mol. Ecol. n/a. [online].

Peverell SC, Pillans RD, Salini J (2005). Determining feasibility of acoustic tag attachment and documenting short-term movement in Pristis zijsron. Report for the National Oceans Office.

Peverell, SC (2005). Distribution of sawfishes (Pristidae) in the Queensland Gulf of Carpentaria, Australia, with notes on sawfish ecology', Environmental Biology of Fishes, vol. 73, pp. 391–402.

Pusey B, Arthington AH, Kennard M. (2004), Freshwater fishes of North-Eastern Australia, CSIRO Pub., Collingwood, Vic.

Pusey B, Kennard M, Bird, J. (2000), Fishes of the dune fields of Cape Flattery, northern Queensland and other dune systems in north-eastern Australia. Ichthyological Explorations in Freshwater, 11, 65–74.

Simpfendorfer CC, Kyne A, Rigby P, Sherman C, White S, William S. (2019). A Report Card for Australia's Sharks.

Stevens JD, Pillans RD, Salini J. (2014). Conservation assessment of Glyphis sp. A (speartooth shark), Glyphis sp. C (northern river shark), Pristis microdon (freshwater sawfish) and Pristis zijsron (green sawfish). CSIRO (Commonwealth Scientific and Industrial Research Organisation)

Stead DG (1963). Sharks and rays of Australian seas. Sydney, NSW. Angus and Robertson.

Threatened Species Scientific Committee (TSSC) (2011). *Commonwealth Listing Advice on* Stiphodon semoni *(Opal Cling Goby)*. Department of Sustainability, Environment, Water, Population and Communities. Canberra, ACT: Department of Sustainability, Environment, Water, Population and Communities. Available
from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/83909-listing-advice.pdf.

Thuesen P, Ebner B, and Silcock R, (2009). Distribution and abundance of Cling Gobies (Stiphodon spp.) in the Australian Wet Tropics. James Cook University. Queensland. Unpublished.

Thuesen, P., B. Ebner & R. Silcock (2009). *Distribution and abundance of Cling Gobies* (Stiphodon *spp.) in the Australian Wet Tropics*. In preperation. Queensland: James Cook University.

Timms, B (1982). Coastal dune waterbodies of north-eastern New South Wales', Marine and freshwater research, vol. 33, no. 2, pp. 203–222.

Timms, B (1986). Reconnaissance limnology of some coastal Dune Lakes of Cape York Peninsula, Queensland', Marine and freshwater research, vol. 37, no. 2, pp. 167–176.

Whitty, J, Morgan, D, Thorburn, D, Fazeldean, T & Peverell, S (2008), 'Tracking the movements of freshwater sawfish (Pristis microdon) and northern river sharks (Glyphis sp. C) in the Fitzroy River', in JM Whitty, NM Phillips, DL Morgan, JA Chaplin, DC Thorburn & SC Peverell (eds), Habitat associations of freshwater sawfish (Pristis microdon) and northern river shark (Glyphis sp. C): including genetic analysis of P. microdon across northern Australia, Centre for Fish and Fisheries Research (Murdoch University) report to the Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra.

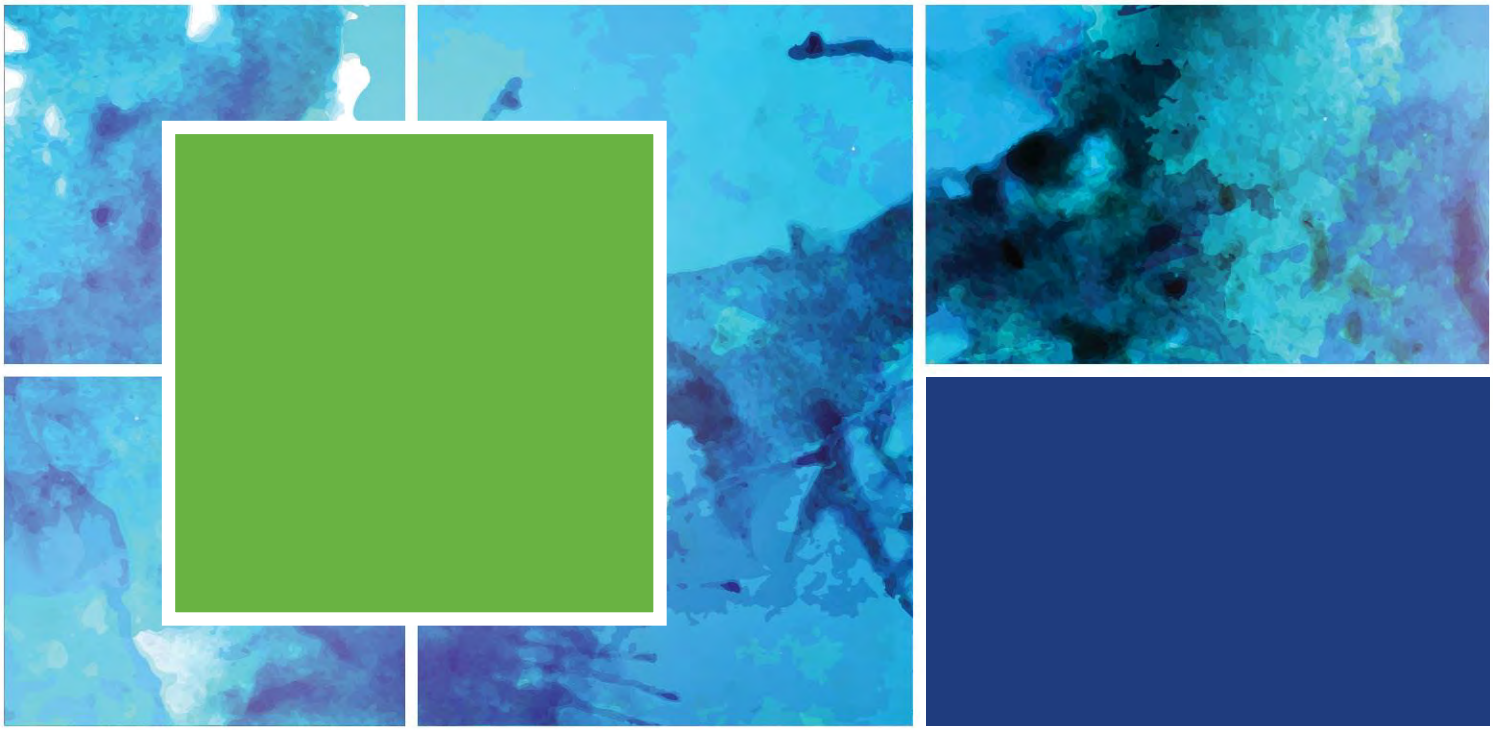
Whitty JM, Keleher J, Ebner BC, Gleiss AC, Morgan D. (2017). Habitat use of critically endangered elasmobranchs, the largetooth sawfish *Pristis pristis*, in an intermittently flowing river nursey. Endangered Species Research. 34: 211-227.

Wilson S. Swan G. (2003). A Complete Guide to Reptiles of Australia. New Holland Publishers, Frenchs Forest, NSW

Wright, I. and Burgin, S. (2007), Species richness and distribution of eastern Australian lake chironomids and chaoborids. Freshwater Biology, 52: 2354-2368. https://doi.org/10.1111/j.1365-2427.2007.01853.x

WRM (2022). Cape Flattery Silica Same Project. Surface Water Impact Assessment. Report prepared for Epic Environmental.

APPENDIX A. METHODS



HABITAT

DATA COLLECTION

Modified State of the River-style and AUSRIVAS habitat descriptions of bed, banks, and riparian zones were completed along a 100m reach at each site which was considered to be a defined watercourse. This included descriptions of:

- Macro and microhabitat;
- Bed and bank conditions as well as the identification of the major types of instability (eroding, slumping and aggrading). Information relating to the slope and shape of the banks.
- Bed substrate composition and embeddedness;
- Adjacent land use and the condition that prevailed at the time of sampling;
- Riparian cover and composition, noting percentage cover of trees, shrubs, grasses/herbs/sedges and bare areas; and
- Channel alteration, including presence of scouring and/or deposition.

Additional notes regarding the level and types of disturbance evident (human habitation, activity, feral animals, etc), diversity and abundance of weeds and the general bank morphology were made at each site. Site information sheets were compiled (Appendix B) for each monitoring site, which describe the above listed features.

To assist with interpreting habitat classification, the River Bioassessment Program scores (bioassessment scores) (out of 135) were calculated for all sites based on nine AUSRIVAS categories, including: habitat availability (pool/riffle, run/bend ratio); bank stability; streamside cover; bed substrate composition and embeddedness; channel alteration; and presence of scouring and/or deposition. From these scores, an aquatic habitat condition rating was calculated and categorised into poor, fair, good or excellent habitat conditions.

DATA ANALYSIS

Qualitative habitat assessment sheets were digitised and along with photos and field observations, supported a narrative assessment of in-stream and riparian habitat types. This information is used to contextualise results of the aquatic fauna sampling and, also provide a basis of monitoring.

DRONE SURVEYS

DATA COLLECTION

An un-manned Aerial Vehicle (UAV) [DJI Mavic Pro] was flown at a height of 60 m over a 400 m transect where possible (generally mid-stream) at each site.

DATA ANALYSIS

Data Processing Artificial intelligence powered drone data processing service provided by DroneDeploy was used to create mosaic and 3D images of the study site.

GDE PRESENCE AND VALUE

In order to identify the presence of GDEs at each site, an assessment relative to that developed by Eamus et al. (2006) was implemented. The below assessment was undertaken specifically for surface

GDEs and the series of questions relevant to Queensland and freshwater systems (Table A1). Questions relevant to terrestrial GDEs are being assessed by other consultants. In addition to Eamus et al. (2006), the presence of cracking clays can also indicate that a waterbody is less likely to be groundwaters (Doody et al. 2018). As this could be easily identified in the field, it was included in the GDE presence assessment.

Table A1 Questions to guide the assessment of groundwater use in ecosystems (Eamus et al. 2006; Doody et al. 2018).

Item	Positive answers to the following questions suggest an ecosystem may use groundwater:
1	Does a stream/river continue to flow all year, despite prolonged periods of zero or very low rainfall?*
2	Does the volume of flow in a stream/river increase downstream in the absence of inflow from a tributary? *
3	Is the level of water in a wetland/swamp maintained during extended dry periods?*
4	Were cracking clays present? Where cracking clay soils exist or Holocene muds, waterbodies are less likely to be groundwater fed

*Based on field results and interpretations from historical aerial imagery. Historical imagery was sourced from QLD Globe (https://qldglobe.information.qld.gov.au/)

In order to define the inherent value of any identified GDEs, The Serov et al (2012) method for attributing low, moderate or high value to GDEs was adopted as defined in Doody et al. (2018), including:

- The sensitivity of GDE communities to changes in groundwater (ie *high value* - GDEs for which only slight changes in groundwater level can result in loss of biota or services; *moderate value* - GDEs that require a moderate change in groundwater to cause change in their distribution, composition or condition);
- Location of GDEs (ie *high value* - within State Reserves);
- Condition (ie *high value* - GDE is relatively unaltered with good condition; *low value* - highly modified from natural state and declining in ecosystem condition);
- Uniqueness (ie *high value* - GDE contains endemic, rare or endangered species; *moderate value* - GDEs contain vulnerable or threatened biota); and
- Services (ie *high value* - GDEs that provide multiple ecosystem services to society).

WATER QUALITY

DATA COLLECTION

At each site, physicochemical parameters were measured in-situ with a calibrated YSI DSS Pro water quality meter. The following parameters were assessed:

- Temperature (°C);
- Electrical conductivity @ 25°C (µS/cm);
- pH (pH unit);
- Turbidity (NTU); and
- Dissolved oxygen (% saturation and mg/L).

Physicochemical measurements were collected from below the water's surface (0.2 to 0.4 m). The following in-situ QA/QC measures were used to ensure the accuracy and reliability of collected samples:

- The water quality meter was fully calibrated a day prior to use. The water quality meter was checked prior to the collection of data at each site to assess for any anomalies;
- The water quality meter was cleaned at the end of each field day and between sites; and
- Physico-chemical readings were recorded once values stabilised (approximately three minutes).

DATA ANALYSIS

Collected water quality data was compared to the Environment Protection Policy (Water) – Water Quality Objectives (WQOs) defined for the Jeannie and Endeavour River Basins (DES, 2020). The tributary and wetland systems were unlisted within the relevant basin guidelines and thus ANZG guidelines for lowland rivers and wetlands were instead used (ANZG 2018). It is important to note that defined objectives do not provide an assessment relevant to toxicity, but provide objectives, based on catchment reference sites, for which water quality is to be maintained.

MACROINVERTEBRATES

DATA COLLECTION

Standard sized dip nets with 250 µm mesh were used to collect triplicate macroinvertebrate samples at each site. To address habitat variation within a site, samples were obtained from a number of locations in the study reach from two distinct aquatic habitats:

- Edge habitat – sampling for this habitat involved sweeping a dip-net along bank habitat in an upstream direction over an aggregate distance of 10 m, proportionally incorporating the spatial occurrence of key microhabitats present within the sampled stream reach (ie including backwaters and undercuts, tree roots, trailing bank vegetation, where there is little or no flow, macrophytes, etc).
- Bed habitat – samples were obtained using the kick-sampling method, which consisted of kicking and disturbing the bed and sweeping the disturbance with a dip-net to capture dislodged macroinvertebrates over an aggregate distance of 10 m.

Collected samples were jarred, preserved in ethanol (70%) and returned to the laboratory for picking, identification and enumeration. Taxonomic identification was to Family level, with the exception of lower Phyla (Porifera, Nematoda, Nemertea), Oligochaeta (freshwater worms) and Acarina (mites). Chironomids were identified to sub-family level.

Specific QA/QC procedures implemented during macroinvertebrate identification included:

- All sampling and macroinvertebrate enumeration and identification were undertaken by AUSRIVAS accredited taxonomists; and
- 10% of all samples were cross checked to assess the accuracy of identification and enumeration of the samples collected. Compliance was within the 90% similarity level for all checked samples.

DATA ANALYSIS

UNIVARIATE STATISTICAL ANALYSES

Macroinvertebrate data collected were used to calculate several diversity indices, including:

- Taxonomic richness;
- Plecoptera, Ephemeroptera and Trichoptera (PET) richness;

- SIGNAL 2; and
- % tolerant taxa.

Calculated diversity indices described above were tested with a one-way (factor of habitat) Permutational ANOVA (PERMANOVA) based on Euclidean distance matrix. Significant results ($p<0.05$) were followed by pairwise comparisons.

MULTIVARIATE STATISTICAL ANALYSES

Differences in macroinvertebrate assemblages were presented using non-parametric, multi-dimensional scaling (nMDS), based on Bray-Curtis similarity matrices, which graphically present community composition from different treatments in a two-dimensional space. Pairwise comparison for differences in community assemblages among treatments were also tested with a one-way (factor of habitat) analysis of similarity (ANOSIM) test based on Bray-Curtis.

VERTEBRATES – FISH AND AQUATIC REPTILES

DATA COLLECTION

Vertebrate surveys were conducted in accordance with Hydrobiology's current General Fisheries Permit (no. 206951) and Animal Ethics approval (CA 2021/02/1462), as described below. In order to capture the range of species present, both active (electrofishing) and passive (fyke) sampling techniques were employed. Electrofishing was undertaken at all sites, with fyke nets only being undertaken at 4 larger waterbodies. The selected range of gear is suitable and commonly used apparatus for the survey of fish (small and large bodies species), aquatic reptiles and platypus (DES, 2018a). The below methods are also efficient methods for the capture of macrocrustaceans, and while not specifically used for this reason, were commonly caught as by-catch.

All exotic and voucher specimens were euthanised via a lethal dose of Aqui-S® solution in accordance with Hydrobiology's Animal Ethics approval. Exotics were disposed of in accordance with current State legislative requirements.

ELECTROFISHING

Backpack electrofishing was in wadable areas using a Smith-root APEX backpack electrofisher fitted with a 28 cm anode ring and a tightly covered dip net (10 mm stretched mesh). Both frequency (300 Hz) and duty cycle (~50%) was fixed to maintain a constant pulse width, with voltage varying according to conductivity levels. Sampling effort aimed to be consistent across habitats, with approximately 600 seconds 'on time' at sites

All electrofishing sampling were undertaken by senior electrofishing operators. Electrofishing was not undertaken at S1 (palustrine wetland) due to the risk associated with sampling in deep waters with the presence of crocodiles.

FYKE NETTING

Where sufficient water levels were present, two paired fyke nets were deployed at each waterway site, with entrances facing downstream. Two fyke net sizes were used in this study. One had two 5 m wings, with a 0.9 m drop and the other with a single 5 m wing and a 0.6 m drop. Both nets had 2 mm mesh. A float was placed in the cod end of each fyke net to provide an air space for air breathing fauna (turtles, etc). Fyke nets were set in the afternoon and cleared the following morning.

Fyke nets were not deployed at S1 (palustrine wetland) due to the risk associated with sampling in deep waters with the presence of crocodiles.

EDNA

Sample Collection

At a subset of sites, approximately 6 L of water was collected from areas of likely fish habitat (amongst snags, large woody debris, macrophytes, downstream of riffles and boulders, undercut banks, etc.). Cellulose nitrate filter papers with an aperture size of 0.8 µm were used to capture fish DNA via a vacuum filter flask kit and handheld pump. Four to six separate filters were needed per site (depending on the amount of particulates) to process 6 L of site water. Each filter paper was stored and transported in individual 7 mL vials with 99% ethanol. This particular capture, storage and preservation technique has been identified by Hinlo et al., (2017) as one of the more successful techniques in terms of cost and efficiency for DNA recovery

Fish DNA extraction, purification and quantification are detailed below. Laboratory analysis was undertaken at enviroDNA laboratories.

DNA extraction

DNA was extracted from the filters using a DNeasy Blood and Tissue Kit (Qiagen), including an extraction negative. Biodiversity assessments were performed with a universal Fish assay targeting a small region of the 12S mitochondrial DNA (McColl-Gausden et al. 2020). Library construction involved two rounds of PCR whereby the first round employed gene-specific primers to amplify the target region and the second round incorporated sequencing adapters and unique barcodes for each sample-amplicon combination included in the library. Negative controls were also included during library construction. Negative controls consisted of the extraction negative as well as PCR negatives where nuclease-free water was used in place of DNA during both rounds of PCR. Sequencing was carried out on an Illumina MiSeq machine.

DNA Assignment

Following quality control filtering to remove primer sequences, truncated reads and lowfrequency reads, DNA sequences were clustered into Operational Taxonomic Units (OTUs) on the basis of sequence similarity. Taxonomic assignment was performed with VSEARCH. software (Rognes et al. 2016) whereby each OTU cluster was assigned a species identity using a threshold of 95% by comparing against a reference sequence database. Where a species could not be assigned (i.e. reference database was deficient and/or taxa were poorly-characterised), taxonomic assignments were manually vetted by first obtaining a list of possible species through BLASTN searches against the public repository Genbank (www.ncbi.nlm.nih.gov), then eliminating species on the basis of their geographic distribution using information from the Atlas of Living Australia (ALA). In cases where an OTU could not be adequately resolved to a single species (due to shared haplotypes for instance), either a list of multiple species was included, or it was assigned to the lowest taxonomic rank without further classification

VERTEBRATE PROCESSING

The following vertebrate processing methods were employed at all sites:

- Fish, macrocrustaceans, and turtles were identified to species level, enumerated, and assessed for obvious wounds, lesions, or deformities; and
- Each specimen was measured for length until 20 individuals of the species were recorded for the particular site and capture method. Following this, the individuals would be counted.

DATA ANALYSIS

Total species richness and abundances was summarised from all methods and all sites. The conservation significance of collected fauna was assessed by reference to State and Federal databases and in-house knowledge of the distribution of species from previous studies in the area.

CONSERVATION SIGNIFICANT SPECIES

At each site habitat assessments were undertaken for conservation significant (State and/or Federally listed endangered, vulnerable, near threatened, and MNES species identified during the desktop assessment which included the classification of the likelihood of any one species occurring at each site. Assessments were undertaken for three sawfish species, an aquatic reptile and a goby. The likelihood of species occurring was considered under four categories; (i) unlikely; (ii) possible; (iii) likely; and (iv) Known. The criterion used to define each category is provided in Table A2.

Table A2. Criteria used for assigning likelihood of occurrences relevant to EVNT and special least concern species.

Likelihood of occurrence category	Criteria
Unlikely	• No suitable habitat present.
Possible	• Suitable species habitat present.
Likely	• Suitable species habitat present and; • A record occurs nearby (10 km) in similar habitat.
Known	• Species recorded during field surveys (including past records).

IMPACT ASSESSMENT

IDENTIFYING THE IMPACT

Each identified impact was categorised, and the significance of the impact determined using the methodology set out below.

CATEGORISING THE IMPACT

PHASE

Impacts will be categorised into either or both of the following phases.

- Construction
- Operation

Where an impact exists in both construction and operation phases, it will be included in both categories (i.e. twice)

DIRECTION

The impact will be identified as positive or negative

RATING THE IMPACT

Impacts will be assessed using a standardised method, which is based on a set of criteria as set out in Table A3. The assessment matrix presented as Table A4 demonstrates how the impact rating is derived.

Table A3 Impact categorisation

Aspect	Magnitude	Duration/Reversibility	Likelihood/frequency
Environment-biological	• Negligible- Little noticeable impact to the environment, impacts consistent with existing activities taking place in the area • Minor- Limited impacts, may affect some common species within a local context but unlikely to change ecological dynamics • Moderate- Impacts to multiple species or communities requiring complex mitigation or management, widespread impacts • Major- Impacts to multiple species of communities, possibly including significant impacts to threatened species or critical biological systems, affects may be felt outside of the region	• Short term- effects will be occur over a period of weeks or months; are easily reversible • Long Term – effects will occur for years • Permanent- values will never return to pre-existing state	• Rare- may occur in exceptional circumstances • Possible- may occur on this project, has occurred occasionally or intermittently on similar projects or actions in the past • Likely – could be expected to occur, has occurred on similar projects or actions in the past. Intermittent affects have occurred frequently in the past. • Almost certain- Is expected to occur, has occurred recently on similar projects or actions and is very likely to occur again
Environment-physical	• Negligible- Little measurable impact to physical environmental features, no additional surface disturbance above that normally created by existing activities • Minor- Limited physical disturbance or minimal changes which are within the normal range of variability, impacts limited to an immediate area of disturbance • Moderate- Measurable changes to physical environment which are outside of the range of normal variability, impacts which extend beyond the immediate disturbance area • Major- Serious physical disturbance or changes which pose a significant risk to physical environment, extensive physical changes well beyond the project area	• Short term- effects will be occur over a period of weeks or months. • Long Term – effects will occur for years • Permanent- values will never return to pre-existing state	• Rare- may occur in exceptional circumstances • Possible- may occur on this project, has occurred occasionally or intermittently on similar projects or actions in the past • Likely – could be expected to occur, has occurred on similar projects or actions in the past. Intermittent affects have occurred frequently in the past. • Almost certain- Is expected to occur, has occurred recently on similar projects or actions and is very likely to occur again

Table A4 Impact rating matrix

Magnitude	Duration	Likelihood	Impact Significance
Negligible	Short Term	Rare	Insignificant
		Possible	Insignificant
		Likely	Insignificant
		Almost Certain	Insignificant
	Long Term	Rare	Insignificant
		Possible	Insignificant
		Likely	Insignificant
		Almost Certain	Insignificant
	Permanent	Rare	Insignificant
		Possible	Insignificant
		Likely	Insignificant
		Almost Certain	Insignificant
Minor	Short Term	Rare	Insignificant
		Possible	Insignificant
		Likely	Low
		Almost Certain	Low
	Long Term	Rare	Low
		Possible	Low
		Likely	Medium
		Almost Certain	Medium
	Permanent	Rare	Low
		Possible	Medium
		Likely	Medium
		Almost Certain	Medium
Moderate	Short Term	Rare	Low
		Possible	Low
		Likely	Medium

Magnitude	Duration	Likelihood	Impact Significance
		Almost Certain	Medium
	Long Term	Rare	Low
		Possible	Low
		Likely	Medium
		Almost Certain	High
	Permanent	Rare	Low
		Possible	Medium
		Likely	High
		Almost Certain	High
Major	Short Term	Rare	Low
		Possible	Medium
		Likely	Medium
		Almost Certain	High
	Long Term	Rare	Low
		Possible	Medium
		Likely	High
		Almost Certain	High
	Permanent	Rare	Medium
		Possible	High
		Likely	High
		Almost Certain	High

SENSITIVITY/IMPORTANCE

The intrinsic sensitivity or importance of the environmental or social was assessed by the subject expert. The rating was derived depending on the type of value, and each subject expert provided definition within the subject chapter to demonstrate how the relative sensitivity/importance has been derived.

Sensitivity/Importance encompassed the intrinsic worth of the value, and related to legal protection e.g. red listed species, or was defined by individual or community perception of social or cultural worth. Rarity or uniqueness was considered to increase the importance of a value. In this way a moderate impact on an irreplaceable value was considered alongside a high impact on a value that is replicated many times in the local area to determine the relative significance of the impact.

Values were rated as low, moderate, high or extreme sensitivity/importance.

IMPACT SIGNIFICANCE

The significance of the impact was derived based on the matrix below. Positive impacts have been excluded from the matrix but were reported in the impact assessment.

