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Rockhampton Ring Road - Business Case
Department of Transport and Main Roads
20-Feb-2020
Doc No. 00014 - 60593305 - RRR BC -
Flora and Wetlands Technical Report

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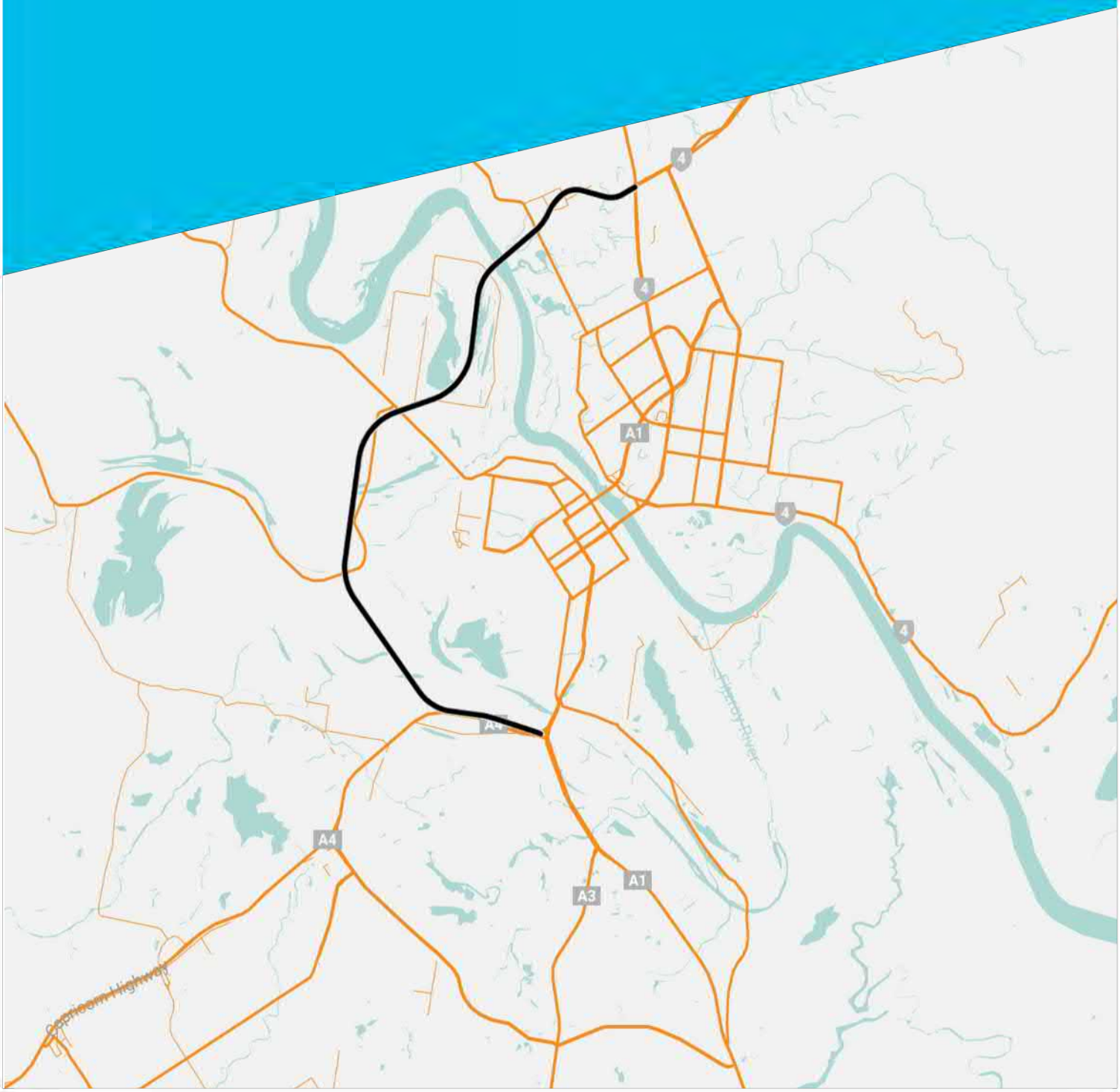

Flora and Wetlands Technical Report

Rockhampton Ring Road - Business Case

Client: Department of Transport and Main Roads

ABN: 39 407 690 291

Prepared by

AECOM Australia Pty Ltd
Level 1, 130 Victoria Parade, PO Box 1049, Rockhampton QLD 4700, Australia
T +61 7 4927 5541 F +61 7 4927 1333 www.aecom.com
ABN 20 093 846 925

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Job No.: 60593305

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Executive summary

The Rockhampton Ring Road (RRR) is the key piece of road infrastructure recommended in the Fitzroy River Floodplain and Road Planning Study (FRFRPS) (AECOM, 2011) which investigated long-term solutions for Bruce Highway flooding impacts on freight, road and rail transport in and around the city of Rockhampton. Since the completion of the FRFRPS, a number of further studies have been carried out to refine the alignment and to investigate issues of flood immunity and the implications of other major infrastructure proposed for the floodplain. The key scope of the Project is to supplement the previous planning report outcomes with a view to compiling and completing a