Table A5 Impact significance matrix

		Sensitivity/Importance			
		Low sensitivity	Moderately sensitive	Highly sensitive	Extremely sensitive
Impact rating	Insignificant	Minor	Minor	Minor	Minor
	Low	Minor	Minor	Moderate	Moderate
	Medium	Minor	Moderate	Moderate	Major
	High	Moderate	Moderate	Major	Major

The impact significance categories were defined as follows:

Minor: Impact is acceptable on the value; impact is consistent with accepted good practice. Monitoring may be required to assess whether impacts remain acceptable.

Moderate: Impact is acceptable although not ideal. Mitigation can be expected to be required to minimise impacts on the values. Impact is likely to require monitoring if there are opportunities to further reduce impact level.

Major: Impact on the value is unacceptable, is likely to exceed accepted or legislated thresholds, is not in compliance with good practice outcomes. Mitigation is required to reduce the impact. Impacts at this level should not be permitted unless all practicable mitigation measures have been considered.

MITIGATION

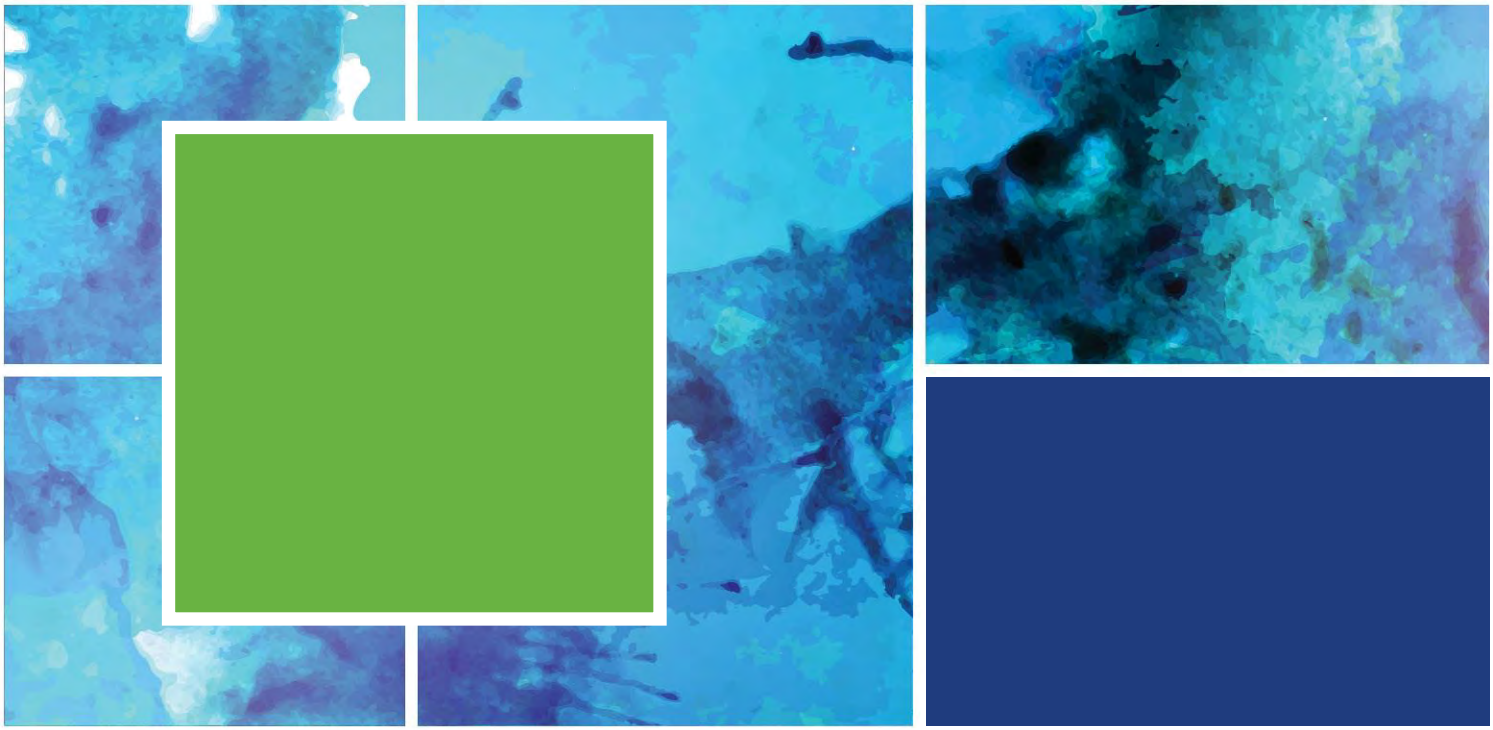
Mitigation measures were nominated by the subject expert for each impact. Mitigation options were generally considered in the following order of preference:

1. Avoidance of impacts altogether;
2. Reduction of impacts where unavoidable;
3. Restoration of the environmental or social or cultural value following the impact; and
4. Offset or enhancements delivered elsewhere.

RESIDUAL IMPACT RATING

Following the nomination of appropriate mitigation measures, the impact significant assessment process was repeated, considering the proposed mitigation measure, and a residual impact classification was derived using the same matrix presented above. The objective of mitigation was to reduce the impact significance to as low as reasonably practicable.

APPENDIX B.
SITE PROFILES



Site code	S1	Watercourse:	Wetland	Date:	26/11/21	Latitude:	-14.9757	Longitude:	145.3390

Watercourse Description	
Watercourse Type (river, tributary, wetland)	Palustrine wetland
Water presence	Mid-level
Flow Level (m/s)	0
Macrohabitat (%)	
Riffle (%)	0
Run (%)	0
Pool (rocky) (%)	0
Pool (sandy/silt) (%)	100
Dry (%)	0
Water Quality	
Clear or turbid	Clear
Water Surface	-
Water temperature (°C)	27.9
Water Odour	Yes
pH	5.8
Electrical Conductivity (µS/cm)	239
Dissolved Oxygen (mg/L)	7.3
Dissolved Oxygen (% Saturation)	93.6
Turbidity (NTU)	3.2
Substratum (%)	
Bedrock	0
Boulders	0
Cobbles	0
Pebbles	0
Gravel	0
Sand	100
Silt / Clay	0
Bed compaction	
Low compaction – poor grading, some packing and structure, little overlap, can be dislodged easily.	

Microhabitat (%)	
Logs (>15cm Ø)	0
Sticks & branches (<15cm Ø)	10
Detritus (leaves, twigs)	5
Periphyton (fine algae on rocks)	0
Blanketing silt	0
Undercut banks	0
Moss	0
Filamentous algae	0
Aquatic Flora	80
Bank overhang veg.	0
Bank trailing veg.	0
Substrate anoxia	0
Shading	0
Canopy cover	0

Habitat bioassessment		
Habitat variable	**Condition**	**Notes**
Not applicable		
EVNT species		
Stiphodon semoni — Opal Cling Goby	Unlikely	
Crocodylus porosus – estuarine crocodile	Confirmed	
Pristis zijsron – green sawfish	Unlikely	
Anoxypristis cuspidate – narrow sawfish	Unlikely	
Pristis pristis – largetooth sawfish	Unlikely	

Bank/riparian structure	Left	Right
Bank land use	Native	Native
Bank erosion (%)	0	0
Bare (%)	5	5
Grasses (%)	90	90
Shrubs (%)	10	10
Trees <10m (%)	0	0
Trees >10m (%)	0	0
Exotics (%)	0	0

Aquatic Flora	
Species list	**Proportion (%)**
Lepironia articulata	60
Leptocarpus spp.	30
Xyris sp.	5
Drosera sp.	5

Comments

Layer of peat decaying
Vegetation on sand

Site code	S7	Watercourse:	Unnamed waterway	Date:	27/11/21	Latitude:	-14.9594	Longitude:	145.3396

Watercourse Description	
Watercourse Type (river, tributary, wetland)	Unnamed waterway
Water presence	Low-level
Flow Level (m/s)	0
Macrohabitat (%)	
Riffle (%)	0
Run (%)	0
Pool (rocky) (%)	100
Pool (sandy/silt) (%)	0
Dry (%)	0
Water Quality	
Clear or turbid	Turbid
Water Surface	-
Water temperature (°C)	27.7
Water Odour	None
pH	4.96
Electrical Conductivity (µS/cm)	289
Dissolved Oxygen (mg/L)	5.87
Dissolved Oxygen (% Saturation)	70.4
Turbidity (NTU)	80.1
Substratum (%)	
Bedrock	40
Boulders	50
Cobbles	0
Pebbles	0
Gravel	0
Sand	5
Silt / Clay	5
Bed compaction	
Moderate compaction	

Microhabitat (%)	
Logs (>15cm Ø)	0
Sticks & branches (<15cm Ø)	5
Detritus (leaves, twigs)	20
Periphyton (fine algae on rocks)	5
Blanketing silt	0
Undercut banks	10
Moss	0
Filamentous algae	5
Aquatic Flora	25
Bank overhang veg.	5
Bank trailing veg.	40
Substrate anoxia	0
Shading	60
Canopy cover	60

Habitat bioassessment		
Habitat variable	**Condition**	**Notes**
Substrate embeddedness	Good	Larger substrate particles are surrounded by between 25-50% of fine sediment
Channel alteration	Excellent	No enlargement of islands or point bars and no channelisation
Bed stability (scouring/deposits)	Excellent	Less than 5% of the bed is affected by scouring and deposition
Bank stability (erosion)	Excellent	Stable, no evidence of erosion or bank failure.
Bank vegetation	Excellent	>80% of the banks are covered by vegetation or boulders and cobble.

EVNT species	
Stiphodon semoni — Opal Cling Goby	Unlikely
Crocodylus porosus – estuarine crocodile	Unlikely
Pristis zijsron – green sawfish	Unlikely
Anoxypristis cuspidate – narrow sawfish	Unlikely
Pristis pristis – largetooth sawfish	Unlikely

Bank/riparian structure	Left	Right
Bank land use	Native	Native
Bank erosion (%)	1	1
Bare (%)	0	0
Grasses (%)	20	20
Shrubs (%)	60	60
Trees <10m (%)	20	20
Trees >10m (%)	0	0
Exotics (%)	0	0

Aquatic Flora	
Species list	**Proportion**
Gahnia sp.	100%

Comments

Highly incised rock watercourse.
Presents minimal aquatic habitat.

Site code	S8	Watercourse:	Unnamed waterway	Date:	24/11/21	Latitude:	-14.9676	Longitude:	145.3484

Watercourse Description	
Watercourse Type (river, tributary, wetland)	Unnamed waterway - estuarine
Water presence	Low-level
Flow Level (m/s)	0.01
Macrohabitat (%)	
Riffle (%)	0
Run (%)	0
Pool (rocky) (%)	0
Pool (sandy/silt) (%)	100
Dry (%)	0
Water Quality	
Clear or turbid	Clear
Water Surface	-
Water temperature (°C)	30.2
Water Odour	None
pH	6.99
Electrical Conductivity (µS/cm)	5187.8
Dissolved Oxygen (mg/L)	3.68
Dissolved Oxygen (% Saturation)	60.4
Turbidity (NTU)	4.54
Substratum (%)	
Bedrock	0
Boulders	0
Cobbles	0
Pebbles	0
Gravel	0
Sand	100
Silt / Clay	0
Bed compaction	
Low compaction – poor grading, some packing and structure, little overlap and can be dislodged easily.	

Microhabitat (%)	
Logs (>15cm Ø)	5
Sticks & branches (<15cm Ø)	0
Detritus (leaves, twigs)	5
Periphyton (fine algae on rocks)	0
Blanketing silt	0
Undercut banks	15
Moss	0
Filamentous algae	5
Aquatic Flora	65
Bank overhang veg.	20
Bank trailing veg.	5
Substrate anoxia	0
Shading	35
Canopy cover	40

Habitat bioassessment		
Habitat variable	**Condition**	**Notes**
Substrate embeddedness	Good	30-50% gravel, rubble or another suitable habitat.
Channel alteration	Fair	Moderate deposition of coarse material on old and new bars. Pools partly filled by silt.
Bed stability (scouring/deposits)	Excellent	>5% of the bottom affected by scouring and deposition.
Bank stability (erosion)	Good	Moderately stable; small erosion areas. Side slopes up to 40% on one bank.
Bank vegetation	Good	50-79% of the streambank surfaces covered by vegetation or larger material.
EVNT species		
Stiphodon semoni — Opal Cling Goby	Unlikely	
Crocodylus porosus – estuarine crocodile	Confirmed	
Pristis zijsron – green sawfish	Unlikely – though could possibly occur in downstream supratidal and coastal habitat	
Anoxypristis cuspidate – narrow sawfish	Unlikely – though could possibly occur in downstream supratidal and coastal habitat	
Pristis pristis – largetooth sawfish	Unlikely – though could possibly occur in downstream supratidal and coastal habitat	

Bank/riparian structure	Left	Right
Bank land use	Native	Native
Bank erosion (%)	0	0
Bare (%)	10	30
Grasses (%)	0	100
Shrubs (%)	40	30
Trees <10m (%)	45	30
Trees >10m (%)	0	0
Exotics (%)	0	0

Aquatic Flora	
Species list	**Proportion (%)**
Rhizophora stylosa	80
Ceriops spp.	10
Avicennia marina	10

Comments

Rhizophora dominated tidal mangrove lagoon.
Some mangrove dieback on left bank.

Site code	S9	Watercourse:	Unnamed Waterway	Date:	25/11/21	Latitude:	-14.9515	Longitude:	145.3375

Watercourse Description	
Watercourse Type (river, tributary, wetland)	Unnamed Waterway
Water presence	Low-level
Flow Level (m/s)	0
Macrohabitat (%)	
Riffle (%)	0
Run (%)	0
Pool (rocky) (%)	5
Pool (sandy/silt) (%)	0
Dry (%)	95
Water Quality	
Clear or turbid	Clear
Water Surface	-
Water temperature (°C)	30.7
Water Odour	None
pH	7.32
Electrical Conductivity (µS/cm)	1484
Dissolved Oxygen (mg/L)	6.89
Dissolved Oxygen (% Saturation)	92.7
Turbidity (NTU)	1.06
Substratum (%)	
Bedrock	20
Boulders	30
Cobbles	20
Pebbles	10
Gravel	10
Sand	10
Silt / Clay	0
Bed compaction	
Tightly packed, armoured – array of sizes, overlapping, hard to dislodge.	

Microhabitat (%)	
Logs (>15cm Ø)	15
Sticks & branches (<15cm Ø)	10
Detritus (leaves, twigs)	10
Periphyton (fine algae on rocks)	50
Blanketing silt	0
Undercut banks	5
Moss	0
Filamentous algae	30
Aquatic Flora	30
Bank overhang veg.	0
Bank trailing veg.	0
Substrate anoxia	0
Shading	50
Canopy cover	20

Habitat bioassessment		
Habitat variable	**Condition**	**Notes**
Substrate embeddedness	Good	30-50% gravel, rubble or another suitable habitat.
Channel alteration	Fair	Moderate deposition of coarse material on old and new bars. Pools partly filled by silt.
Bed stability (scouring/deposits)	Excellent	>5% of the bottom affected by scouring and deposition.
Bank stability (erosion)	Good	Moderately stable; small erosion areas. Side slopes up to 40% on one bank.
Bank vegetation	Good	50-79% of the streambank surfaces covered by vegetation or larger material.
EVNT species		
Stiphodon semoni — Opal Cling Goby	Unlikely	
Crocodylus porosus – estuarine crocodile	Unlikely – though confirmed in downstream supratidal and coastal area	
Pristis zijsron – green sawfish	Unlikely – though could possibly occur in downstream supratidal and coastal habitat	
Anoxypristis cuspidate – narrow sawfish	Unlikely – though could possibly occur in downstream supratidal and coastal habitat	
Pristis pristis – largetooth sawfish	Unlikely – though could possibly occur in downstream supratidal and coastal habitat	

Bank/riparian structure	Left	Right
Bank land use	Native	Native
Bank erosion (%)	10	10
Bare (%)	10	10
Grasses (%)	10	10
Shrubs (%)	20	20
Trees <10m (%)	30	30
Trees >10m (%)	30	30
Exotics (%)	0	0

Aquatic Flora	
Species list	**Proportion (%)**
Eleocharis sp.	40
Cyperus spp.	35
Gahnia sp.	35

Comments

Waterfall carved into bedrock with pool below (approx. 1.5m depth).
Mostly rocky substrate.
Extensive algae and Periphyton coverage.
Downstream end open channel with sandy substrate, eroded banks and mangrove presence.

Site code	S10	Watercourse:	Unnamed waterway	Date:	23/11/21	Latitude:	-14.9569	Longitude:	145.3238

Watercourse Description	
Watercourse Type (river, tributary, wetland)	Unnamed Waterway
Water presence	-
Flow Level (m/s)	None
Macrohabitat (%)	
Riffle (%)	0
Run (%)	0
Pool (rocky) (%)	0
Pool (sandy/silt) (%)	0
Dry (%)	100
Water Quality	
Clear or turbid	Dry
Water Surface	Dry
Water temperature (°C)	Dry
Water Odour	Dry
pH	Dry
Electrical Conductivity (µS/cm)	Dry
Dissolved Oxygen (mg/L)	Dry
Dissolved Oxygen (% Saturation)	Dry
Turbidity (NTU)	Dry
Substratum (%)	
Bedrock	0
Boulders	0
Cobbles	0
Pebbles	0
Gravel	0
Sand	100
Silt / Clay	0
Bed compaction	
Low compaction, poor grading with some packing structure but little substrate overlaps. Substrate can be dislodged easily.	

Microhabitat (%)	
Logs (>15cm Ø)	20
Sticks & branches (<15cm Ø)	10
Detritus (leaves, twigs)	60
Periphyton (fine algae on rocks)	0
Blanketing silt	0
Undercut banks	0
Moss	0
Filamentous algae	0
Aquatic Flora	0
Bank overhang veg.	90
Bank trailing veg.	5
Substrate anoxia	0
Shading	90
Canopy cover	95

Habitat bioassessment		
Habitat variable	**Condition**	**Notes**
Substrate embeddedness	Poor	<10% larger substrate particles or suitable habitat.
Channel alteration	Poor	Larger particles are >75% surrounded by fine sediment.
Bed stability (scouring/deposits)	Fair	30-50% of the bed is affected. Scours at obstructions and bends. Some deposition in pools.
Bank stability (erosion)	Good	Moderately stable; small erosion areas. Side slopes up to 40% on one bank.
Bank vegetation	Excellent	>80% of the banks are covered by vegetation or boulders and cobble.
EVNT species		
Stiphodon semoni — Opal Cling Goby	Unlikely	
Crocodylus porosus – estuarine crocodile	Unlikely	
Pristis zijsron – green sawfish	Unlikely	
Anoxypristis cuspidate – narrow sawfish	Unlikely	
Pristis pristis – largetooth sawfish	Unlikely	

Bank/riparian structure	Left	Right
Bank land use	Native	Native
Bank erosion (%)	0	0
Bare (%)	0	0
Grasses (%)	5	5
Shrubs (%)	5	5
Trees <10m (%)	90	90
Trees >10m (%)	0	0
Exotics (%)	0	0

Aquatic Flora	
Species list	**Position**
None present	

Comments

Very intermittent stream outlet onto beach.
Minimal freshwater values, stream order 1.
Potentially marine values on king tide.

Site code	S11	Watercourse:	Unnamed Waterway	Date:	23/11/21	Latitude:	-14.9567	Longitude:	145.3263

Watercourse Description	
Watercourse Type (river, tributary, wetland)	Unnamed waterway
Water presence	-
Flow Level (m/s)	0
Macrohabitat (%)	
Riffle (%)	0
Run (%)	0
Pool (rocky) (%)	0
Pool (sandy/silt) (%)	0
Dry (%)	100
Water Quality	
Clear or turbid	Dry
Water Surface	Dry
Water temperature (°C)	Dry
Water Odour	Dry
pH	Dry
Electrical Conductivity (µS/cm)	Dry
Dissolved Oxygen (mg/L)	Dry
Dissolved Oxygen (% Saturation)	Dry
Turbidity (NTU)	Dry
Substratum (%)	
Bedrock	0
Boulders	0
Cobbles	0
Pebbles	0
Gravel	0
Sand	100
Silt / Clay	0
Bed compaction	
Packed but not armoured – array of sizes, tightly packed, overlapping and can be dislodged.	

Microhabitat (%)		Habitat bioassessment		
Logs (>15cm Ø)	30	**Habitat variable**	**Condition**	**Notes**
Sticks & branches (<15cm Ø)	10	Substrate embeddedness	Poor	<10% larger substrate particles or suitable habitat.
Detritus (leaves, twigs)	40	Channel alteration	Poor	Larger particles are >75% surrounded by fine sediment.
Periphyton (fine algae on rocks)	0	Bed stability (scouring/deposits)	Fair	30-50% of the bed is affected. Scours at obstructions and bends. Some deposition in pools.
Blanketing silt	0	Bank stability (erosion)	Good	Moderately stable; small erosion areas. Side slopes up to 40% on one bank.
Undercut banks	0	Bank vegetation	Excellent	>80% of the banks are covered by vegetation or boulders and cobble.
Moss	90	**EVNT species**		
Filamentous algae	5	*Stiphodon semoni* — Opal Cling Goby	Unlikely	
Aquatic Flora	0	*Crocodylus porosus* – estuarine crocodile	Unlikely	
Bank overhang veg.	90	*Pristis zijsron* – green sawfish	Unlikely	
Bank trailing veg.	20	*Anoxypristis cuspidate* – narrow sawfish	Unlikely	
Substrate anoxia	0	*Pristis pristis* – largetooth sawfish	Unlikely	
Shading	90			
Canopy cover	80			

Bank/riparian structure	Left	Right	Aquatic Flora	
Bank land use	Native	Native	**Species list**	**Position**
Bank erosion (%)	30	30	None present	
Bare (%)	30	30		
Grasses (%)	5	5		
Shrubs (%)	20	20		
Trees <10m (%)	10	40		
Trees >10m (%)	5	5		
Exotics (%)	0	0		

Comments

Incised, compact sand channel (flat bottomed).
Sedimentation, depth 0.5m, eroded banks, negligible connectivity to the marine environment, minimal freshwater value.

Site code	S12	Watercourse:	Creek	Date:	23/11/21	Latitude:	-14.9549	Longitude:	145.3188

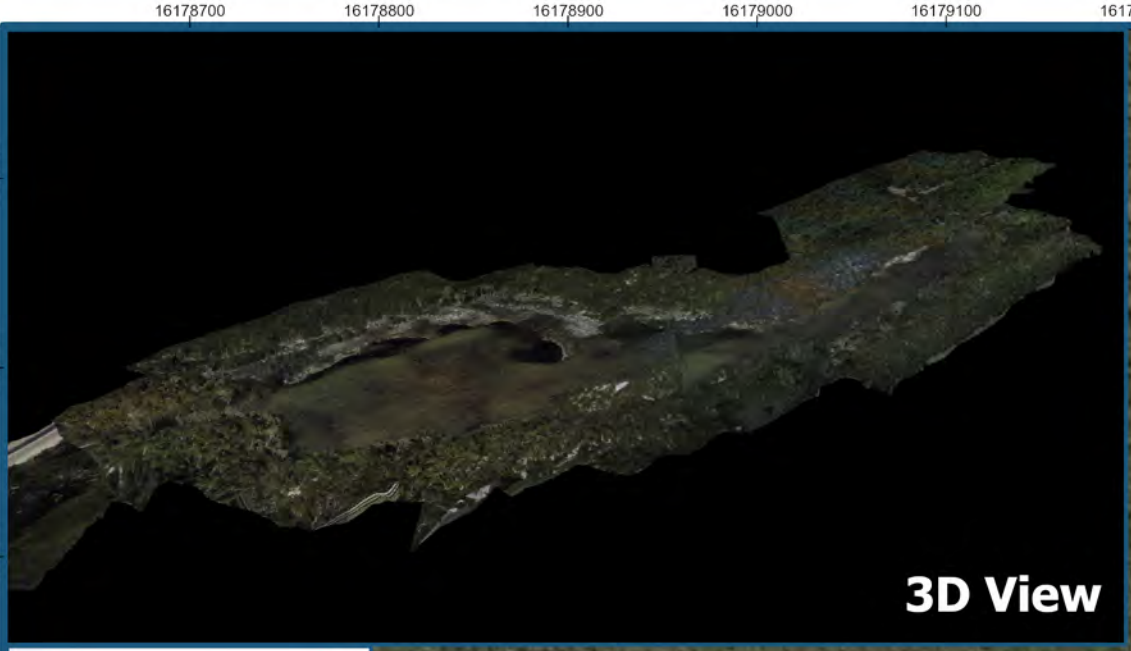
Watercourse Description	
Watercourse Type (river, tributary, wetland)	Creek
Water presence	Dry
Flow Level (m/s)	None
Macrohabitat (%)	
Riffle (%)	0
Run (%)	0
Pool (rocky) (%)	0
Pool (sandy/silt) (%)	0
Dry (%)	100
Water Quality	
Clear or turbid	Dry
Water Surface	Dry
Water temperature (°C)	Dry
Water Odour	Dry
pH	Dry
Electrical Conductivity (µS/cm)	Dry
Dissolved Oxygen (mg/L)	Dry
Dissolved Oxygen (% Saturation)	Dry
Turbidity (NTU)	Dry
Substratum (%)	
Bedrock	0
Boulders	60
Cobbles	10
Pebbles	10
Gravel	5
Sand	15
Silt / Clay	0
Bed compaction	
Tightly packed, armoured – array of sizes, overlapping and can be dislodged.	

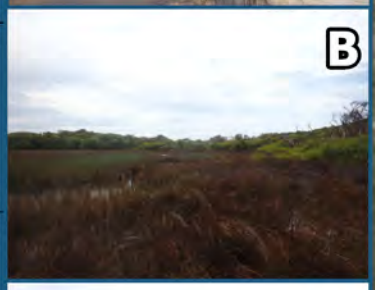
Microhabitat (%)		Habitat bioassessment		
Logs (>15cm Ø)	10	**Habitat variable**	**Condition**	**Notes**
Sticks & branches (<15cm Ø)	10	Substrate embeddedness	Good	30-50% gravel, rubble or another suitable habitat.
Detritus (leaves, twigs)	30	Channel alteration	Fair	Moderate deposition of coarse material on old and new bars. Pools partly filled by silt.
Periphyton (fine algae on rocks)	0	Bed stability (scouring/deposits)	Fair	30-50% of the bed is affected. Scours at obstructions and bends. Some deposition in pools.
Blanketing silt	0	Bank stability (erosion)	Good	Moderately stable; small erosion areas. Side slopes up to 40% on one bank.
Undercut banks	0	Bank vegetation	Good	50-79% of the streambank surfaces covered by vegetation or larger material.
Moss	0	**EVNT species**		
Filamentous algae	0	*Stiphodon semoni* — Opal Cling Goby	Unlikely	
Aquatic Flora	30	*Crocodylus porosus* – estuarine crocodile	Unlikely	
Bank overhang veg.	60	*Pristis zijsron* – green sawfish	Unlikely	
Bank trailing veg.	30	*Anoxypristis cuspidate* – narrow sawfish	Unlikely	
Substrate anoxia	0	*Pristis pristis* – largetooth sawfish	Unlikely	
Shading	70			
Canopy cover	40			

Bank/riparian structure	Left	Right	Aquatic Flora	
Bank land use	Native	Native	**Species list**	**Proportion (%)**
Bank erosion (%)	0	0	*Sporobolus virginicus*	100
Bare (%)	5	5		
Grasses (%)	5	5		
Shrubs (%)	50	50		
Trees <10m (%)	35	35		
Trees >10m (%)	5	5		
Exotics (%)	0	0		

Comments

Highly incised, steep (approx. 20°) rocky channel, likely to have pool at bottom (wet sand present).
Low freshwater value.





Legend

Field Images

Site S1

Site Profiles and associated Imagery

0 30 60 90 120

Meters

Scale: 1:4,000

Projection: Mercator Auxiliary Sphere

Datum: WGS 1984

Grid: WGS 1984 Web Mercator Auxiliary

N

Hydrobiology

Prepared by:	UR
Checked by:	JC
Revision No:	1-0
Publication Date:	16/02/2022
Project No:	B21054

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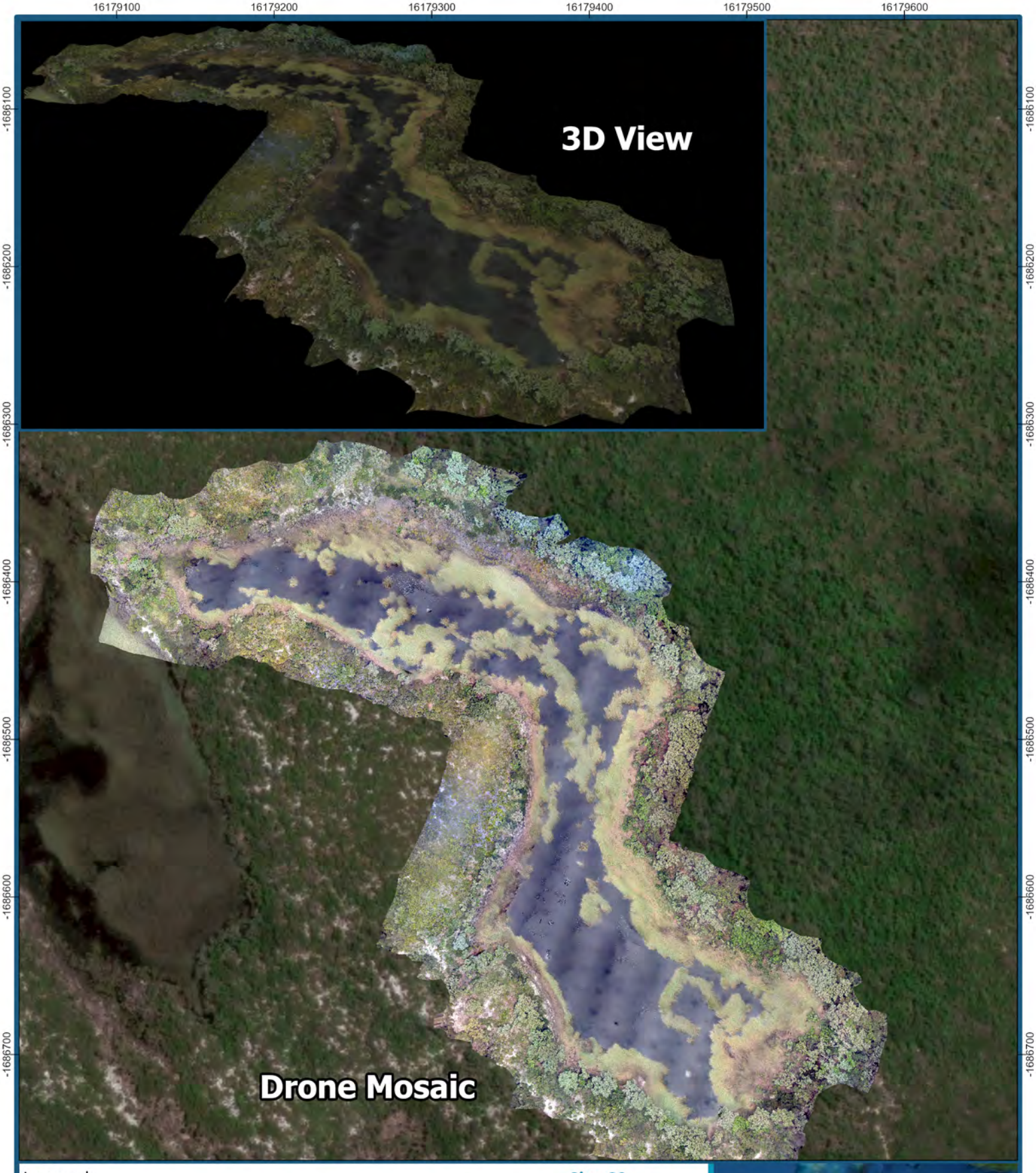

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Site S2

Site Profiles and associated Imagery

0 25 50 75 100

Meters

Scale: 1:3,200

Projection: Mercator Auxiliary Sphere

Datum: WGS 1984

Grid: WGS 1984 Web Mercator Auxiliary

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Hydrobiology

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Checked by:	JC
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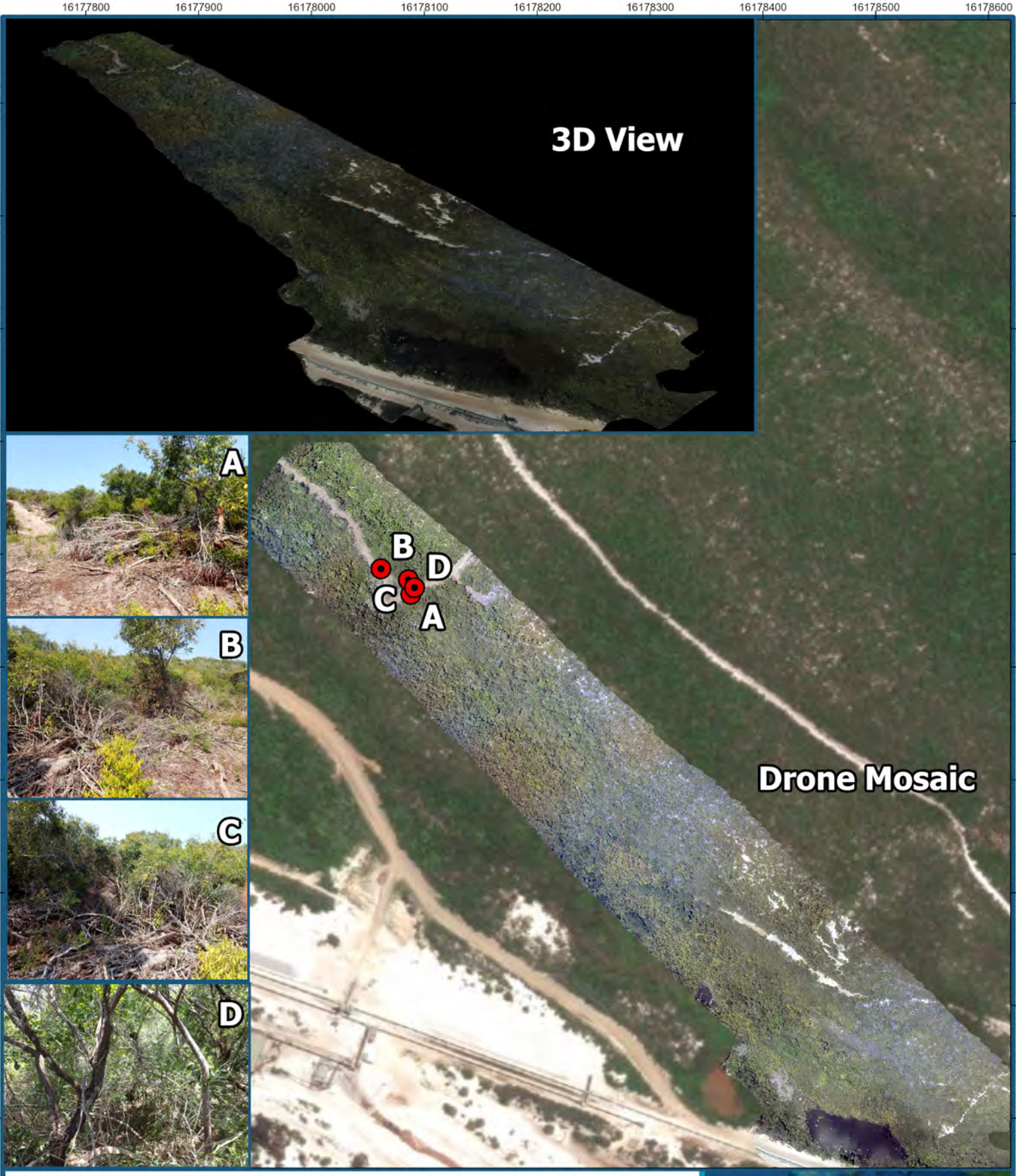

Legend

Field Images

Site S3

Site Profiles and associated Imagery

0 30 60 90 120

Meters

Scale: 1:4,500

Projection: Mercator Auxiliary Sphere

Datum: WGS 1984

Grid: WGS 1984 Web Mercator Auxiliary

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Project No:	B21054

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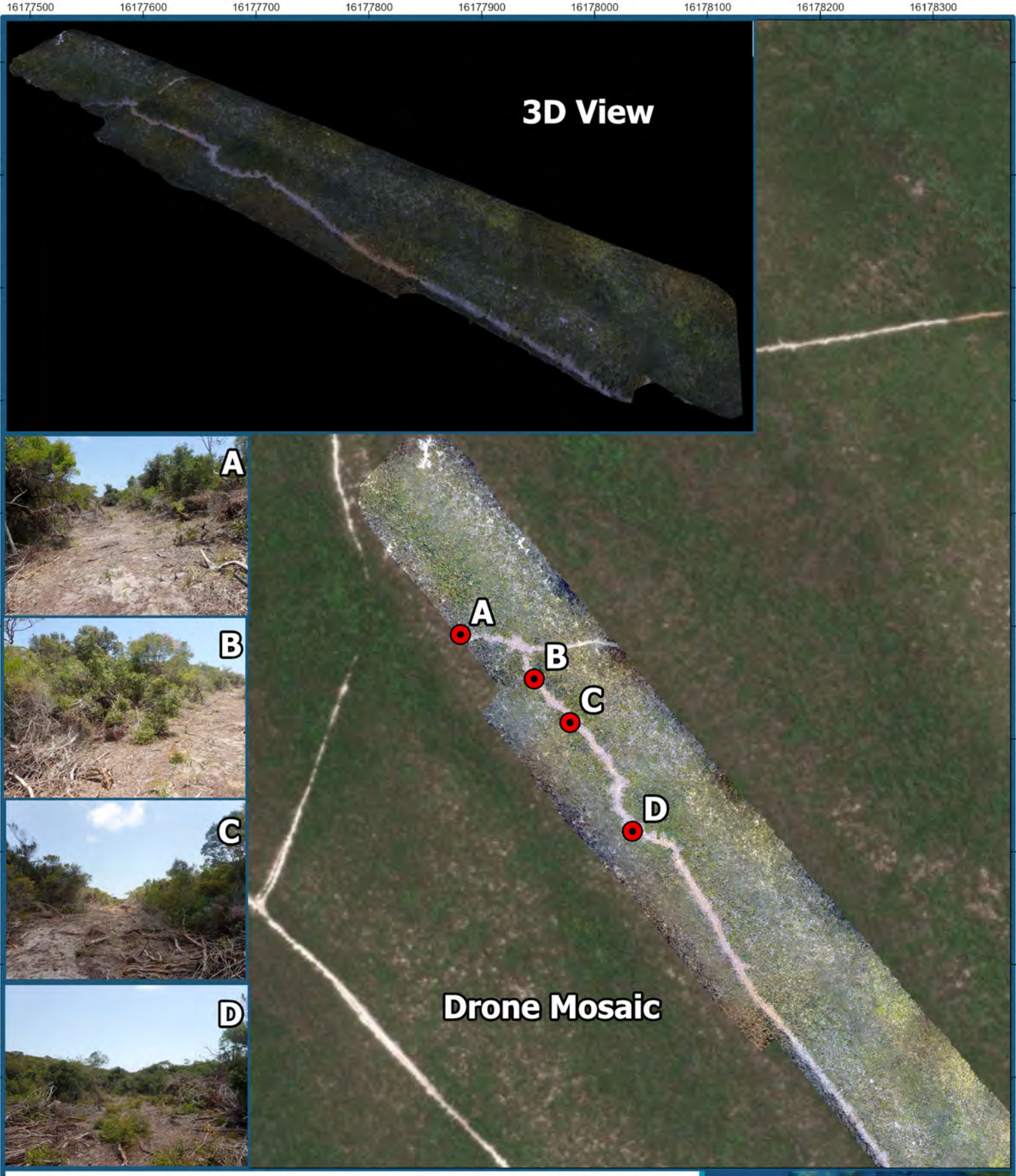

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Field Images

Site S4

Site Profiles and associated Imagery

0 30 60 90 120

Meters

Scale: 1:4,500

Projection: Mercator Auxiliary Sphere

Datum: WGS 1984

Grid: WGS 1984 Web Mercator Auxiliary

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Project No:	B21054

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Earthstar Geographics, Maxar

Legend

Field Images

Site S5

Site Profiles and associated Imagery

0 30 60 90 120

Meters

Scale: 1:4,000

Projection: Mercator Auxiliary Sphere

Datum: WGS 1984

Grid: WGS 1984 Web Mercator Auxiliary

N

Hydrobiology

Prepared by:	UR
Checked by:	SD
Revision No:	1-0
Publication Date:	18/02/2022
Project No:	B

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Legend

Site S6

Site Profiles and associated Imagery

0 40 80 120 160

Meters

Scale: 1:5,500

Projection: Mercator Auxiliary Sphere

Datum: WGS 1984

Grid: WGS 1984 Web Mercator Auxiliary

N

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Project No:	B

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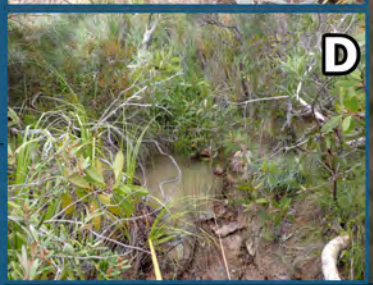
Earthstar Geographics, Maxar



Legend

Field Images

Site S7

Site Profiles and associated Imagery

0 20 40 60 80

Meters

Scale: 1:2,200

Projection: Mercator Auxiliary Sphere

Datum: WGS 1984

Grid: WGS 1984 Web Mercator Auxiliary

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Revision No:	1-0
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Project No:	B21054

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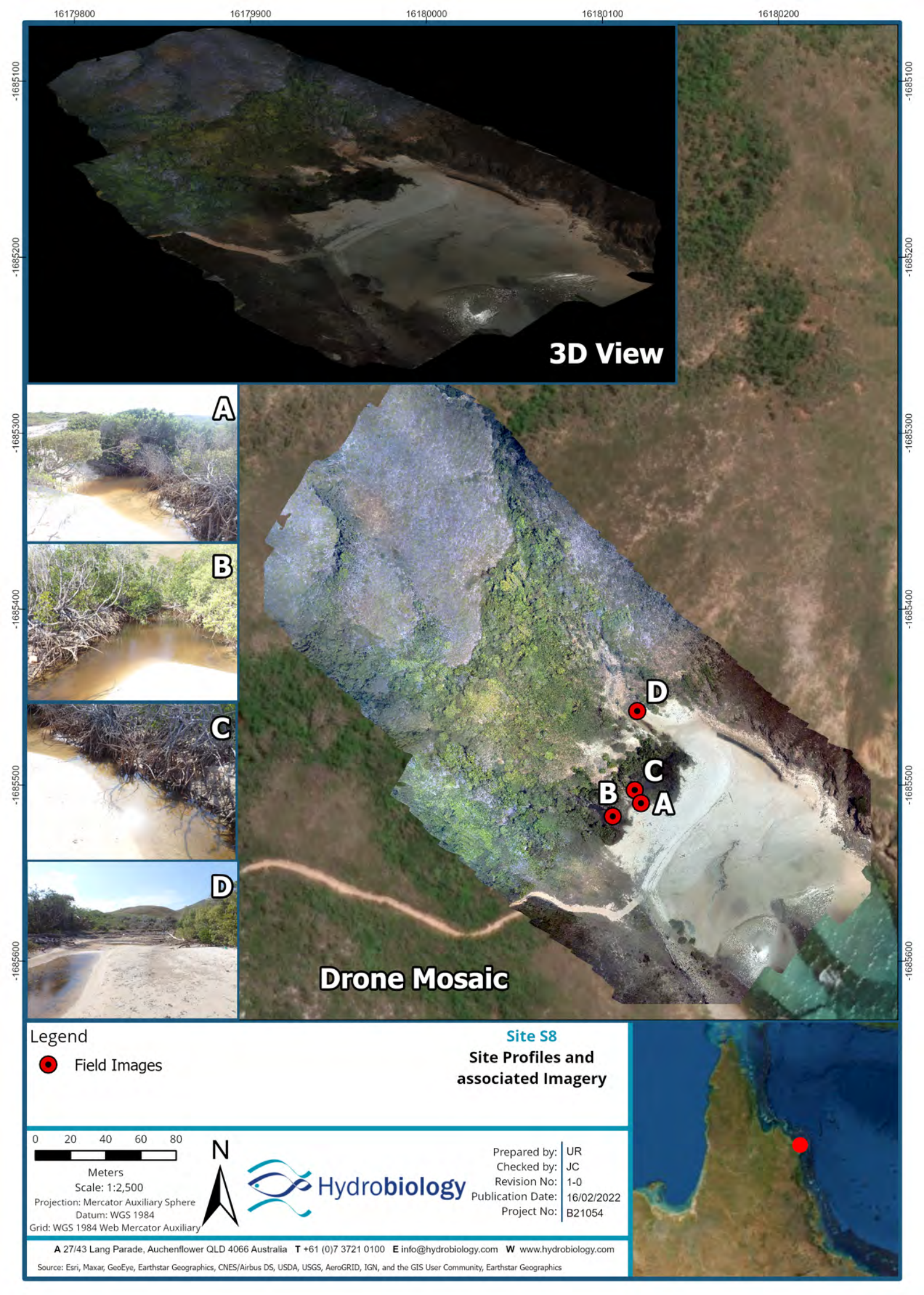

Legend

Field Images

Site S8

Site Profiles and associated Imagery

0 20 40 60 80

Meters

Scale: 1:2,500

Projection: Mercator Auxiliary Sphere

Datum: WGS 1984

Grid: WGS 1984 Web Mercator Auxiliary

N

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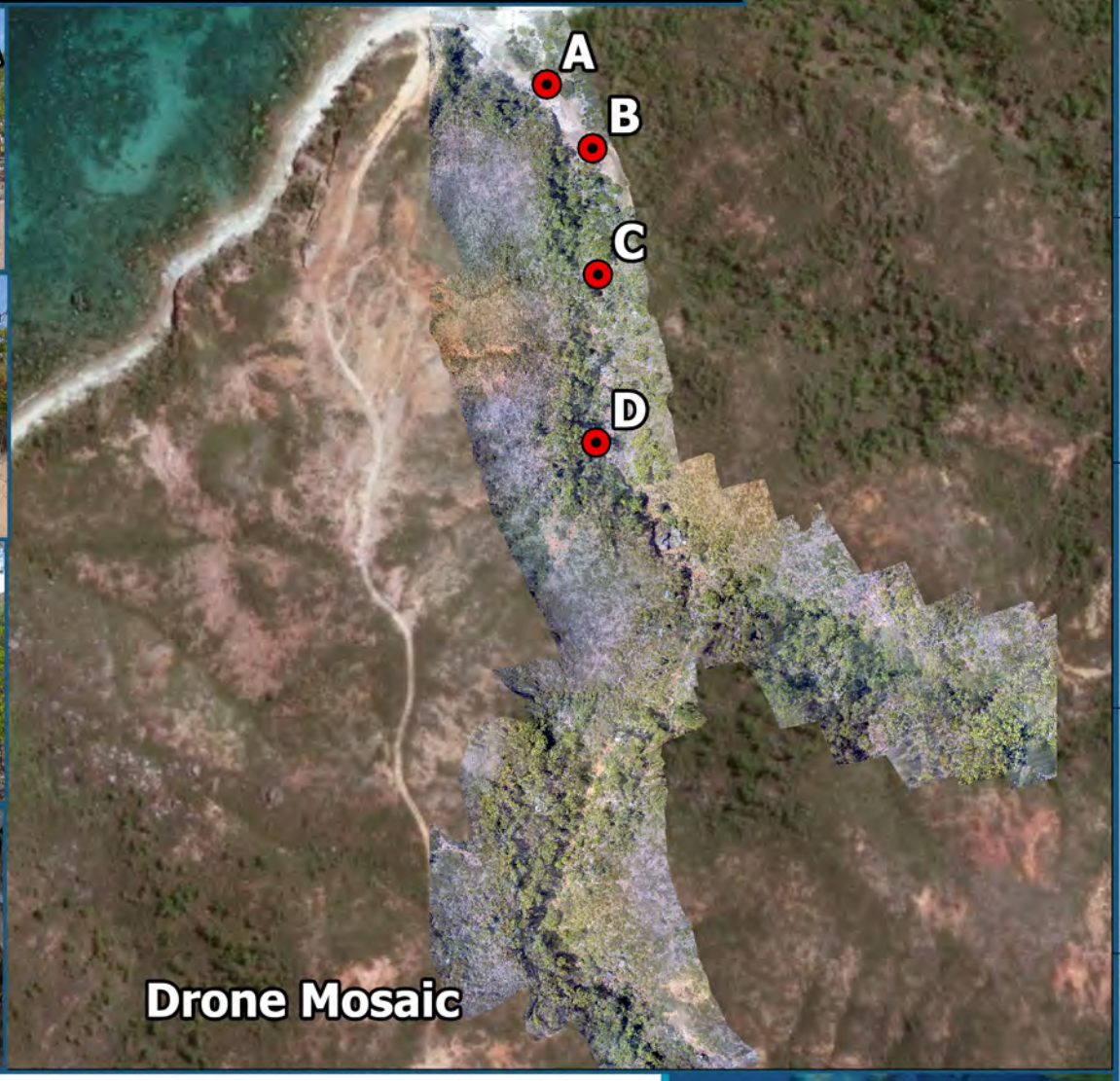

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Field Images

Site S9

Site Profiles and associated Imagery

0 25 50 75 100

Meters

Scale: 1:3,000

Projection: Mercator Auxiliary Sphere

Datum: WGS 1984

Grid: WGS 1984 Web Mercator Auxiliary

N

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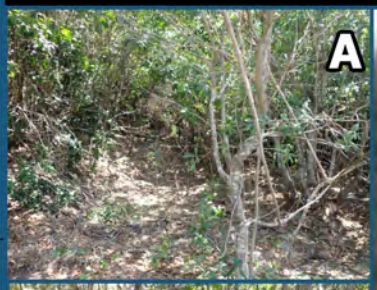
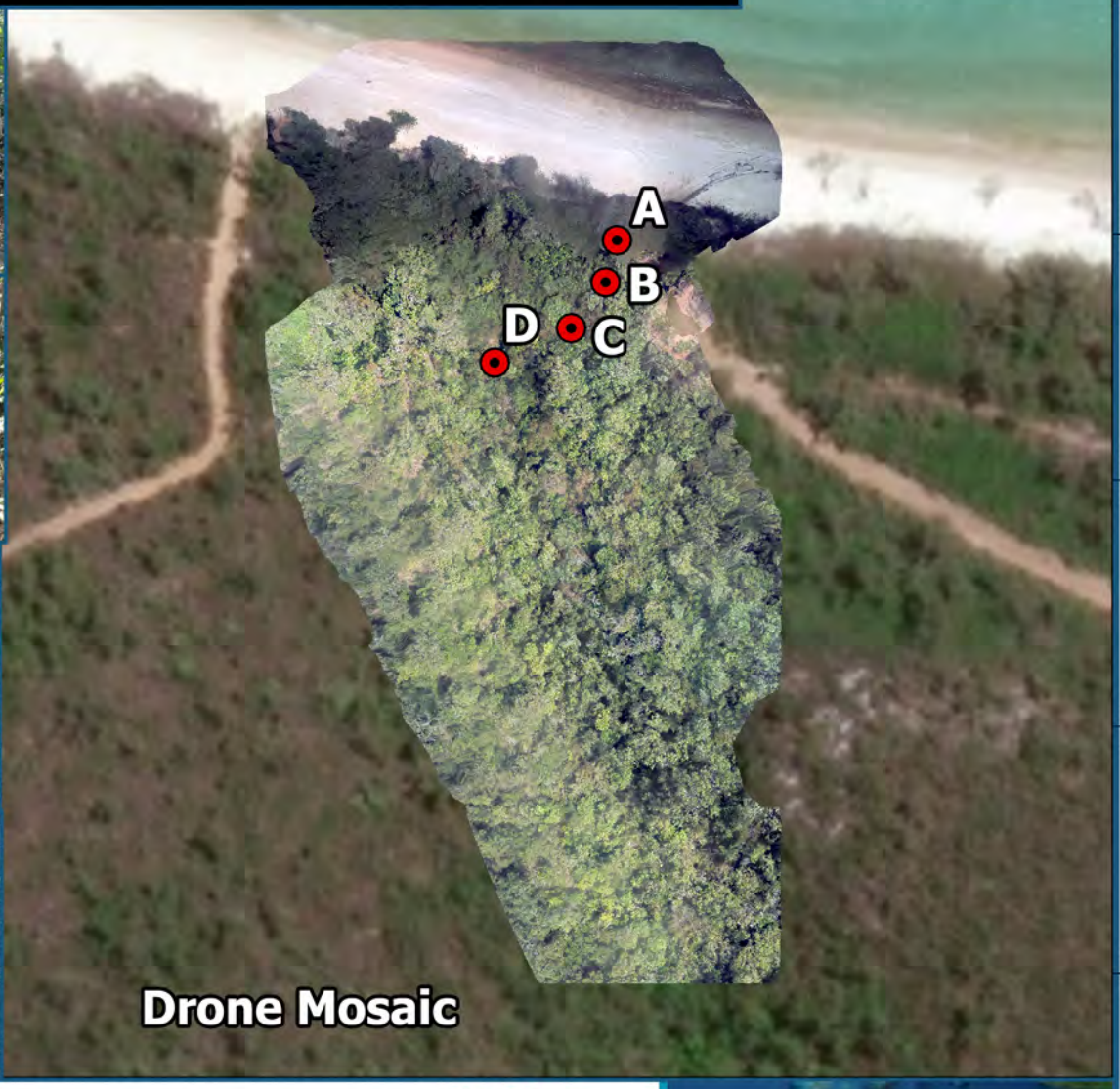
-1684050 -1684100 -1684150 -1684200 -1684250 -1684300 -1684350





Legend

Field Images

Site S10

Site Profiles and associated Imagery

0 10 20 30 40

Meters

Scale: 1:1,500

Projection: Mercator Auxiliary Sphere

Datum: WGS 1984

Grid: WGS 1984 Web Mercator Auxiliary

N

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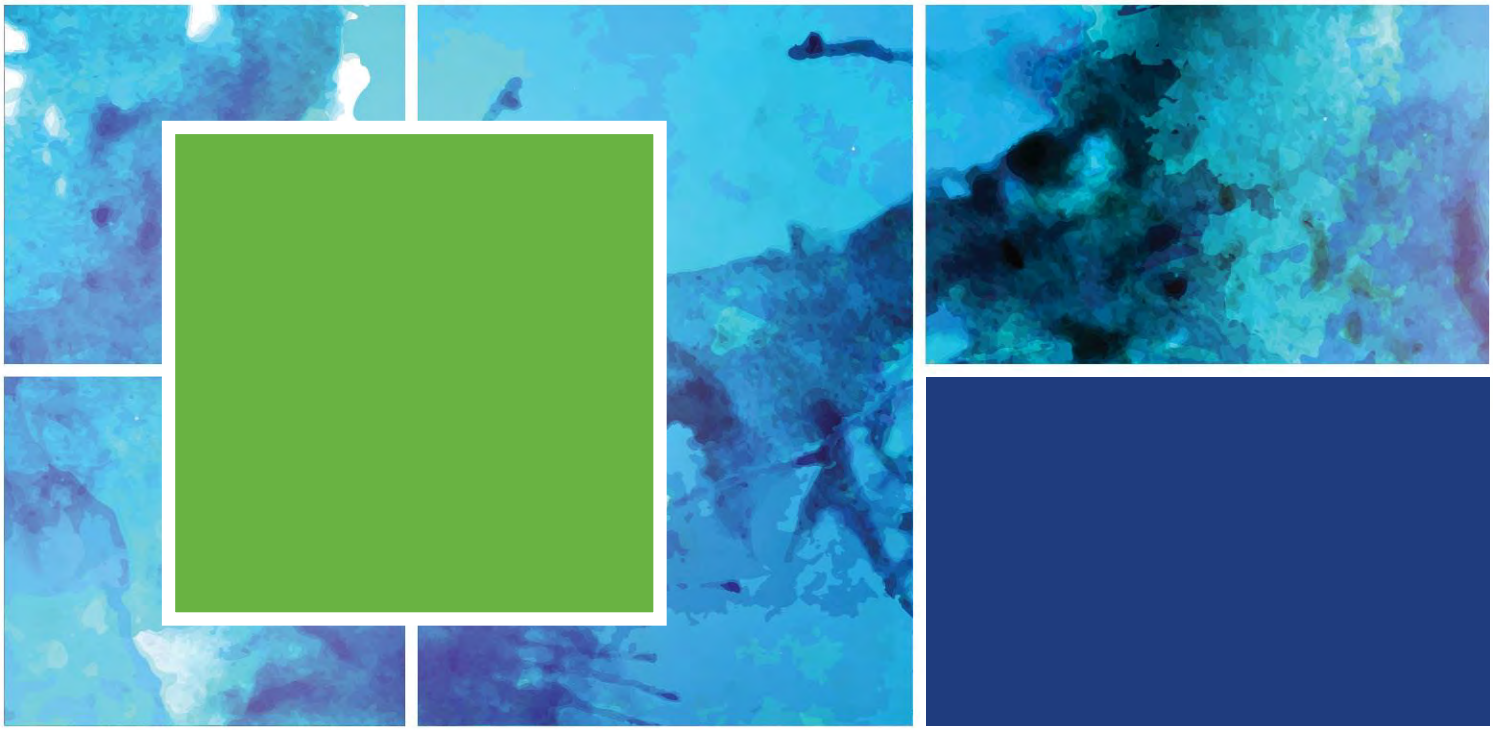
APPENDIX C. DATABASE EXTRACTS



Australian Government

Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

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

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

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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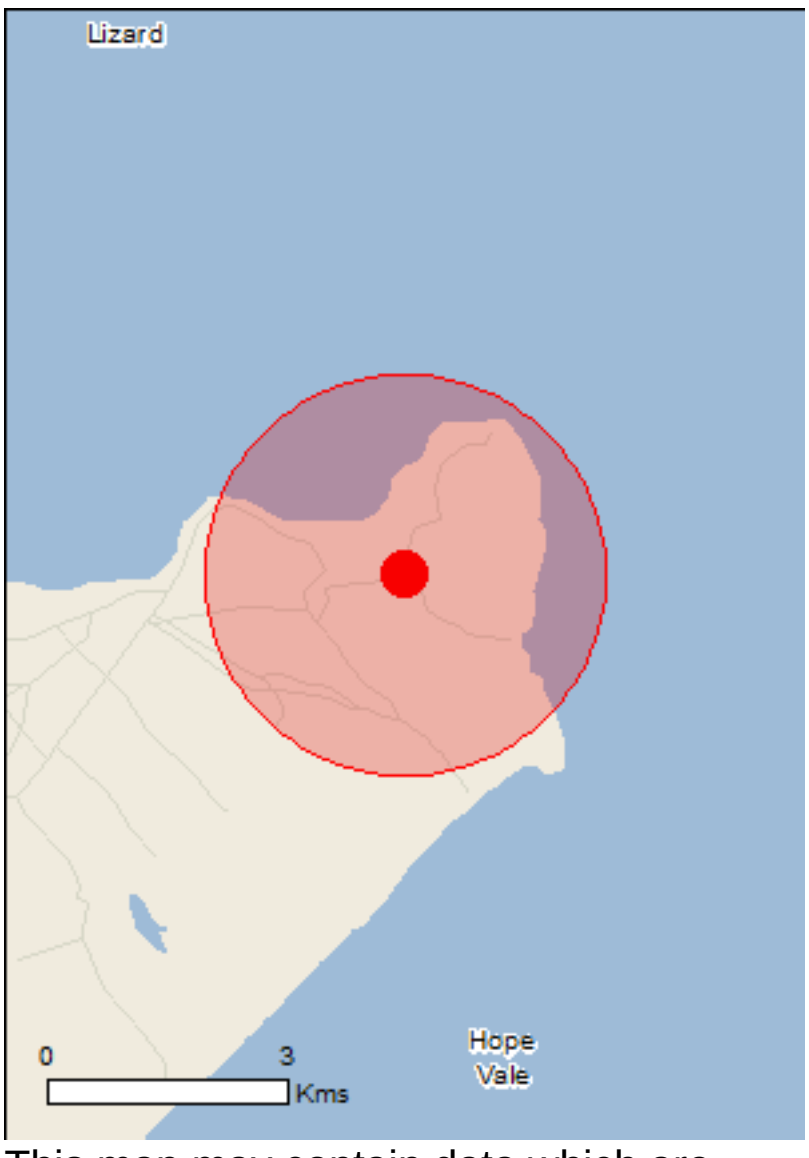

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2015

Coordinates

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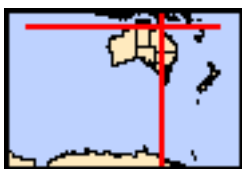


Summary

Matters of National Environmental Significance

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

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	37
Listed Migratory Species:	42

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	49
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	6
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

World Heritage Properties		[Resource Information]
Name	State	Status
Great Barrier Reef	QLD	Declared property

National Heritage Properties		[Resource Information]
Name	State	Status
Natural		
Great Barrier Reef	QLD	Listed place

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Probosciger aterrimus macgillivrayi Palm Cockatoo (Australian) [67033]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Fish		

Name	Status	Type of Presence
Stiphodon semoni		
Opal Cling Goby [83909]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus		
Blue Whale [36]	Endangered	Species or species habitat may occur within area
Dasyurus hallucatus		
Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Hipposideros semoni		
Semon's Leaf-nosed Bat, Greater Wart-nosed Horseshoe-bat [180]	Vulnerable	Species or species habitat may occur within area
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Mesembriomys gouldii rattoides		
Black-footed Tree-rat (north Queensland), Shaggy Rabbit-rat [87620]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Pteropus conspicillatus		
Spectacled Flying-fox [185]	Endangered	Species or species habitat may occur within area
Rhinolophus robertsi		
Large-eared Horseshoe Bat, Greater Large-eared Horseshoe Bat [87639]	Vulnerable	Species or species habitat likely to occur within area
Xeromys myoides		
Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area
Plants		
Dendrobium johannis		
Chocolate Tea Tree Orchid [13585]	Vulnerable	Species or species habitat may occur within area
Eremochloa muricata		
[6469]	Endangered	Species or species habitat known to occur within area
Myrmecodia beccarii		
Ant Plant [11852]	Vulnerable	Species or species habitat likely to occur within area
Phlegmariurus dalhousieanus		
BlueTassel-fern [86550]	Endangered	Species or species habitat likely to occur within area
Vappodes phalaenopsis		
Cooktown Orchid [78894]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Breeding known to occur within area

Name	Status	Type of Presence
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Foraging, feeding or related behaviour known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat likely to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Foraging, feeding or related behaviour known to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat likely to occur within area
Anous stolidus Common Noddy [825]		Foraging, feeding or related behaviour known to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur

Name	Threatened	Type of Presence
		within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Monarcha trivirgatus Spectacled Monarch [610]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area

Name	Threatened	Type of Presence
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Laticauda colubrina a sea krait [1092]		Species or species habitat may occur within area
Laticauda laticaudata a sea krait [1093]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
[Delphinus delphis](#) Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
[Grampus griseus](#) Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
[Megaptera novaeangliae](#) Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
[Orcaella brevirostris](#) Irrawaddy Dolphin [45]		Species or species habitat likely to occur within area
[Orcinus orca](#) Killer Whale, Orca [46]		Species or species habitat may occur within area
[Sousa chinensis](#) Indo-Pacific Humpback Dolphin [50]		Foraging, feeding or related behaviour known to occur within area
[Stenella attenuata](#) Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
[Tursiops aduncus](#) Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
[Tursiops truncatus s. str.](#) Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Plants		
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Reptiles		
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat may occur within area

Nationally Important Wetlands

[Resource Information]

Name	State
Cape Flattery Dune Lakes	QLD

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-14.96141 145.33648

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.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111

Queensland Government

Department of Environment and Science

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest
Longitude: 145.33632 Latitude: -14.96143 with 2 kilometre radius

Environmental Reports - General Information

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

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

Figures in tables may be affected by rounding.

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

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

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

Disclaimer

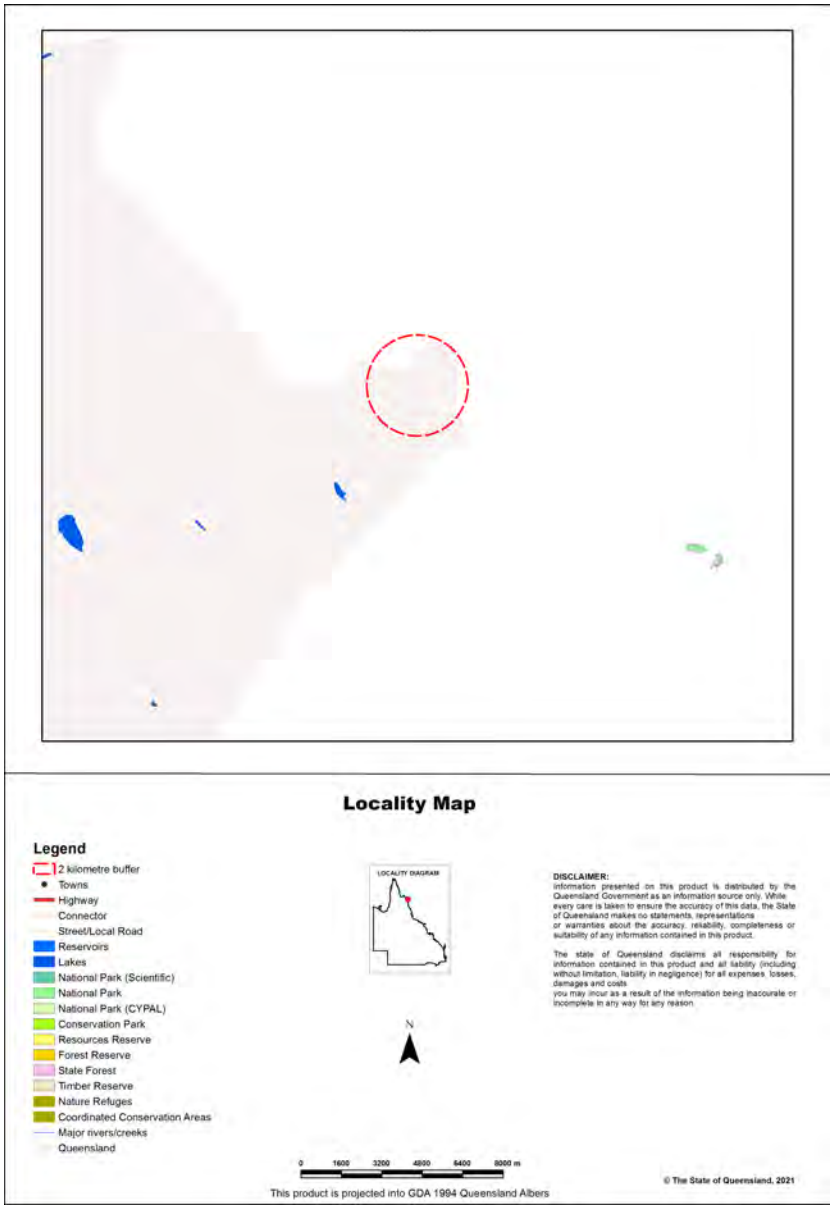
Table of Contents

Assessment Area Details

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

Table 1: Summary table, details for AOI Longitude: 145.33632 Latitude: -14.96143

Size (ha)	1,256.55
Local Government(s)	Cook Shire, Hope Vale Aboriginal Shire
Bioregion(s)	Cape York Peninsula
Subregion(s)	Starke Coastal Lowlands
Catchment(s)	Jeannie



Matters of State Environmental Significance (MSES)

MSES Categories

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

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

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

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992* ;

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the *Marine Parks Act 2004* ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- Threatened wildlife under the *Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

    • Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;

    • Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;

    • Category R areas on the regulated vegetation management map;

    • Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;

    • Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;

- Legally secured offset areas.

MSES Values Present

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

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0.0 ha	0.0 %
1b Protected Areas- nature refuges	0.0 ha	0.0 %
1c Protected Areas- special wildlife reserves	0.0 ha	0.0 %
2 State Marine Parks- highly protected zones	0.0 ha	0.0 %
3 Fish habitat areas (A and B areas)	0.0 ha	0.0 %
4 Strategic Environmental Areas (SEA)	0.0 ha	0.0 %
5 High Ecological Significance wetlands on the map of Referable Wetlands	5.92 ha	0.5%
6a High Ecological Value (HEV) wetlands	0.0 ha	0.0 %
6b High Ecological Value (HEV) waterways **	0.0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	302.55 ha	24.1%
7b Special least concern animals	0.0 ha	0.0 %
7c i Koala habitat area - core (SEQ)	0.0 ha	0.0 %
7c ii Koala habitat area - locally refined (SEQ)	0.0 ha	0.0 %
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	148.11 ha	11.8%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	0.0 ha	0.0 %
8c Regulated Vegetation - Category R (GBR riverine regrowth)	1.27 ha	0.1%
8d Regulated Vegetation - Essential habitat	0.29 ha	0.0%
8e Regulated Vegetation - intersecting a watercourse **	16.3 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	29.27 ha	2.3%
9a Legally secured offset areas- offset register areas	0.0 ha	0.0 %
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0.0 ha	0.0 %

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(no results)

1b. Protected Areas - nature refuges

(no results)

1c. Protected Areas - special wildlife reserves

(no results)

2. State Marine Parks - highly protected zones

(no results)

3. Fish habitat areas (A and B areas)

(no results)

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

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(no results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

Natural wetlands that are 'High Ecological Significance' (HES) on the Map of Queensland Wetland Environmental Values are present.

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

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

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Values are present

7b. Special least concern animals

Not applicable

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
Boronia keysii		V	None
Calyptorhynchus lathami	Glossy black cockatoo	V	None
Casuarius casuarius johnsonii	Sthn population cassowary	E	None
Crinia tinnula	Wallum froglet	V	None
Denisonia maculata	Ornamental snake	V	None
Litoria freycineti	Wallum rocketfrog	V	None
Litoria olongburensis	Wallum sedgefrog	V	None
Melaleuca irbyana		E	None
Petaurus gracilis	Mahogany Glider	E	None
Petrogale persephone	Proserpine rock-wallaby	E	None
Phascolarctos cinereus	Koala - outside SEQ*	V	None
Pezoporus wallicus wallicus	Eastern ground parrot	V	None
Taudactylus pleione	Kroombit tinkerfrog	E	None
Xeromys myoides	Water Mouse	V	None

**For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.*

Threatened (endangered or vulnerable) wildlife species records

Scientific name	Common name	NCA status	EPBC status	Migratory status
Dermochelys coriacea	leatherback turtle	E	E	M-B/E
Ctenotus rawlinsoni	Cape heath ctenotus	V		
Crocodylus porosus	estuarine crocodile	V		M-B/E

Special least concern animal species records

(no results)

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

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:
https://www.qld.gov.au/environment/plants-animals/species-list/

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/
For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:
https://environment.ehp.qld.gov.au/regional-ecosystems/

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

Regional ecosystem	Vegetation management polygon	Vegetation management status
3.2.21a/3.2.26/3.2.22	O-subdom	rem_oc
3.11.21/3.11.19b/3.11.19a	O-dom	rem_oc

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

Not applicable

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

Regulated vegetation map category	Map number	RVM rule
R	7968	None

8d. Regulated Vegetation - Essential habitat

Values are present

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

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

Regulated vegetation map category	Map number	RVM rule
B	7968	None
R	7968	None

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

MSES - Offsets

9a. Legally secured offset areas - offset register areas

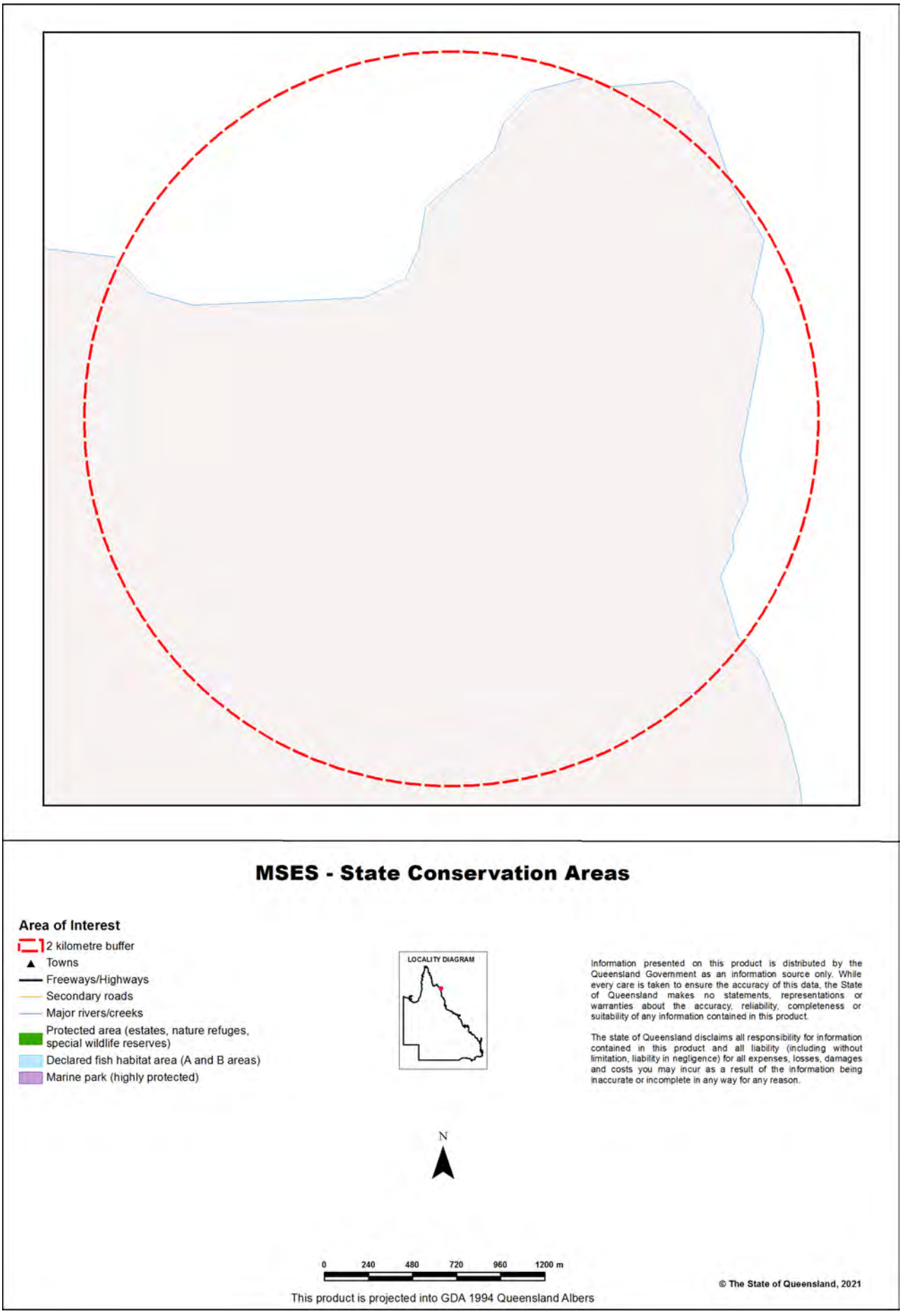
(no results)

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

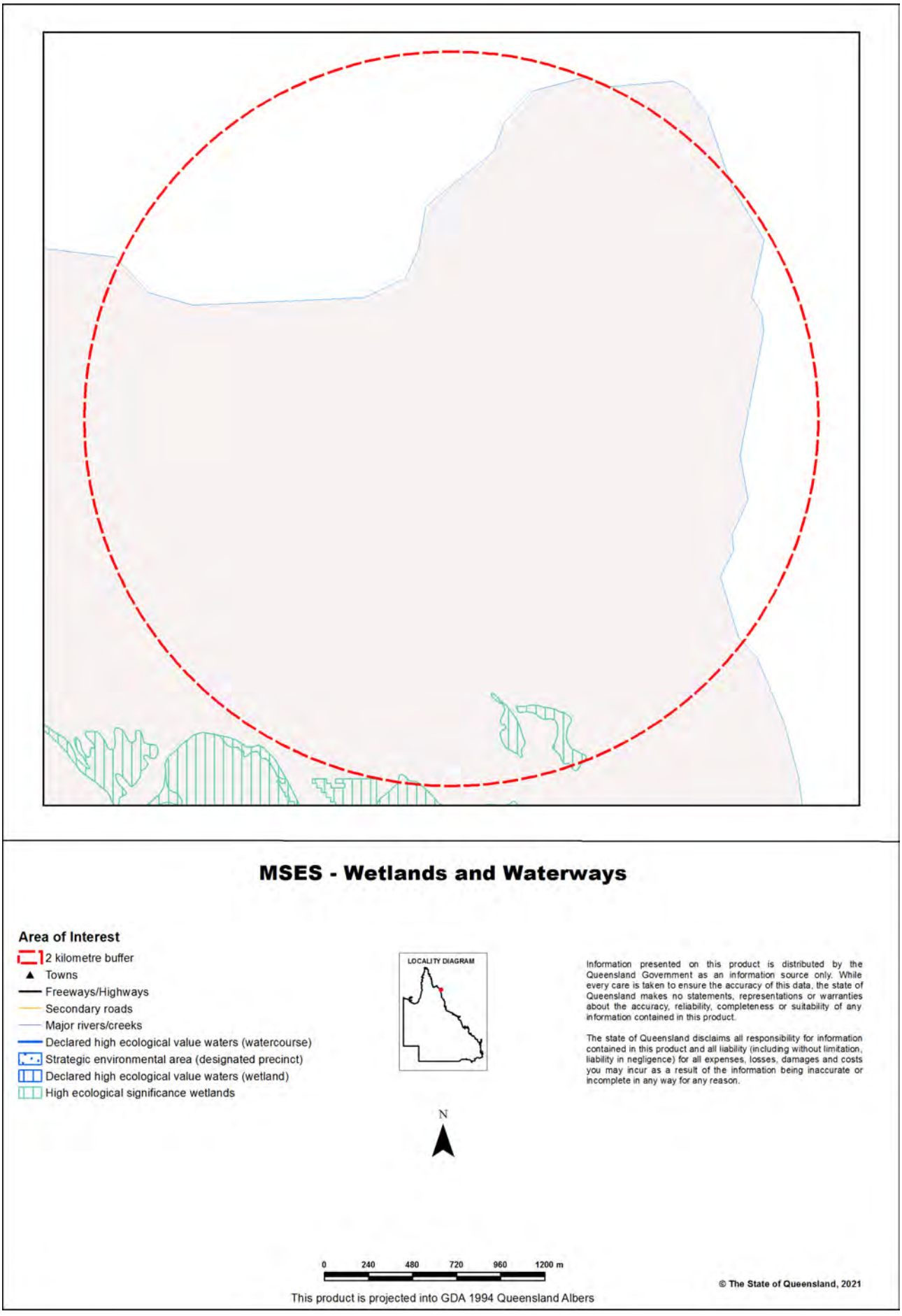
(no results)

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

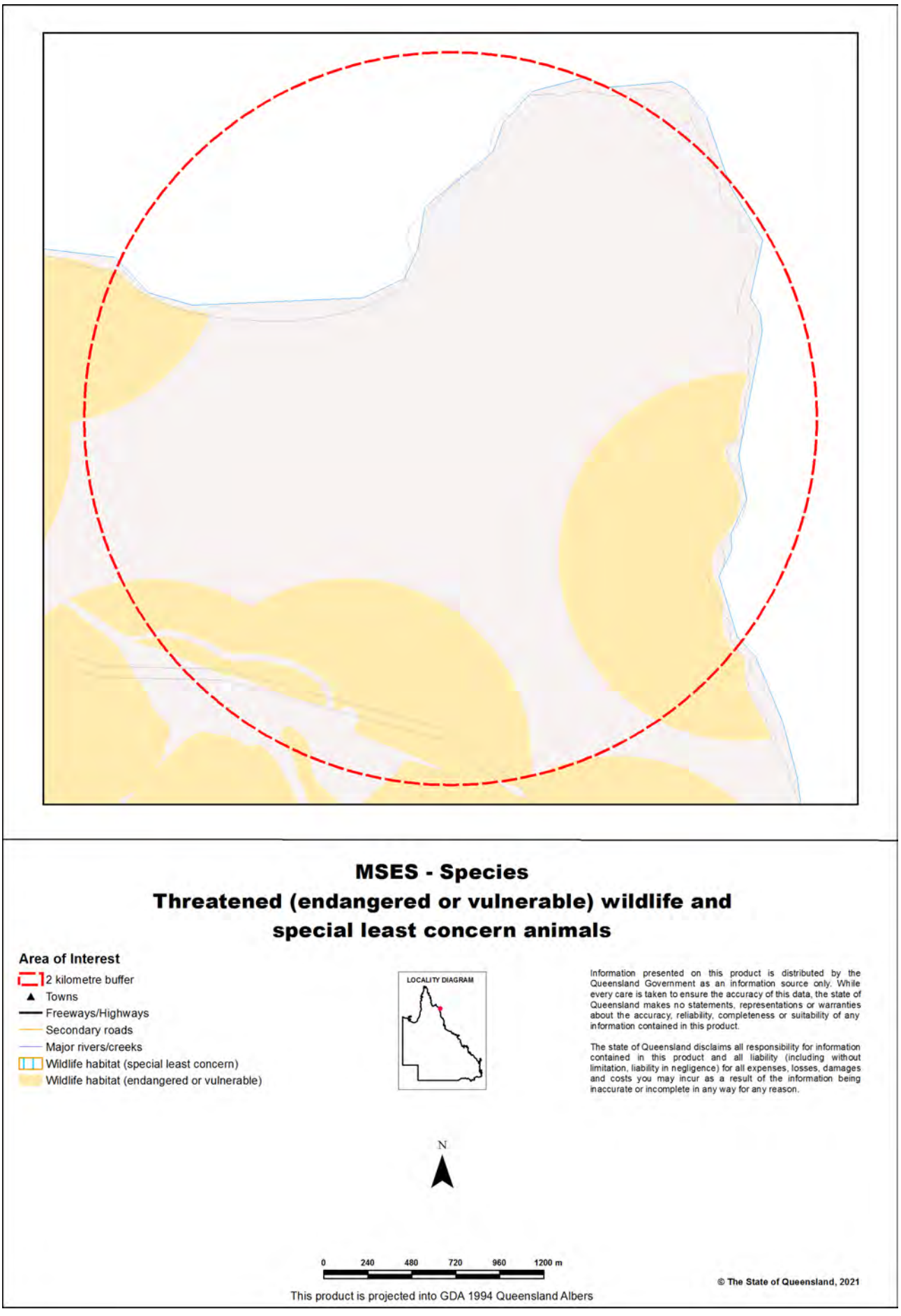
Map 1 - MSES - State Conservation Areas



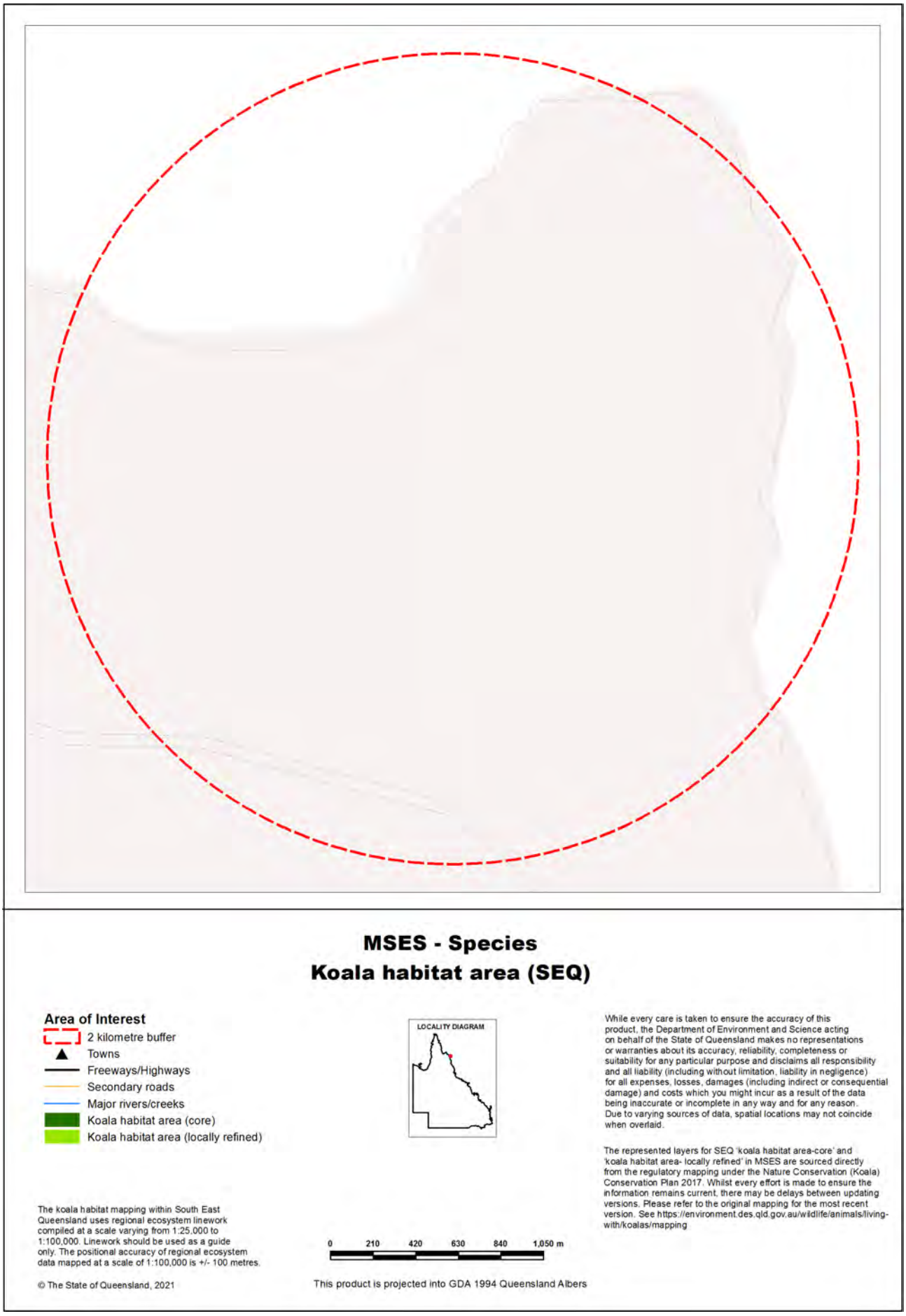
Map 2 - MSES - Wetlands and Waterways



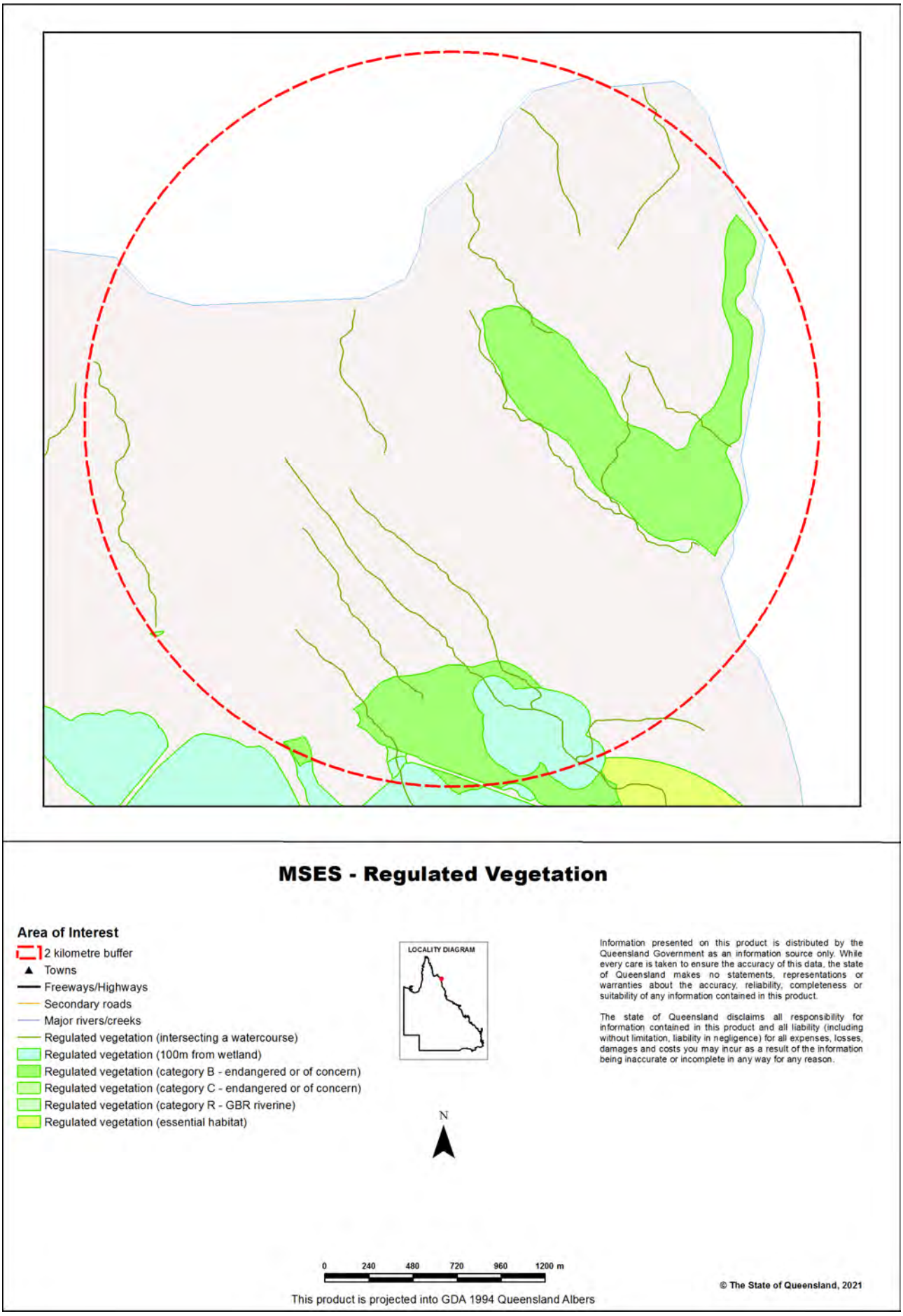
Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



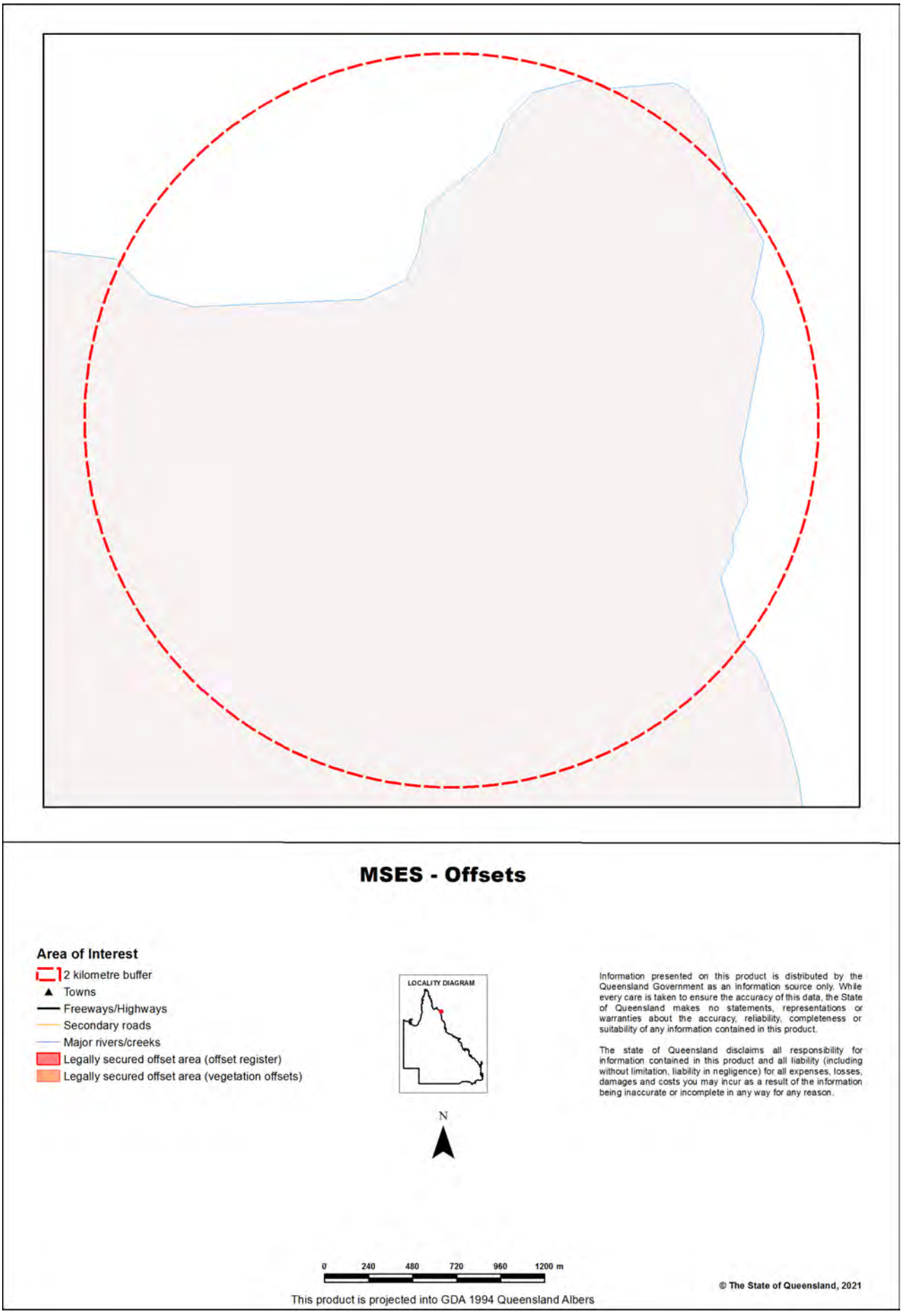
Map 3b - MSES - Species - Koala habitat area (SEQ)



Map 4 - MSES - Regulated Vegetation



Map 5 - MSES - Offset Areas



Appendices

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

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

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

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

Appendix 2 - Source Data

The datasets listed below are available on request from:

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

- Matters of State environmental significance

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

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

MSES layers	**current QSpatial data (http://qspatial.information.qld.gov.au)**
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	-WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DES
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

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

Queensland Government

Department of Environment and Science

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
Longitude: 145.33632 Latitude: -14.96143 with 2 kilometre radius

Environmental Reports - General Information

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

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

Figures in tables may be affected by rounding.

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

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

Important Note to User

Information presented in this report is based upon the Queensland Herbarium's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Resources website https://www.dnrme.qld.gov.au/

Please direct queries about these reports to: Queensland.Herbarium@qld.gov.au

Disclaimer

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

Table of Contents

Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Area of interest details: Longitude: 145.33632 Latitude: -14.96143 with 2 kilometre radius

Size (ha)	1,256.55
Local Government(s)	Cook Shire, Hope Vale Aboriginal Shire
Bioregion(s)	Cape York Peninsula
Subregion(s)	Starke Coastal Lowlands
Catchment(s)	Jeannie

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.0	0.0
Of concern	93.21	7.42
No concern at present	844.05	67.17
Total remnant vegetation	937.26	74.59

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

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and are usually distinguished by differences in dominant species, frequently in the shrub or ground layers and are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2020) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Resources website.

https://www.dnrme.qld.gov.au/

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 per cent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (1000 ha); or patch size (100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

*****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.*

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
3.10.19	Asteromyrtus lysicephala and Neofabricia myrtifolia dwarf open heath or Schizachyrium pachyarthron closed tussock grassland on sandstone plateaus and headlands	No concern at present	114.62	9.12
3.10.6x4	Eucalyptus tetrodonta +/- Corymbia stockeri subsp. stockeri woodland on sandstone plateaus	No concern at present	104.32	8.3
3.11.19a	Themeda triandra closed tussock grassland or Asteromyrtus lysicephala, Neofabricia myrtifolia, Grevillea pteridifolia dwarf open heathlands on headlands and islands	Of concern	17.42	1.39
3.11.19b	Themeda triandra closed tussock grassland or Asteromyrtus lysicephala, Neofabricia myrtifolia, Grevillea pteridifolia dwarf open heathlands on headlands and islands	Of concern	34.85	2.77
3.11.21	Deciduous vine thicket on metamorphic slopes	Of concern	34.85	2.77
3.2.10	Eucalyptus tetrodonta and Corymbia clarksoniana +/- E. brassiana or Erythrophleum chlorostachys woodland on stabilised dunes	No concern at present	138.31	11.01
3.2.12b	Acacia crassicarpa, Syzygium banksii low closed forest +/- emergent Araucaria cunninghamii var. cunninghamii on coastal dunefields and beach ridges	No concern at present	24.38	1.94
3.2.18	Thryptomene oligandra open heath +/- Asteromytrtus lysicephala on flat sand plains	No concern at present	0.18	0.01
3.2.21a	Neofabricia myrtifolia +/- Jacksonia thesioides open to closed heath on dunefields	No concern at present	449.98	35.81
3.2.22	Mixed dwarf open heath on dunes and headlands	Of concern	6.1	0.49
3.2.26	Sparse herbland and/or shrubland and bare sand areas predominantly on sand blows	No concern at present	12.2	0.97
3.2.3	Melaleuca dealbata or Lophostemon suaveolens open forest in dune swales	No concern at present	0.06	less than 0.01
non-remnant	None	None	31.73	2.53

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification,

whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
3.10.19	Pre-clearing 11000 ha; Remnant 2019 11000 ha	29a	None	High
3.10.6x4	Pre-clearing 396000 ha; Remnant 2019 396000 ha	14d	None	High
3.11.19a	Pre-clearing 1000 ha; Remnant 2019 1000 ha	29a	None	High
3.11.19b	Pre-clearing 1000 ha; Remnant 2019 1000 ha	29a	None	High
3.11.21	Pre-clearing 5000 ha; Remnant 2019 5000 ha	7b	None	High
3.2.10	Pre-clearing 36000 ha; Remnant 2019 36000 ha	14b	None	High
3.2.12b	Pre-clearing 24000 ha; Remnant 2019 24000 ha	3a	None	High
3.2.18	Pre-clearing 52000 ha; Remnant 2019 52000 ha	29a	Contains palustrine wetland (e.g. in swales).	High
3.2.21a	Pre-clearing 58000 ha; Remnant 2019 58000 ha	29a	None	High
3.2.22	Pre-clearing 4000 ha; Remnant 2019 4000 ha	29a	None	High
3.2.26	Pre-clearing 14000 ha; Remnant 2019 14000 ha	28d	None	High
3.2.3	Pre-clearing 17000 ha; Remnant 2019 17000 ha	22b	Palustrine wetland (e.g. vegetated swamp).	Low
non-remnant	None	None	None	None

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
3.10.19	Potential habitat for NCA listed species: Lepturus geminatus
3.10.6x4	Potential habitat for NCA listed species: Acacia guymeri, Cucumis costatus, Dianella incollata, Gardenia psidioides, Homoranthus tropicus, Stemona angusta, Stenanthemum argenteum, Syzygium rubrimolle
3.11.19a	None
3.11.19b	None
3.11.21	Potential habitat for NCA listed species: Dockrillia wassellii

Regional Ecosystem	Special Values
3.2.10	None
3.2.12b	High numbers of endemic plant species. The vulnerable plant species Cycas silvestris and near threatened species Xanthostemon arenarius occur in this ecosystem.
3.2.18	Potential habitat for NCA listed species: Acacia solenota, Dendrobium bigibbum, Habenaria xanthantha
3.2.21a	Potential habitat for NCA listed species: Acacia solenota, Dendrobium bigibbum, Dendrobium johannis, Dockrillia wassellii, Stackhousia sp. (McIvor River J.R.Clarkson 5201)
3.2.22	Potential habitat for NCA listed species: Dendrobium bigibbum
3.2.26	Potential habitat for NCA listed species: Dendrobium bigibbum, Dendrobium johannis
3.2.3	None
non-remnant	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at:

https://publications.qld.gov.au/dataset/redd/resource/

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
None	None	31.73	2.53
14b	Woodlands dominated by Eucalyptus tetrodonta (Darwin stringybark) (or E. megasepala (Melville Island bloodwood)) or E. chartaboma (or E. miniata (Darwin woollybutt)), with Corymbia clarksoniana (grey bloodwood) on erosional surfaces, residual sands and occasionally alluvial plains. (land zones 5, 3, 7, 10, 2) (CYP, GUP, EIU, NWH, [DEU])	138.31	11.01
14d	Woodlands dominated by Corymbia stockeri (or C. hylandii) and Eucalyptus megasepala (or E. tetrodonta (Darwin stringybark)) on sandstone, metamorphic and ironstone ranges. (land zones 10, 11, 12, 7) (CYP, GUP, EIU, [DEU])	104.32	8.3
22b	Open forests and low open forests dominated by Melaleuca spp. (M. saligna, M. leucadendra (broad-leaved tea-tree), M. clarksonii or M. arcana (winti) in seasonally inundated swamps. (land zones 2, 3, 1) (CYP, GUP, CQC, WET, [DEU, BRB])	0.06	less than 0.01
28d	Sand blows to closed herblands of Lepturus repens (stalky grass) and herbs on sand cays and shingle cays. (land zone 2) (CYP, SEQ, [CQC])	12.2	0.97
29a	Open heaths and dwarf open heaths on coastal dunefields, sandplains and headlands. (land zones 5, 2, 3, [7, 10, 12, 11]) (CYP, SEQ, [WET])	623.15	49.59

BVG (1 Million)	Description	Area (Ha)	% of AOI
3a	Evergreen to semi-deciduous, notophyll to microphyll vine forest/ thicket on beach ridges and coastal dunes, occasionally Araucaria cunninghamii (hoop pine) microphyll vine forest on dunes. Pisonia grandis on coral cays. (land zone 2, [5]) (CYP, GUP, SEQ, WET, BRB, CQC) (Tracey 1982 2b)	24.38	1.94
7b	Deciduous microphyll vine thicket on ranges and heavy clay alluvia in northern bioregions. (land zones 3, 12, 11, 10, 7) (CYP, WET)	34.85	2.77

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

The descriptions are compiled using site survey data from the Queensland Herbarium's CORVEG database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the *Vegetation Management Act 1999*. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2020 (PDF))* section 3.3 of:

https://publications.qld.gov.au/dataset/redd/resource/

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community.

http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

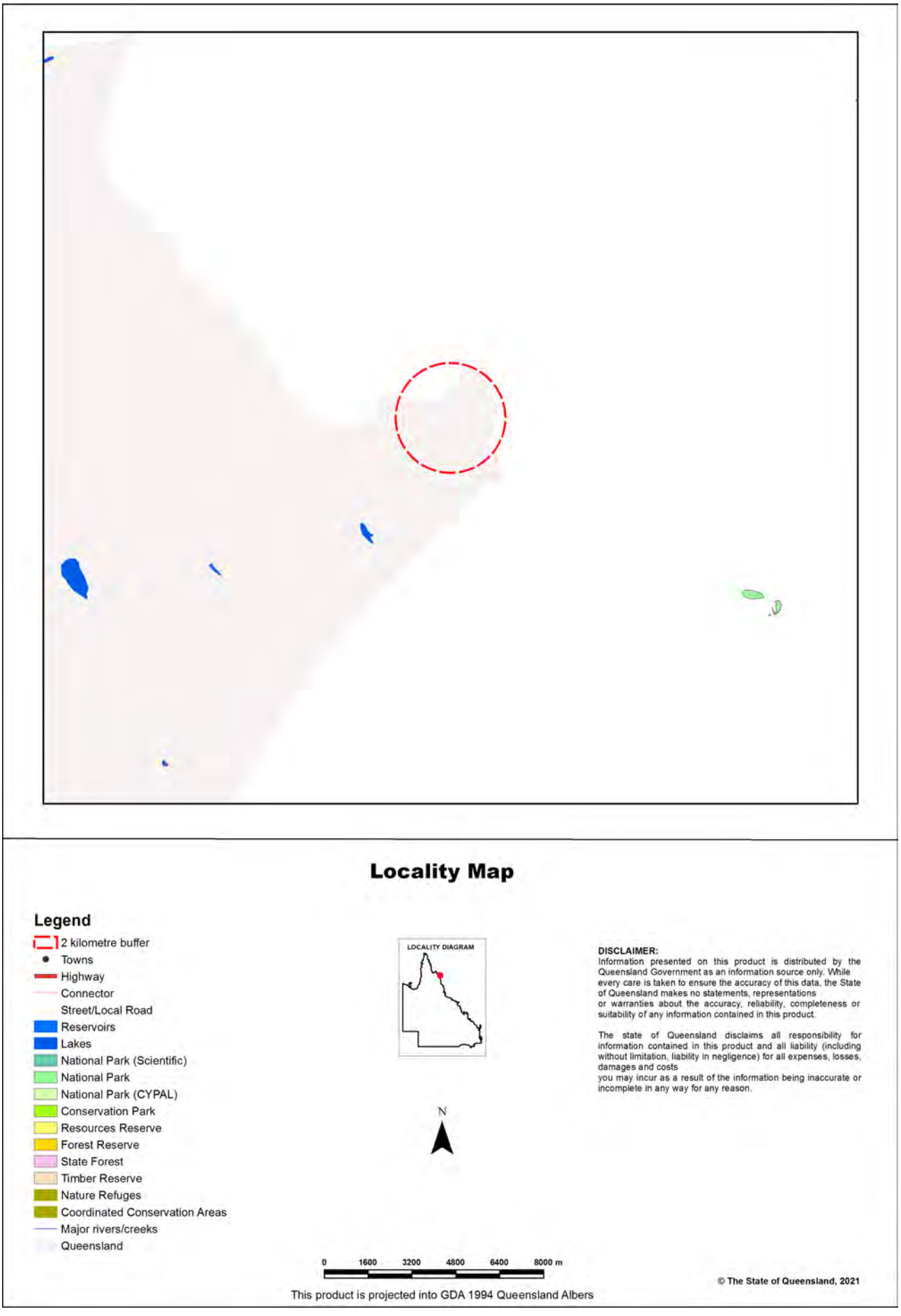
Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
3.10.19	Not currently available	Not currently available
3.10.6x4	Not currently available	Not currently available
3.11.19a	Not currently available	Not currently available
3.11.19b	Not currently available	Not currently available
3.11.21	Not currently available	Not currently available
3.2.10	Not currently available	Not currently available
3.2.12b	Not currently available	Not currently available

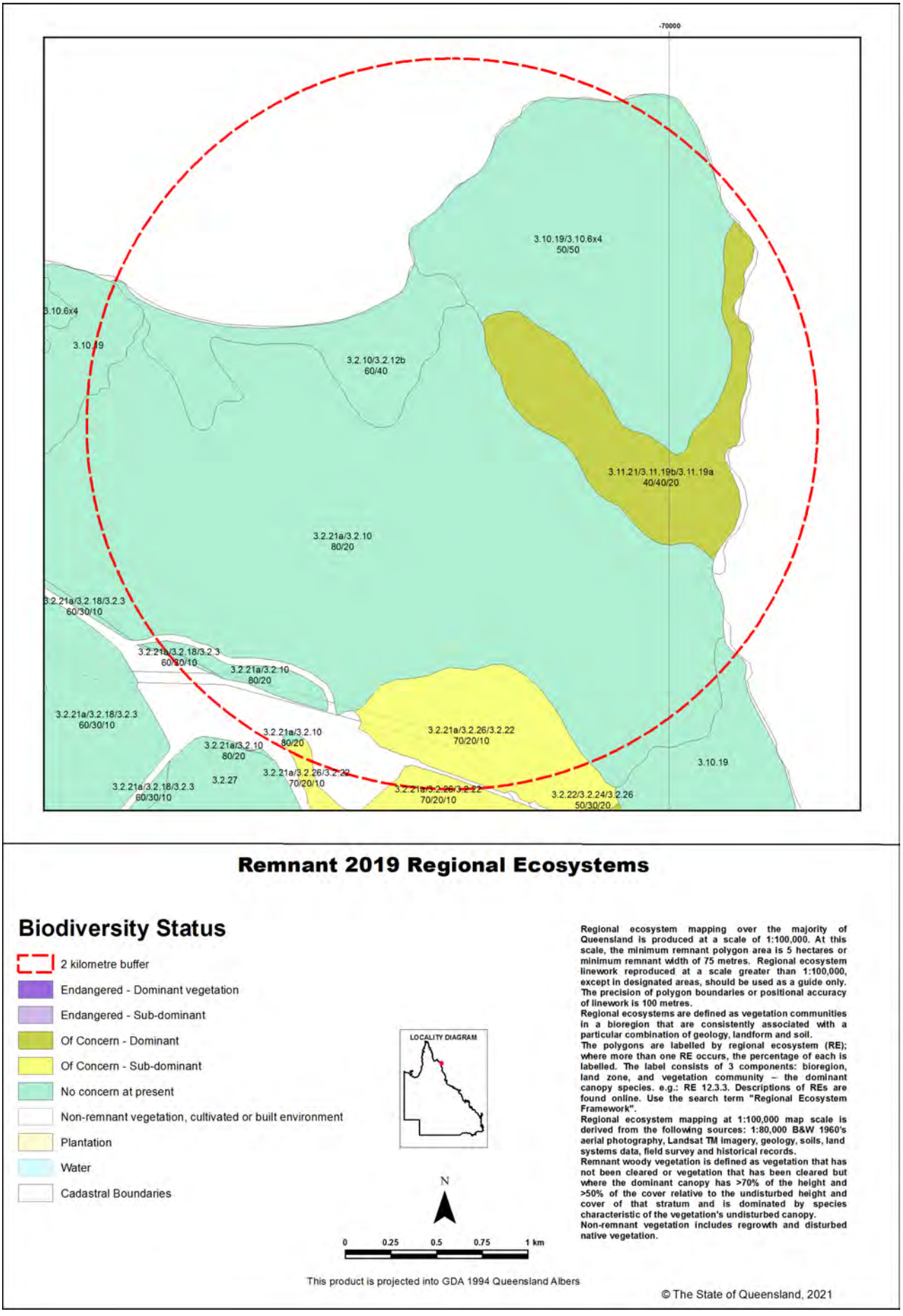
Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
3.2.18	Not currently available	Not currently available
3.2.21a	Not currently available	Not currently available
3.2.22	Not currently available	Not currently available
3.2.26	Not currently available	Not currently available
3.2.3	Not currently available	Not currently available
non-remnant	Not currently available	Not currently available

Maps

Map 1 - Location



Map 2 - Remnant 2019 regional ecosystems



Remnant 2019 Regional Ecosystems

Biodiversity Status

- 2 kilometre buffer
- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Non-remnant vegetation, cultivated or built environment
- Plantation
- Water
- Cadastral Boundaries

LOCALITY DIAGRAM

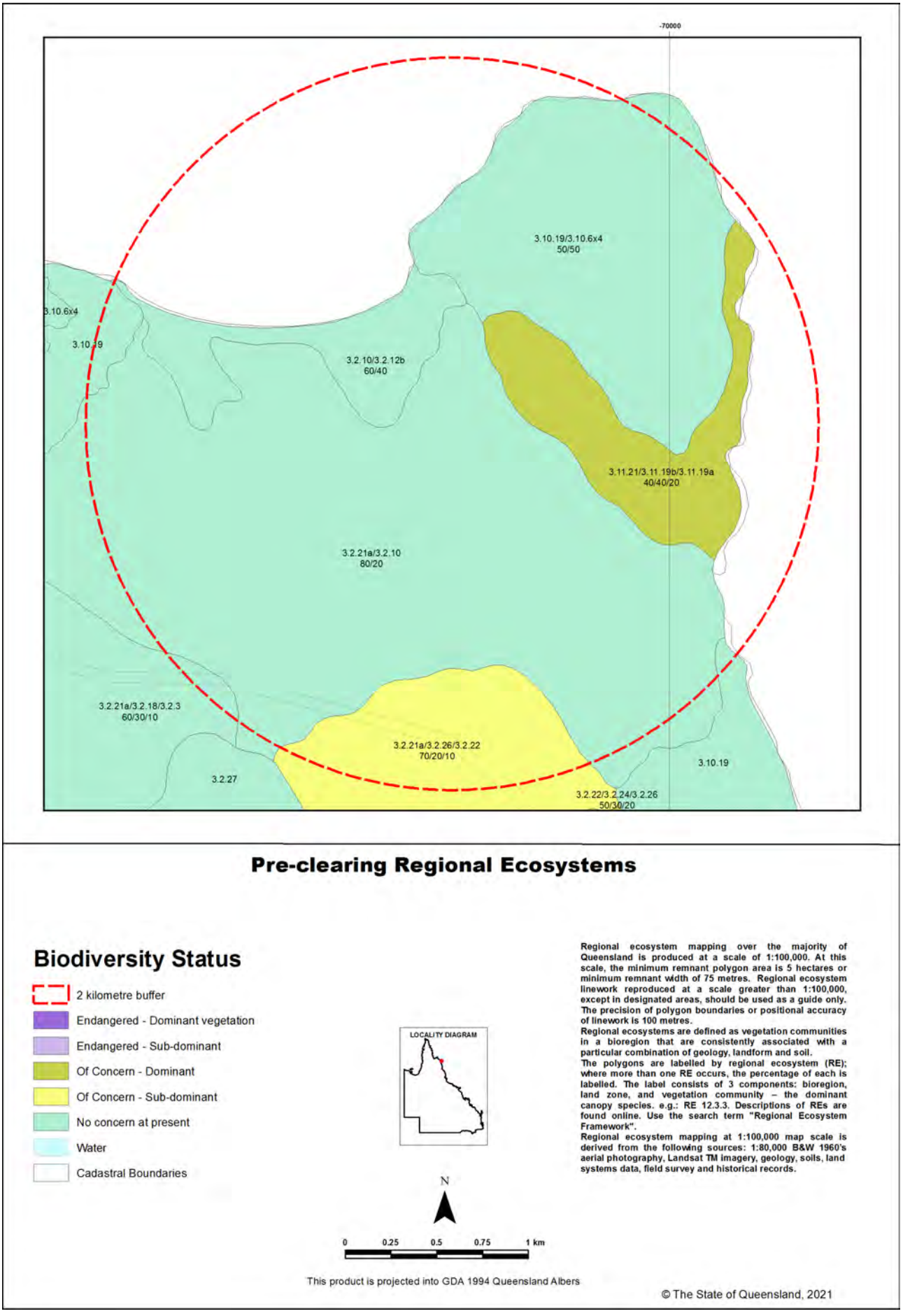
N

0 0.25 0.5 0.75 1 km

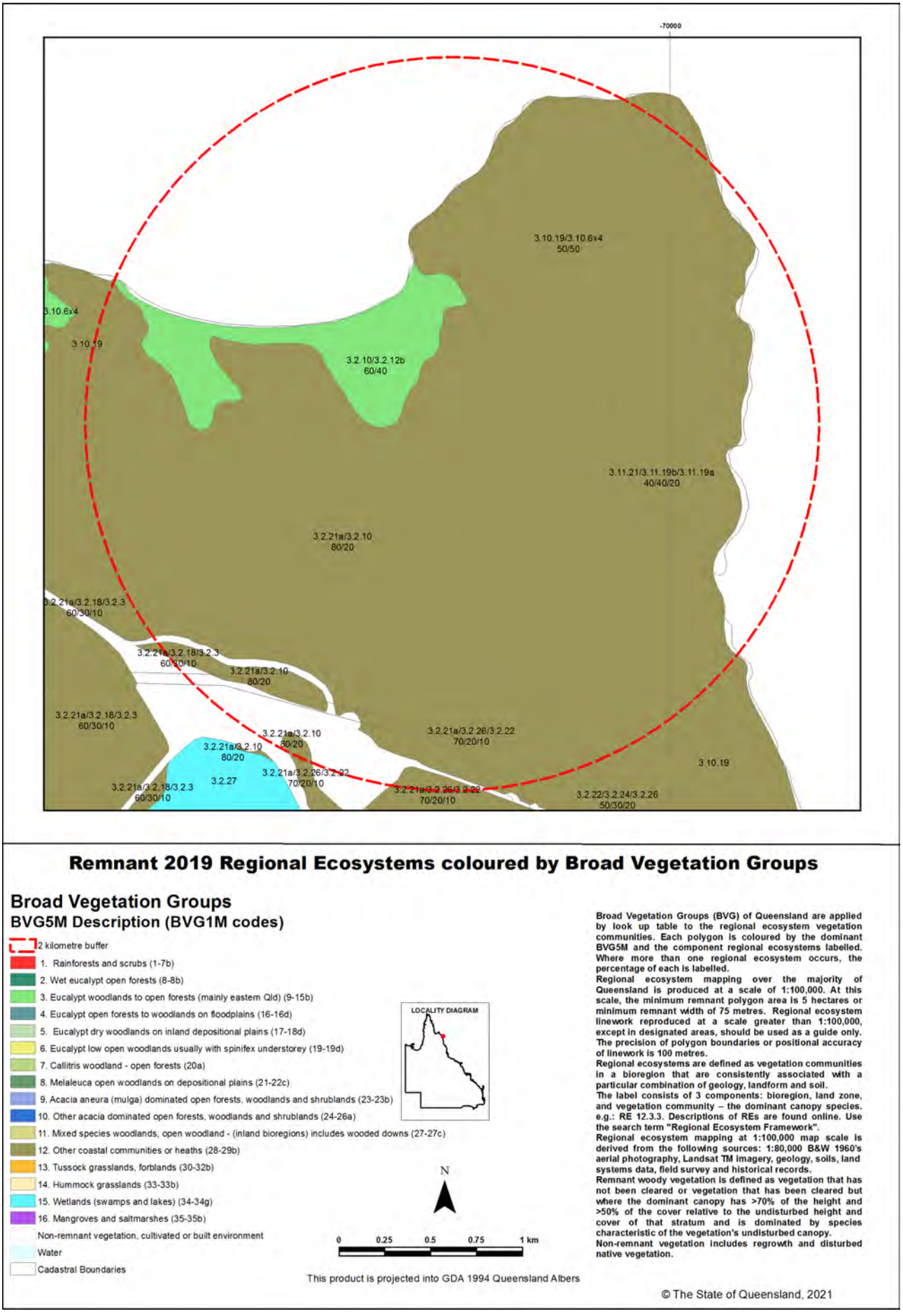
This product is projected into GDA 1994 Queensland Albers

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The polygons are labelled by regional ecosystem (RE); where more than one RE occurs, the percentage of each is labelled. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.
Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Non-remnant vegetation includes regrowth and disturbed native vegetation.

Map 3 - Pre-clearing regional ecosystems



Map 4 - Remnant 2019 regional ecosystems by BVG (5M)



Remnant 2019 Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

- 2 kilometre buffer
- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
- 3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Non-remnant vegetation, cultivated or built environment
- Water
- Cadastral Boundaries

LOCALITY DIAGRAM

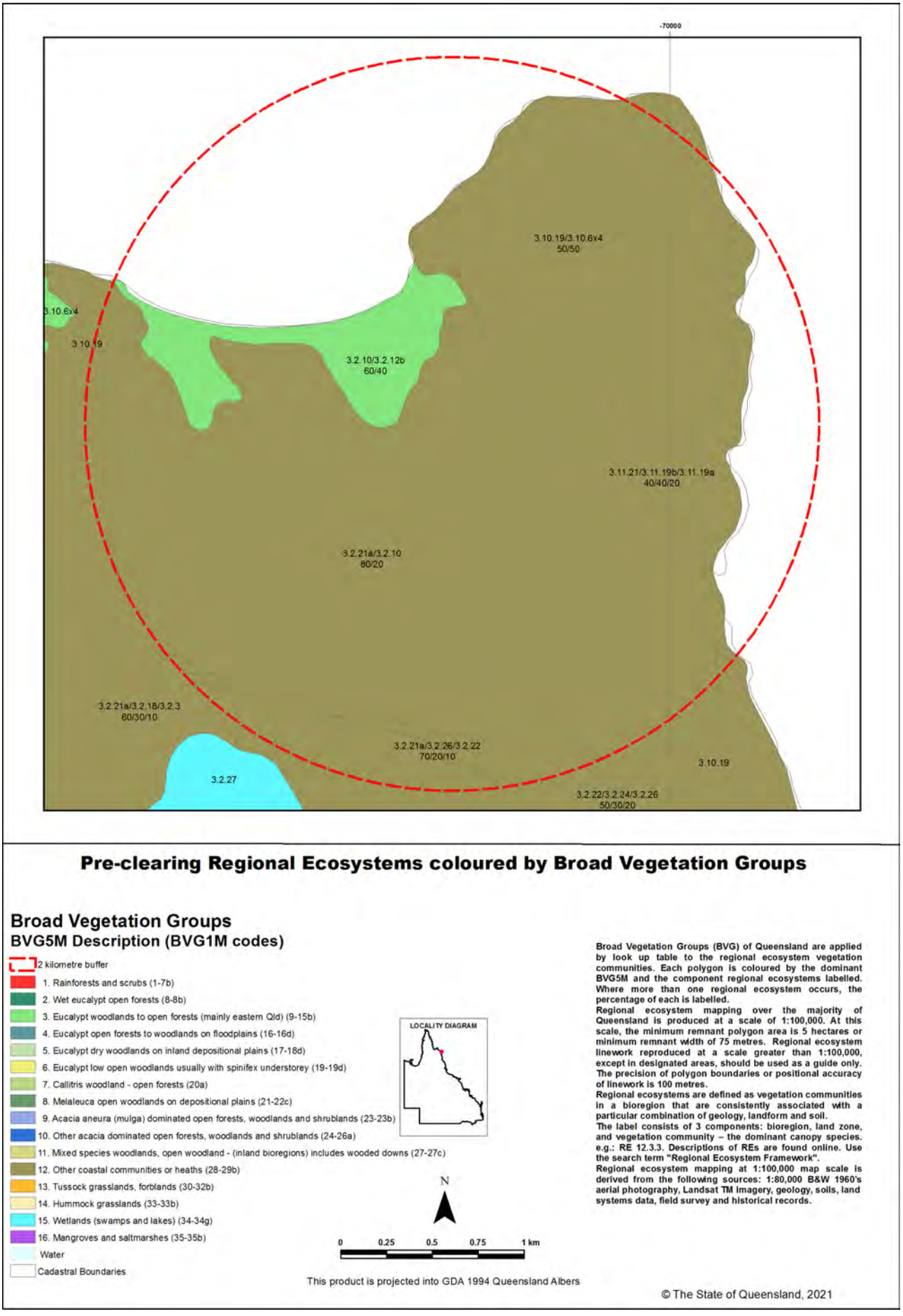
N

0 0.25 0.5 0.75 1 km

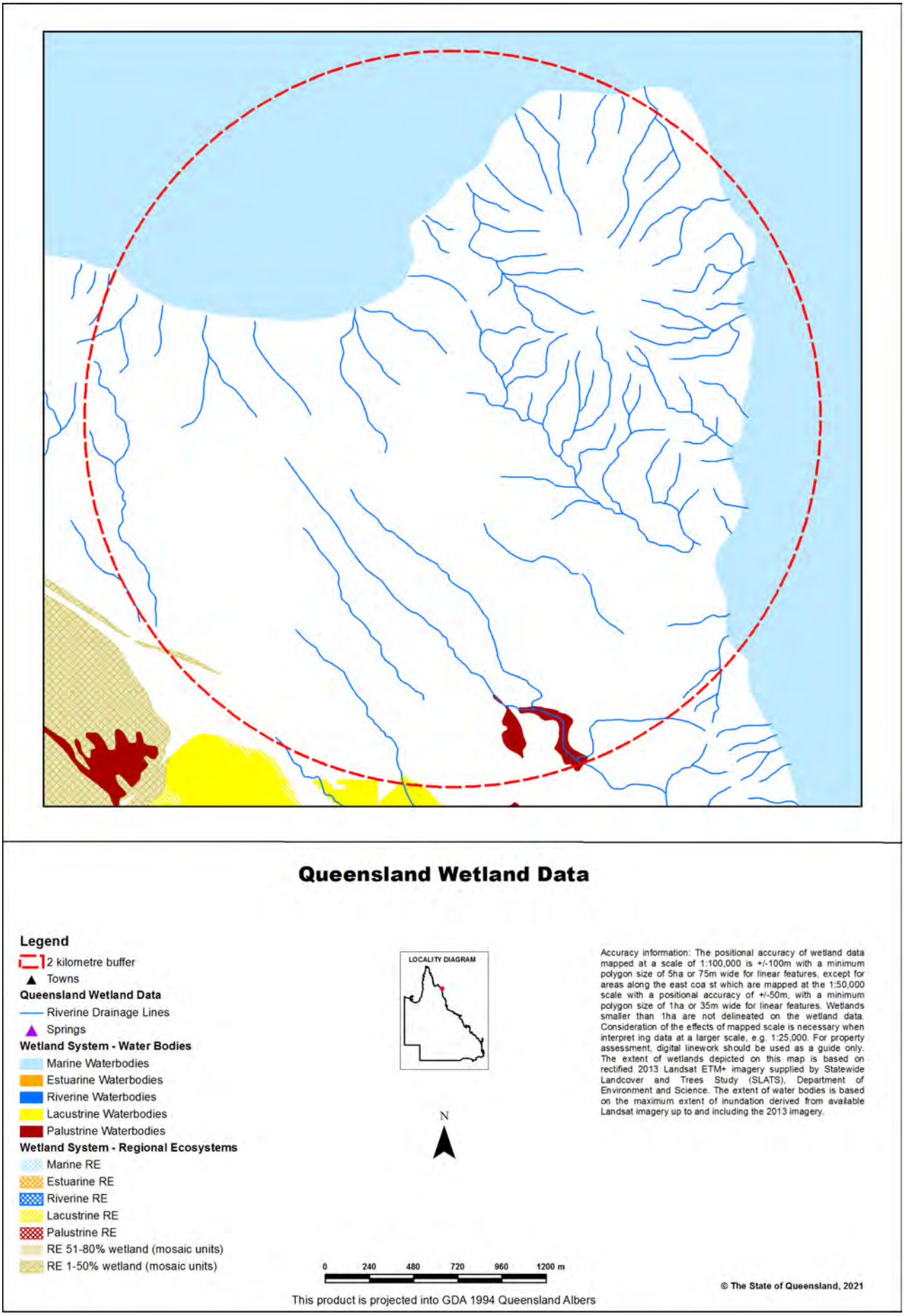
This product is projected into GDA 1994 Queensland Albers

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.
Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Non-remnant vegetation includes regrowth and disturbed native vegetation.

Map 5 - Pre-clearing regional ecosystems by BVG (5M)



Map 6 - Wetlands and waterways



Links and Other Information Sources

The Department of Environment and Science's Website -

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/

provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from:

https://publications.qld.gov.au/dataset/redd/resource/

The methodology for mapping regional ecosystems can be downloaded from:

https://publications.qld.gov.au/dataset/redd/resource/

Technical descriptions for regional ecosystems can be obtained from:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

Benchmarks can be obtained from:

http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Government Information System portal,

http://dds.information.qld.gov.au/dds/

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link:

http://www.dnrm.qld.gov.au/mapping-data/queensland-globe

References

Neldner, V.J., Niehus, R.E., Wilson, B.A., McDonald, W.J.F., Ford, A.J. and Accad, A. (2019). The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Version 4.0. Queensland Herbarium, Department of Environment and Science.

(https://publications.qld.gov.au/dataset/redd/resource/78209e74-c7f2-4589-90c1-c33188359086)

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Addicott, E.P. and Appelman, C.N. (2020). Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 5.1. Updated March 2020. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane.

(https://publications.qld.gov.au/dataset/redd/resource/6dee78ab-c12c-4692-9842-b7257c2511e4)

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

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/

- Regional Ecosystem Description Database

The datasets listed below are available for download from:

http://dds.information.qld.gov.au/dds/

- Biodiversity status of pre-clearing and 2019 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
VMA	- *Vegetation Management Act 1999*

WildNet Records
Conservation Significant Species List

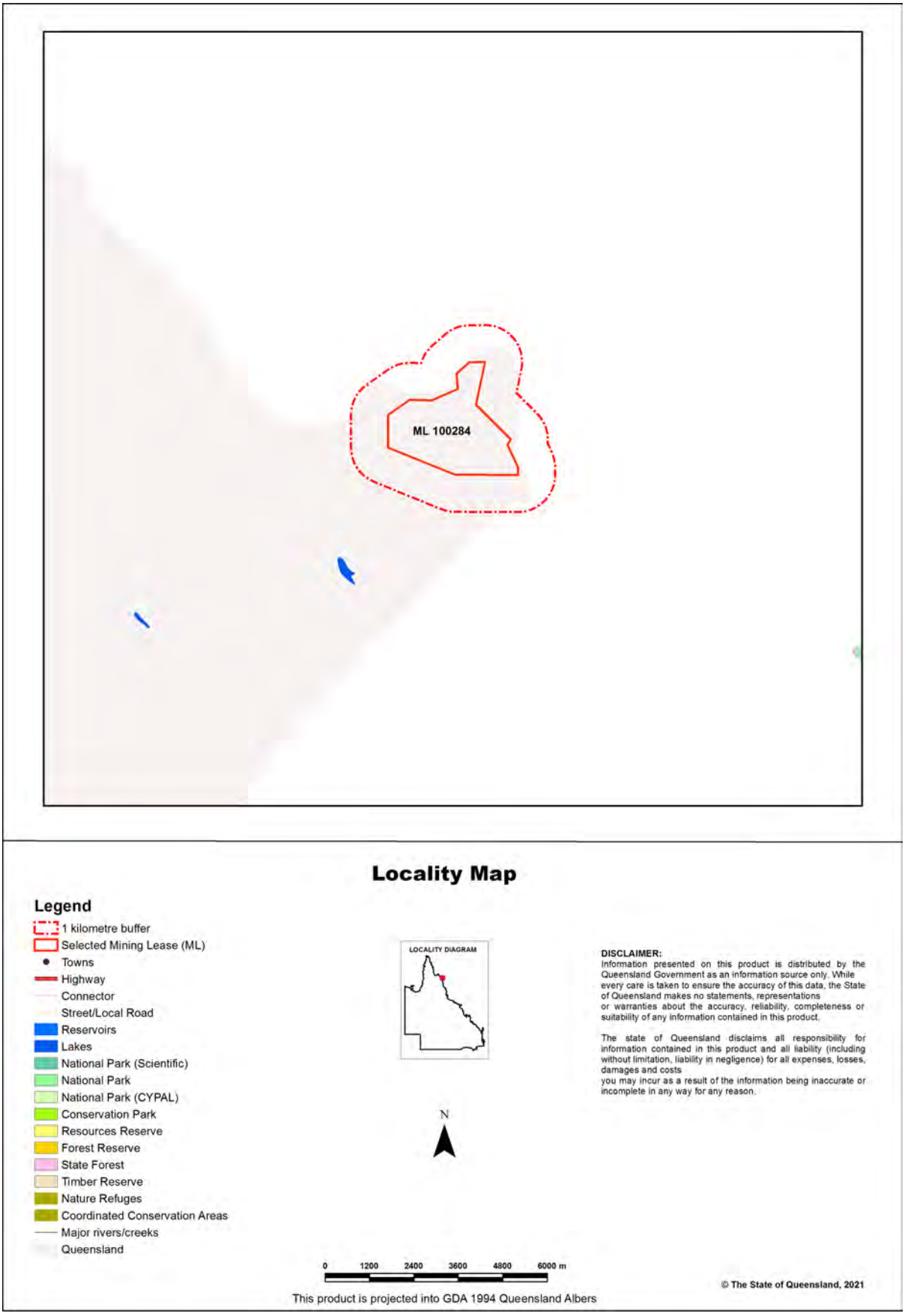
For the selected area of interest 613.67ha ml: 100284

Current as at 20/09/2021

WildNetCSSpeciesList

Queensland Government

Map 1. Locality Map



Summary Information

The following table provides an overview of the area of interest ml: 100284.

Table 1. Area of interest details

Size (ha)	613.67
Local Government(s)	Hope Vale Aboriginal Shire
Bioregion(s)	Cape York Peninsula
Subregion(s)	Starke Coastal Lowlands
Catchment(s)	Jeannie

Protected Area(s)
No estates or reserves are located within the area of interest.

World Heritage Area(s)
No World Heritage Areas are located within the area of interest.

Ramsar Area(s)
No Ramsar Areas are located within the area of interest.

Conservation Significant Species List

Introduction

This report is derived from a spatial layer generated from the WildNet database managed by the Department of Environment and Science. The layer which is generated weekly contains the WildNet wildlife records that are not classed as erroneous or duplicate, that have a location precision equal to or less than 10000 metres and do not have a count of zero.

Conservation significant species are species listed:

- as threatened or near threatened under the Nature Conservation Act 1992;
- as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* or
- migratory species protected under the following international agreements:
  - Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
  - China-Australia Migratory Bird Agreement
  - Japan-Australia Migratory Bird Agreement
  - Republic of Korea-Australia Migratory Bird Agreement

The WildNet dataset is constantly being enhanced and the taxonomic and status information revised. If a species is not listed in this report, it does not mean it doesn't occur there and listed species may also no longer inhabit the area. It is recommended that you also access other internal and external data sources for species information in your area of interest (Refer Links and Support).

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

Table 2. Conservation significant species recorded within the area of interest and its one kilometre buffer

Taxon Id	Kingdom	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
584	Animalia	Reptilia	Crocodylidae	*Crocodylus porosus*	estuarine crocodile	V	None	0	1	31/05/1988
232	Animalia	Reptilia	Scincidae	*Ctenotus rawlinsoni*	Cape heath ctenotus	V	None	0	1	31/12/1982
168	Animalia	Reptilia	Scincidae	*Lerista ingrami*	Ingram's lerista	V	None	0	1	31/12/2003
3362	Plantae	Equisetopsida	Mimosaceae	*Acacia solenota*	None	V	None	3	3	27/03/2021

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

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

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

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

Records: The total number of records of the taxon.

Last record: Date of latest record of the taxon.

Links and Support

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

- Species profile search - access species information approved for publication including species names, statuses, notes, images, distribution maps and records
- Species lists - generate species lists for Queensland protected areas, forestry areas, local governments and areas defined using coordinates
- Biomaps - view biodiversity information, including WildNet records approved for publication, and generate reports
- Queensland Globe - view spatial information, including WildNet records approved for publication
- Qld wildlife data API - access WildNet species information approved for publication such as notes, images and records etc.
- Wetland*Maps* - view species records, survey locations etc. approved for publication
- Wetland*Summary* - view wildlife statistics, species lists for a range of area types, and access WildNet species profiles
- WildNet wildlife records - published - Queensland - spatial layer of WildNet records approved for publication generated weekly
- Generalised distribution and densities of Queensland wildlife - Queensland species distributions and densities generalised to a 10 km grid resolution
- Conservation status of Queensland wildlife - access current lists of priority species for Queensland including nomenclature and status information
- Queensland Confidential Species - the list of species flagged as confidential in the WildNet database.

Please direct queries about this report to the WildNet Team.

Other useful sites for accessing Queensland biodiversity data include:

- Useful wildlife resources
- Queensland Government Data
- Atlas of Living Australia (ALA)
- Online Zoological Collections of Australian Museums (OZCAM)
- Australia's Virtual Herbarium (AVH)
- Protected Matters Search Tool

Disclaimer

WildNet Records
Species List

For the selected area of interest 613.67ha ml: 100284

Current as at 20/09/2021

WildNetSpeciesList

Queensland Government

Map 1. Locality Map

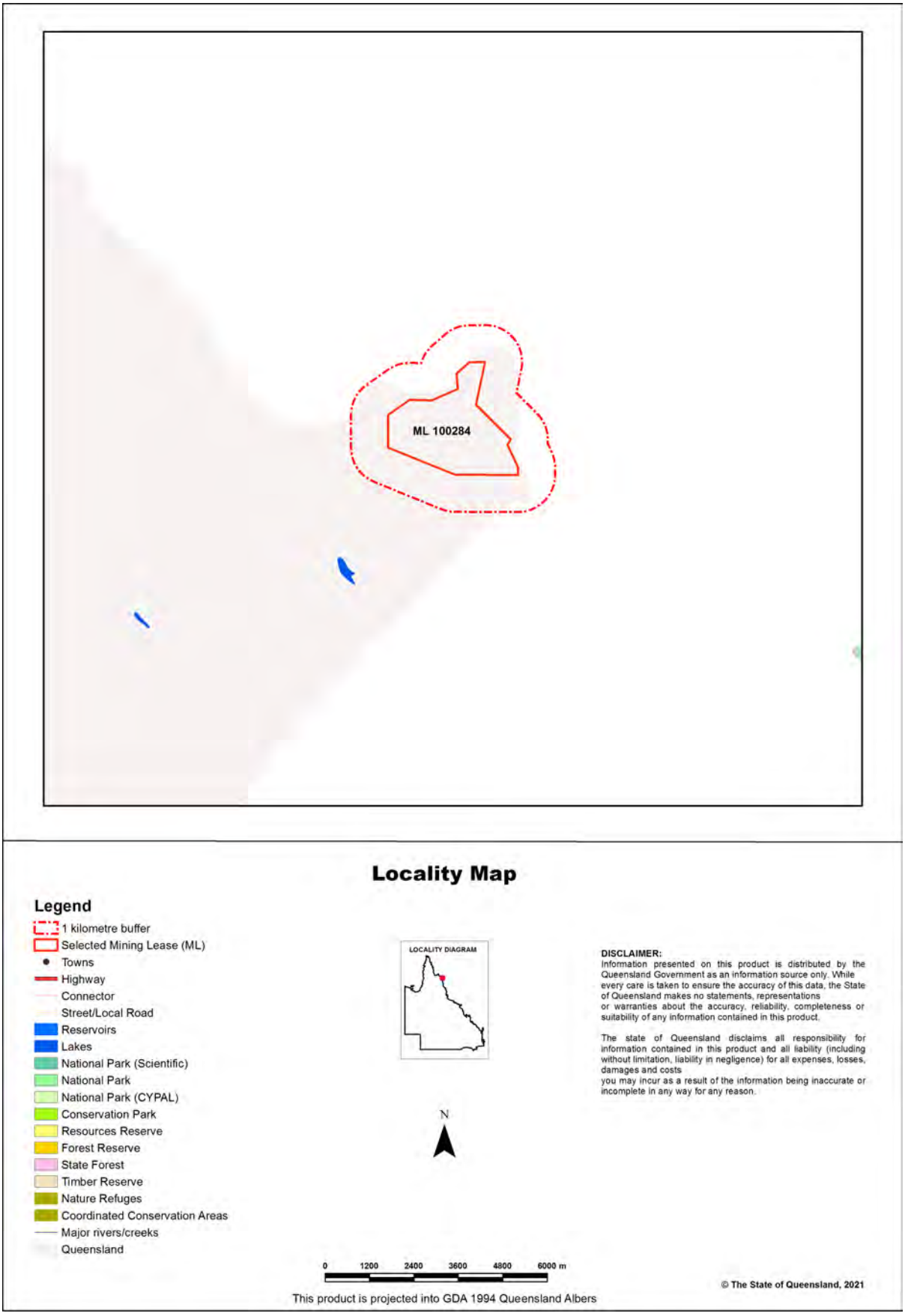


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Table 2 lists the animals recorded within the area of interest and its one kilometre buffer.

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

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

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

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

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
716	Amphibia	Bufonidae	*Rhinella marina*	cane toad	None	None	0	4	04/07/2019
673	Amphibia	Limnodynastidae	*Limnodynastes terraereginae*	scarlet sided pobblebonk	C	None	0	1	02/07/2019
1975	Aves	Caprimulgidae	*Caprimulgus macrurus*	large-tailed nightjar	C	None	0	1	02/07/2019
1912	Aves	Laridae	*Chroicocephalus novaehollandiae*	silver gull	C	None	0	1	31/07/1993
1955	Aves	Podargidae	*Podargus strigoides*	tawny frogmouth	C	None	0	1	01/07/2019
19176	Insecta	Nymphalidae	*Tirumala hamata hamata*	blue tiger	None	None	0	1	29/06/2021

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
772	Mammalia	Muridae	*Melomys burtoni*	grassland melomys	C	None	2	9	04/07/2019
759	Mammalia	Muridae	*Melomys cervinipes*	fawn-footed melomys	C	None	2	3	31/12/1998
734	Mammalia	Muridae	*Rattus tunneyi*	pale field-rat	C	None	1	1	27/09/1995
584	Reptilia	Crocodylidae	*Crocodylus porosus*	estuarine crocodile	V	None	0	1	31/05/1988
361	Reptilia	Elapidae	*Hydrophis elegans*	elegant sea snake	C	None	1	1	18/09/1970
470	Reptilia	Elapidae	*Oxyuranus scutellatus*	coastal taipan	C	None	0	1	30/06/2019
411	Reptilia	Gekkonidae	*Hemidactylus frenatus*	house gecko	None	None	0	1	02/07/2019
18840	Reptilia	Gekkonidae	*Nactus cheverti*	Chevert gecko	C	None	0	1	01/07/2019
291	Reptilia	Scincidae	*Carlia dogare*	sandy rainbow-skink	C	None	0	1	31/12/1982
232	Reptilia	Scincidae	*Ctenotus rawlinsoni*	Cape heath ctenotus	V	None	0	1	31/12/1982
168	Reptilia	Scincidae	*Lerista ingrami*	Ingram's lerista	V	None	0	1	31/12/2003

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

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
6799	Equisetopsida	Acanthaceae	*Avicennia marina subsp. eucalyptifolia*	None	C	None	1	1	15/04/1975
16258	Equisetopsida	Acanthaceae	*Rostellularia adscendens var. hispida*	None	C	None	1	1	20/06/1975
16260	Equisetopsida	Acanthaceae	*Rostellularia adscendens var. latifolia*	None	C	None	1	1	08/02/1976
17979	Equisetopsida	Apocynaceae	*Alyxia spicata*	None	C	None	1	1	15/04/1975
16922	Equisetopsida	Apocynaceae	*Hoya australis subsp. australis*	None	C	None	2	2	01/04/2009
16527	Equisetopsida	Apocynaceae	*Parsonsia velutina*	hairy silkpod	C	None	1	1	06/05/1990
7530	Equisetopsida	Casuarinaceae	*Allocasuarina sp. (Shaw Island G.N.Batianoff+ 3360)*	None	C	None	1	1	27/02/2021
11098	Equisetopsida	Centrolepidaceae	*Centrolepis banksii*	None	C	None	1	1	26/08/1986
13872	Equisetopsida	Combretaceae	*Lumnitzera racemosa*	None	C	None	1	1	15/04/1975
41373	Equisetopsida	Cyperaceae	*Anthelepis clarksonii*	None	C	None	2	2	20/06/1975
14812	Equisetopsida	Cyperaceae	*Arthrostylis aphylla*	None	C	None	2	2	20/06/1975
17780	Equisetopsida	Cyperaceae	*Bulbostylis barbata*	None	C	None	1	1	15/04/1975
17529	Equisetopsida	Cyperaceae	*Cyperus pedunculatus*	None	C	None	1	1	15/04/1975
17481	Equisetopsida	Cyperaceae	*Cyperus stoloniferus*	None	C	None	1	1	15/04/1975
17341	Equisetopsida	Cyperaceae	*Eleocharis geniculata*	None	C	None	1	1	22/07/1949
11959	Equisetopsida	Cyperaceae	*Eleocharis ochrostachys*	None	C	None	1	1	10/05/1988
17113	Equisetopsida	Cyperaceae	*Fimbristylis*	None	None	None	1	1	09/09/1986
11041	Equisetopsida	Cyperaceae	*Fimbristylis recta*	None	C	None	2	2	08/02/1976

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
17130	Equisetopsida	Cyperaceae	*Fuirena ciliaris*	None	C	None	3	3	20/06/1975
17079	Equisetopsida	Cyperaceae	*Gahnia sieberiana*	sword grass	C	None	1	1	20/06/1975
10973	Equisetopsida	Cyperaceae	*Rhynchospora heterochaeta*	None	C	None	1	1	20/06/1975
16212	Equisetopsida	Cyperaceae	*Schoenus calostachyus*	None	C	None	2	2	20/06/1975
14225	Equisetopsida	Cyperaceae	*Schoenus sparteus*	None	C	None	2	2	20/06/1975
11913	Equisetopsida	Cyperaceae	*Scleria rugosa*	None	C	None	1	1	20/06/1975
16007	Equisetopsida	Cyperaceae	*Trachystylis stradbrokensis*	None	C	None	2	2	20/06/1975
8877	Equisetopsida	Dilleniaceae	*Hibbertia banksii forma banksii*	None	C	None	1	1	08/02/1976
35066	Equisetopsida	Droseraceae	*Drosera serpens*	None	C	None	1	1	20/06/1975
41525	Equisetopsida	Ericaceae	*Styphelia lavarackii*	None	C	None	1	1	12/02/2009
41536	Equisetopsida	Ericaceae	*Styphelia ruscifolia*	None	C	None	1	1	20/06/1975
41521	Equisetopsida	Ericaceae	*Styphelia yorkensis*	None	C	None	1	1	26/02/2021
30690	Equisetopsida	Euphorbiaceae	*Shonia tristigma subsp. borealis*	None	C	None	1	1	08/02/1976
15262	Equisetopsida	Fabaceae	*Jacksonia thesioides*	None	C	None	3	3	31/05/2009
14946	Equisetopsida	Fabaceae	*Vandasina retusa*	None	C	None	1	1	15/04/1975
14647	Equisetopsida	Hemerocallidaceae	*Dianella pavopennacea var. pavopennacea*	None	C	None	1	1	20/06/1975
15972	Equisetopsida	Johnsoniaceae	*Tricoryne anceps subsp. anceps*	None	C	None	1	1	31/03/2009
15973	Equisetopsida	Johnsoniaceae	*Tricoryne anceps subsp. pterocaulon*	None	C	None	1	1	08/02/1976
15549	Equisetopsida	Lamiaceae	*Chloanthes parviflora*	None	C	None	1	1	20/06/1975
36450	Equisetopsida	Laxmanniaceae	*Lomandra decomposita*	None	C	None	1	1	31/05/2009
15940	Equisetopsida	Lentibulariaceae	*Utricularia chrysantha*	None	C	None	1	1	20/06/1975
24602	Equisetopsida	Leucobryaceae	*Campylopus*	None	None	None	1	1	31/12/1983
13236	Equisetopsida	Loranthaceae	*Dendrophthoe glabrescens*	None	C	None	1	1	20/06/1975
13937	Equisetopsida	Loranthaceae	*Diplatia furcata*	None	C	None	1	1	15/04/1975
16130	Equisetopsida	Lythraceae	*Sonneratia alba*	None	C	None	1	1	15/04/1975
16957	Equisetopsida	Malvaceae	*Hibiscus meraukensis*	Merauke hibiscus	C	None	1	1	15/04/1975
16897	Equisetopsida	Menispermaceae	*Hypserpa decumbens*	None	C	None	1	1	30/08/1986
15794	Equisetopsida	Mimosaceae	*Acacia crassicarpa*	None	C	None	1	1	15/04/1975
14863	Equisetopsida	Mimosaceae	*Acacia leptoloba*	None	C	None	1	1	15/04/1975
15743	Equisetopsida	Mimosaceae	*Acacia pubirhachis*	None	C	None	1	1	27/02/2021
15688	Equisetopsida	Mimosaceae	*Acacia racospermoides*	None	C	None	1	1	20/06/1975
3362	Equisetopsida	Mimosaceae	*Acacia solenota*	None	V	None	3	3	27/03/2021
17947	Equisetopsida	Myrtaceae	*Asteromyrtus angustifolia*	None	C	None	2	2	15/04/1975
17949	Equisetopsida	Myrtaceae	*Asteromyrtus lysicephala*	None	C	None	1	1	01/12/1947

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
14441	Equisetopsida	Myrtaceae	*Leptospermum polygalifolium*	tantoon	C	None	2	2	20/06/1975
21826	Equisetopsida	Myrtaceae	*Lithomyrtus obtusa*	None	C	None	1	1	11/12/2008
16682	Equisetopsida	Myrtaceae	*Melaleuca arcana*	None	C	None	1	1	30/11/1990
16689	Equisetopsida	Myrtaceae	*Melaleuca leucadendra*	broad-leaved tea-tree	C	None	1	1	15/04/1975
16617	Equisetopsida	Myrtaceae	*Neofabricia myrtifolia*	None	C	None	4	4	20/06/1975
16554	Equisetopsida	Myrtaceae	*Osbornia octodonta*	myrtle mangrove	C	None	1	1	15/04/1975
16621	Equisetopsida	Picrodendraceae	*Neoroepera banksii*	None	C	None	3	3	03/03/2009
14598	Equisetopsida	Poaceae	*Digitaria leucostachya*	None	C	None	2	2	11/12/2008
15440	Equisetopsida	Poaceae	*Ectrosia leporina*	None	C	None	1	1	20/06/1975
15363	Equisetopsida	Poaceae	*Eragrostis interrupta*	None	C	None	1	1	11/12/2008
14587	Equisetopsida	Poaceae	*Eragrostis pubescens*	None	C	None	1	1	15/04/1975
15380	Equisetopsida	Poaceae	*Eremochloa bimaculata*	poverty grass	C	None	1	1	08/02/1976
15250	Equisetopsida	Poaceae	*Ischaemum muticum*	None	C	None	1	1	15/04/1975
15218	Equisetopsida	Poaceae	*Lepturus repens*	stalky grass	C	None	1	1	05/05/1990
15032	Equisetopsida	Poaceae	*Setaria surgens*	None	C	None	1	1	15/04/1975
14974	Equisetopsida	Poaceae	*Themeda triandra*	kangaroo grass	C	None	1	1	08/02/1976
14975	Equisetopsida	Poaceae	*Thuarea involuta*	tropical beachgrass	C	None	1	1	15/04/1975
10112	Equisetopsida	Poaceae	*Triodia microstachya*	None	C	None	1	1	15/04/1975
10126	Equisetopsida	Poaceae	*Whiteochloa airoides*	None	C	None	1	1	08/02/1976
17896	Equisetopsida	Proteaceae	*Banksia dentata*	None	C	None	1	1	15/04/1975
17031	Equisetopsida	Proteaceae	*Grevillea glauca*	bushy's clothes peg	C	None	1	1	15/04/1975
17040	Equisetopsida	Proteaceae	*Grevillea pteridifolia*	golden parrot tree	C	None	1	1	20/06/1975
21908	Equisetopsida	Restionaceae	*Baloskion tetraphyllum subsp. meiostachyum*	None	C	None	1	1	20/06/1975
21909	Equisetopsida	Restionaceae	*Dapsilanthus ramosus*	None	C	None	2	2	09/05/1988
9659	Equisetopsida	Rhamnaceae	*Alphitonia excelsa*	soap tree	C	None	1	1	31/03/2009
16282	Equisetopsida	Rhizophoraceae	*Rhizophora apiculata*	None	C	None	1	1	15/04/1975
16284	Equisetopsida	Rhizophoraceae	*Rhizophora stylosa*	spotted mangrove	C	None	1	1	15/04/1975
22156	Equisetopsida	Rubiaceae	*Atractocarpus sessilis*	None	C	None	1	1	31/05/2009
17829	Equisetopsida	Rutaceae	*Boronia alulata*	None	C	None	1	1	20/06/1975
6236	Equisetopsida	Rutaceae	*Eriostemon banksii*	None	C	None	1	1	20/06/1975
17181	Equisetopsida	Santalaceae	*Exocarpos latifolius*	None	C	None	1	1	01/04/2009
17380	Equisetopsida	Sapindaceae	*Dodonaea polyandra*	None	C	None	1	1	20/06/1975
16996	Equisetopsida	Sapindaceae	*Guioa acutifolia*	northern guioa	C	None	1	1	11/12/2008
16721	Equisetopsida	Sapotaceae	*Manilkara kauki*	None	C	None	1	1	28/02/2021
21883	Equisetopsida	Stylidiaceae	*Stylidium tenerum*	None	C	None	2	2	22/07/1949

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

Taxon Id	Class	Family	Scientific Name	Common Name	NCA	EPBC	Specimens	Records	Last record
26700	Agaricomycetes	Corticiaceae	*Corticium*	None	C	None	1	1	31/12/1983
23533	Lecanoromycetes	Caliciaceae	*Pyxine cocoes*	None	C	None	1	1	20/08/1983
23030	Lecanoromycetes	Cladoniaceae	*Cladonia macilenta*	None	C	None	1	1	31/12/1983
23067	Lecanoromycetes	Collemataceae	*Collema rugosum*	None	C	None	2	2	31/12/1983
23263	Lecanoromycetes	Collemataceae	*Leptogium*	None	None	None	1	1	20/08/1983
23258	Lecanoromycetes	Collemataceae	*Leptogium cyanescens*	None	C	None	1	1	31/12/1983
24214	Lecanoromycetes	Collemataceae	*Leptogium fallax*	None	C	None	2	2	31/12/1983
24486	Lecanoromycetes	Collemataceae	*Leptogium propaguliferum*	None	C	None	1	1	31/12/1983
32871	Lecanoromycetes	Graphidaceae	*Myriotrema subconforme*	None	C	None	1	1	31/12/1983
27407	Lecanoromycetes	Pannariaceae	*Pannaria dissecta*	None	C	None	4	4	31/12/1983
24479	Lecanoromycetes	Pannariaceae	*Parmeliella mariana*	None	C	None	1	1	20/08/1983
25324	Lecanoromycetes	Pannariaceae	*Physma ahtianum*	None	C	None	1	1	20/08/1983
24288	Lecanoromycetes	Parmeliaceae	*Parmotrema judithae*	None	C	None	1	1	20/08/1983
23379	Lecanoromycetes	Parmeliaceae	*Parmotrema robustum*	None	C	None	1	1	20/08/1983
23576	Lecanoromycetes	Parmeliaceae	*Relicina sublanea*	None	C	None	1	1	31/08/1983
25241	Lecanoromycetes	Pertusariaceae	*Pertusaria clarkeana*	None	C	None	1	1	31/12/1983

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

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

Species table headings and codes

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

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

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

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

Records: The total number of records of the taxon.

Last record: Date of latest record of the taxon.

Links and Support

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

- Species profile search - access species information approved for publication including species names, statuses, notes, images, distribution maps and records
- Species lists - generate species lists for Queensland protected areas, forestry areas, local governments and areas defined using coordinates
- Biomaps - view biodiversity information, including WildNet records approved for publication, and generate reports
- Queensland Globe - view spatial information, including WildNet records approved for publication
- Qld wildlife data API - access WildNet species information approved for publication such as notes, images and records etc.
- Wetland*Maps* - view species records, survey locations etc. approved for publication
- Wetland*Summary* - view wildlife statistics, species lists for a range of area types, and access WildNet species profiles
- WildNet wildlife records - published - Queensland - spatial layer of WildNet records approved for publication generated weekly
- Generalised distribution and densities of Queensland wildlife - Queensland species distributions and densities generalised to a 10 km grid resolution
- Conservation status of Queensland wildlife - access current lists of priority species for Queensland including nomenclature and status information
- Queensland Confidential Species - the list of species flagged as confidential in the WildNet database.

Please direct queries about this report to the WildNet Team.

Other useful sites for accessing Queensland biodiversity data include:

- Useful wildlife resources
- Queensland Government Data
- Atlas of Living Australia (ALA)
- Online Zoological Collections of Australian Museums (OZCAM)
- Australia's Virtual Herbarium (AVH)
- Protected Matters Search Tool

Disclaimer

WildNet Records
Pest List

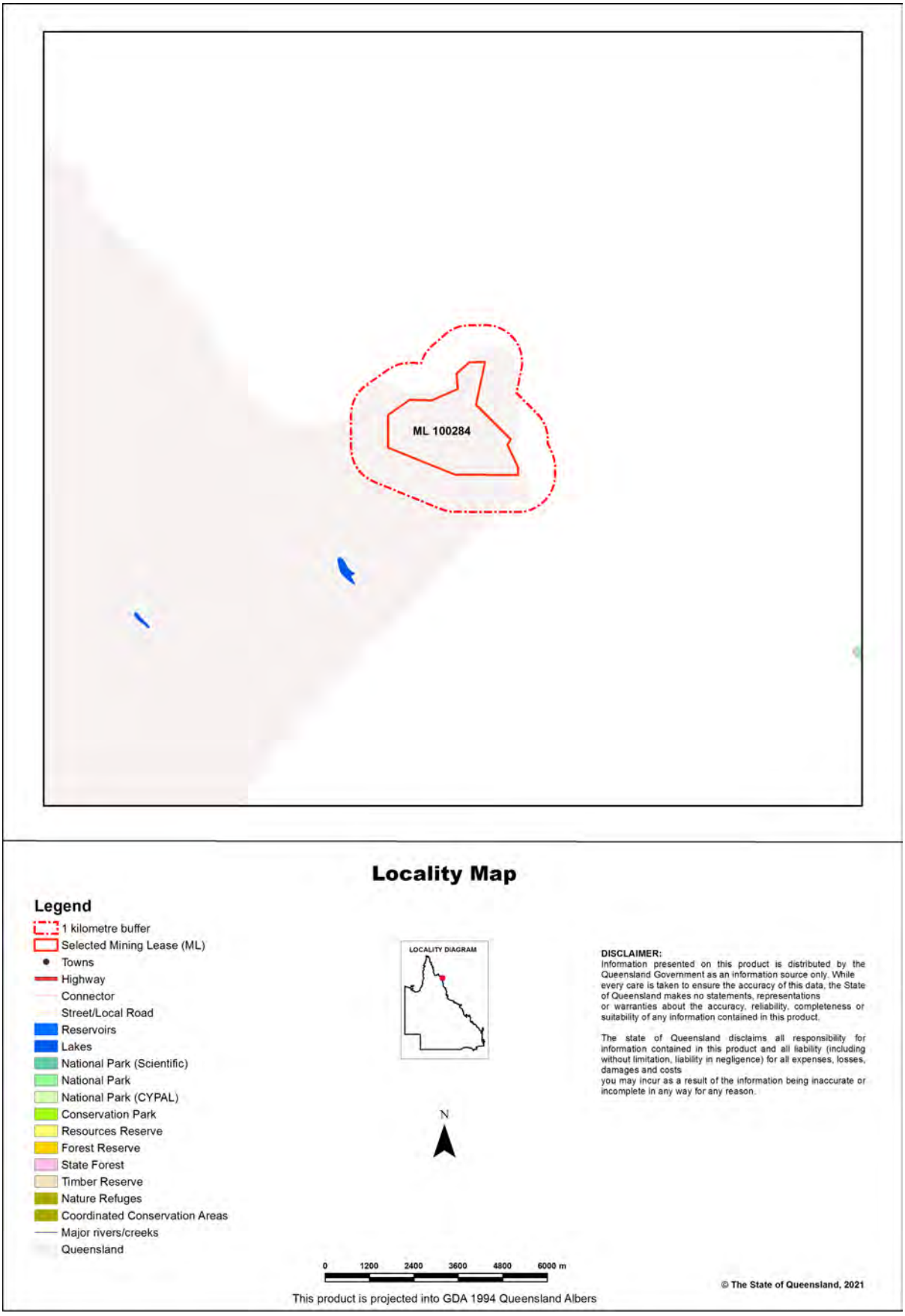
For the selected area of interest 613.67ha ml: 100284

Current as at 20/09/2021

WildNetPestList

Queensland Government

Map 1. Locality Map



Summary Information

The following table provides an overview of the area of interest ml: 100284.

Table 1. Area of interest details

Size (ha)	613.67
Local Government(s)	Hope Vale Aboriginal Shire
Bioregion(s)	Cape York Peninsula
Subregion(s)	Starke Coastal Lowlands
Catchment(s)	Jeannie

Protected Area(s)

No estates or reserves are located within the area of interest.

World Heritage Area(s)

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

Ramsar Area(s)

No Ramsar Areas are located within the area of interest.

Pest List

Introduction

This report is derived from a spatial layer generated from the WildNet database managed by the Department of Environment and Science. The layer which is generated weekly contains the WildNet wildlife records that are not classed as erroneous or duplicate, that have a location precision equal to or less than 10000 metres and do not have a count of zero.

The WildNet dataset is constantly being enhanced and the taxonomic and status information revised. If a species is not listed in this report, it does not mean it doesn't occur there and listed species may also no longer inhabit the area. It is recommended that you also access other internal and external data sources for species information in your area of interest (Refer Links and Support).

Species Data

Contextual location information is presented in Map 1.

A summary of the pests recorded within the area of interest and its one kilometre buffer is presented in Table 2.

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

Taxon Id	Kingdom	Class	Family	Scientific Name	Common Name	Specimens	Records	Last record	Endemicity
716	Animalia	Amphibia	Bufonidae	*Rhinella marina*	cane toad	0	4	04/07/2019	II
411	Animalia	Reptilia	Gekkonidae	*Hemidactylus frenatus*	house gecko	0	1	02/07/2019	II

Species table headings and codes

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

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

Records: The total number of records of the taxon.

Last record: Date of latest record of the taxon.

Endemicity: The endemicity code for the taxon (Introduced (Intranational) (IA), Introduced (International) (II), Introduced (Unknown), Exotic (Intranational) (XA), Exotic (International) (XI) and Exotic (Unknown) (XU)).

Links and Support

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

- Species profile search - access species information approved for publication including species names, statuses, notes, images, distribution maps and records
- Species lists - generate species lists for Queensland protected areas, forestry areas, local governments and areas defined using coordinates
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Disclaimer

WildNet Records
Weed List

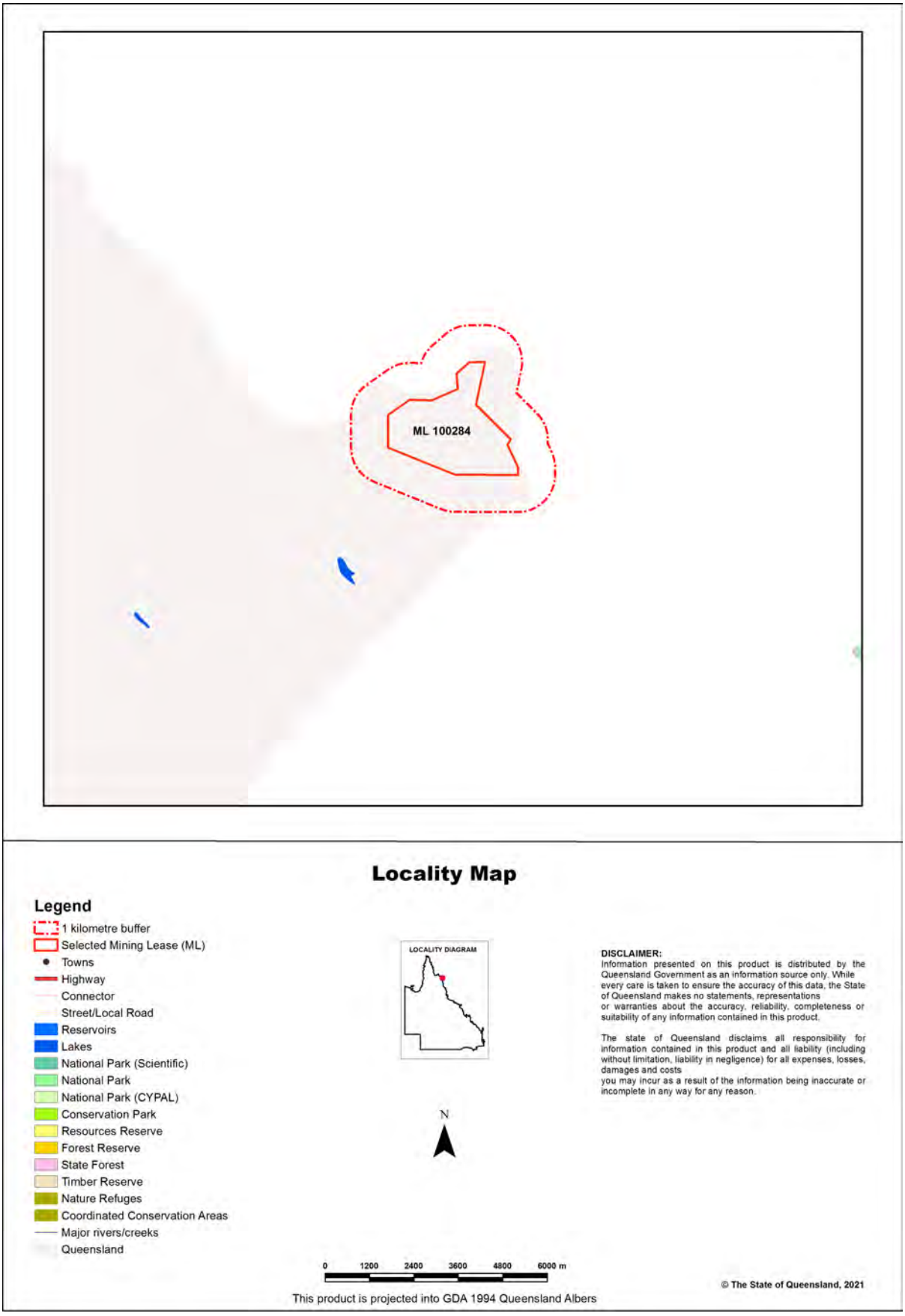
For the selected area of interest 613.67ha ml: 100284

Current as at 20/09/2021

WildNetWeedList

Queensland Government

Map 1. Locality Map



Summary Information

The following table provides an overview of the area of interest ml: 100284.

Table 1. Area of interest details

Size (ha)	613.67
Local Government(s)	Hope Vale Aboriginal Shire
Bioregion(s)	Cape York Peninsula
Subregion(s)	Starke Coastal Lowlands
Catchment(s)	Jeannie

Protected Area(s)

No estates or reserves are located within the area of interest.

World Heritage Area(s)

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No Ramsar Areas are located within the area of interest.

Weed List

Introduction

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Species Data

Contextual location information is presented in Map 1.

A summary of the weeds recorded within the area of interest and its one kilometre buffer is presented in Table 2.

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

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

Species table headings and codes

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

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

Records: The total number of records of the taxon.

Last record: Date of latest record of the taxon.

Endemicity: The endemicity code for the taxon (Introduced (Intranational) (IA), Introduced (International) (II), Introduced (Unknown), Exotic (Intranational) (XA), Exotic (International) (XI) and Exotic (Unknown) (XU)).

Links and Support

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APPENDIX D. RESIDUAL IMPACT ASSESSMENT

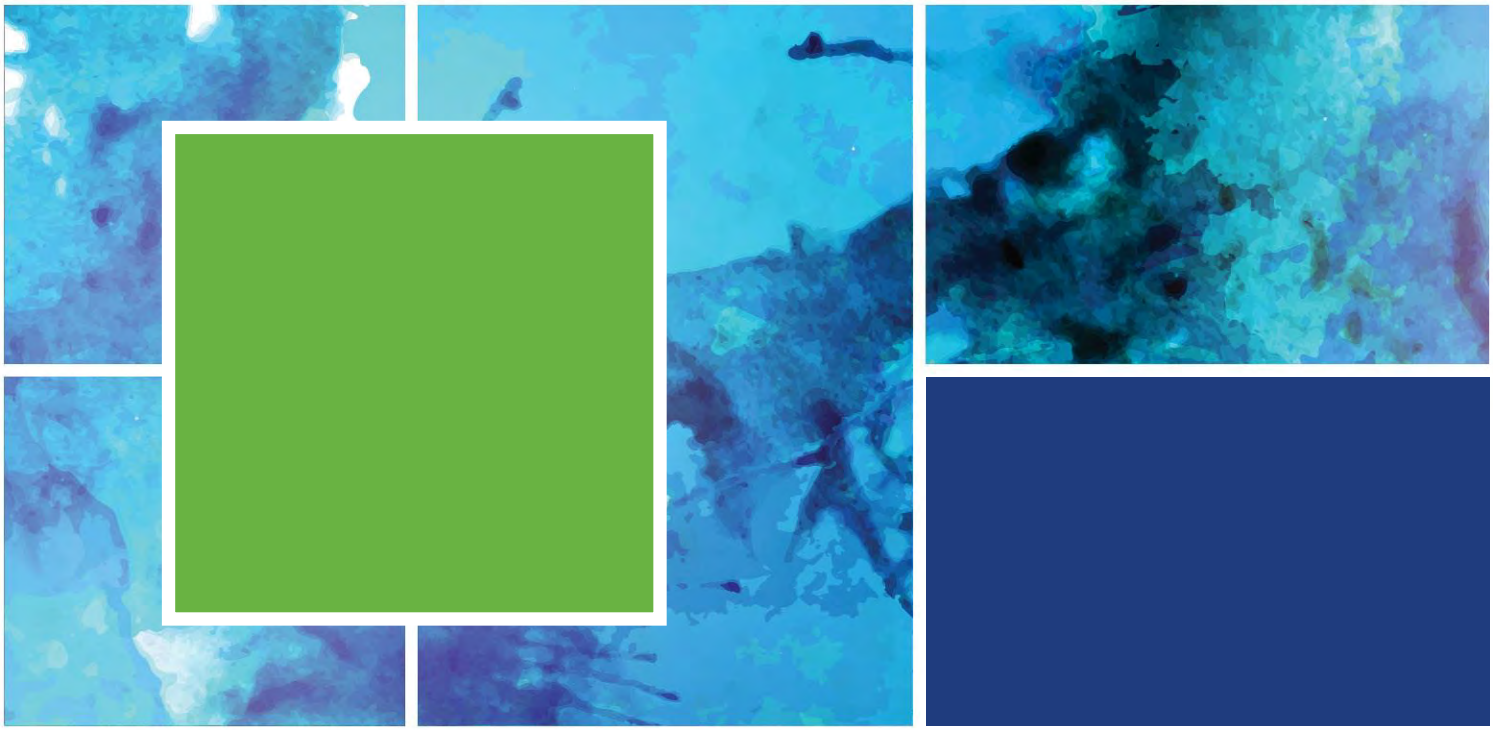

Table E1 - Residual Impact Assessment Matrix

Impact/Activity	Phase	Unmitigated Impact				Residual (Mitigated) Impact				
		Magnitude	Duration	Likelihood	Rating Unmitigated Impact	Potential Elimination, Mitigation or Management Strategy	Magnitude	Duration	Likelihood	Significance of Residual (Mitigated) impact
Loss of Macrohabitat										
Clearing and grubbing	Construction	Moderate	Short term	Almost certain	Medium	See Table 6-1	Moderate	Short term	Possible	Low
	Operation	Moderate	Long term	Almost certain	Medium	See Table 6-1	Moderate	Long term	Possible	Low
Infrastructure (i.e. haul road conveyor, mine lease area buffer)	Construction	Moderate	Short term	Likely	Medium	See Table 6-1	Minor	Short term	Possible	Low
Loss of Microhabitat										
Clearing and grubbing	Construction	Moderate	Short term	Almost certain	Medium	See Table 6-1	Minor	Short term	Possible	Insignificant
	Operation	Moderate	Long term	Almost certain	Medium	See Table 6-1	Minor	Long term	Possible	Low
Land use change	Construction	Moderate	Short term	Almost certain	Medium	See Table 6-1	Minor	Short term	Possible	Insignificant
	Operation	Moderate	Long term	Almost certain	Medium	See Table 6-1	Minor	Long term	Possible	Low
Infrastructure (i.e. haul road conveyor, boundary access road)	Construction	Moderate	Short term	Likely	Medium	See Table 6-1	Minor	Short term	Possible	Insignificant
	Operation	Moderate	Long term	Likely	Medium	See Table 6-1	Minor	Long term	Possible	Low
Impacts to Aquatic Biota from Exotics										
Introduction and spread of aquatic weeds	Construction	Moderate	Short term	Likely	Medium	See Table 6-1	Moderate	Short term	Possible	Low
	Operation	Moderate	Long term	Likely	Medium	See Table 6-1	Moderate	Long term	Possible	Low
Introduction and spread of exotic aquatic fauna	Construction	Negligible	Short term	Rare	Insignificant	n/a				
	Operation	Negligible	Long term	Rare	Insignificant	n/a				
Impacts from Increased Fishing Pressure										
Impacts from overfishing	Construction	Minor	Short term	Possible	Insignificant	• Employees are not to take part in recreational fishing	Minor	Short term	Rare	Insignificant
	Operation	Minor	Long term	Possible	Low	• Employees are not to take part in recreational fishing	Minor	Long term	Rare	Insignificant
Changes to Hydrology and Hydraulics of Waterways and Wetlands										
Land use change	Construction	Minor	Short term	Almost certain	Low	See Table 6-1	Moderate	Short term	Possible	Low

Impact/Activity	Phase	Unmitigated Impact				Residual (Mitigated) Impact				
		Magnitude	Duration	Likelihood	Rating Unmitigated Impact	Potential Elimination, Mitigation or Management Strategy	Magnitude	Duration	Likelihood	Significance of Residual (Mitigated) impact
	Operation	Major	Long term	Almost certain	High	See Table 6-1	Moderate	Long term	Possible	Low
Sediment Basin Releases	Construction	Moderate	Short term	Rare	Low	• There are unlikely to be any releases during the operational phase of the project (WRM, 2020) from the sediment basin. WRM (2020), predicted that the forecasted stored inventory of the Sediment Basin is projected to exceed the preliminary full storage volume during 1%ile climatic conditions. • See Table 6-1	Minor	Short term	Possible	Insignificant
	Operation	Moderate	Short term	Rare	Low	• There are unlikely to be any releases during the operational phase of the project (WRM, 2020) from the sediment basin. WRM (2020), predicted that the forecasted stored inventory of the Sediment Basin is projected to exceed the preliminary full storage volume during 1%ile climatic conditions. • See Table 6-1	Minor	Short term	Rare	Insignificant
Changes to Water Quality										
Runoff from the infrastructure and mining area (operational phase only)	Construction	Moderate	Short term	Almost certain	Medium	See Table 6-1	Moderate	Short term	Possible	Low
	Operation	Major	Long term	Almost Certain	High	• Sediment laden runoff in the mining area will be held in each mining cell to allow for infiltration • See Table 6-1	Moderate	Long term	Possible	Low
Riparian clearing for infrastructure	Construction	Moderate	Short term	Almost certain	Medium	See Table 6-1	Minor	Short term	Possible	Insignificant
Hazardous substance - contamination and spills	Construction	Moderate	Short term	Possible	Low	See Table 6-1	Minor	Short term	Possible	Insignificant
	Operation	Moderate	Short term	Possible	Low	See Table 6-1	Minor	Short term	Possible	Insignificant
Land Use Change	Construction	Major	Short term	Almost certain	High	See Table 6-1	Moderate	Short term	Possible	Low
	Operation	Major	Long term	Almost certain	High	• See Table 6-1 • Sediment laden runoff in the mining area will be held in each mining cell to allow for infiltration	Moderate	Long term	Possible	Low
Sediment Basin Release	Construction	Moderate	Short term	Almost certain	Low	• There are unlikely to be any releases during the operational phase of the project (WRM, 2020) from the sediment basin. WRM (2020), predicted that the forecasted stored inventory of the Sediment Basin is projected to exceed the preliminary full storage volume during 1%ile climatic conditions. • See Table 6-1	Moderate	Short term	Possible	Insignificant

Impact/Activity	Phase	Unmitigated Impact				Residual (Mitigated) Impact				
		Magnitude	Duration	Likelihood	Rating Unmitigated Impact	Potential Elimination, Mitigation or Management Strategy	Magnitude	Duration	Likelihood	Significance of Residual (Mitigated) impact
	Operation	Moderate	Short term	Rare	Low	• There are unlikely to be any releases during the operational phase of the project (WRM, 2020) from the sediment basin. WRM (2020), predicted that the forecasted stored inventory of the Sediment Basin is projected to exceed the preliminary full storage volume during 1%ile climatic conditions. • See Table 6-1	Minor	Short term	Rare	Insignificant

Hydrobiology

STREET
27 / 43 Lang Parade
Auchenflower 4066
QUEENSLAND

POSTAL
PO Box 2151
Toowong 4066
QUEENSLAND

CONTACT
+61 (0)7 3721 0100 P
info@hydrobiology.biz

ABN 26 096 574 659

www.hydrobiology.biz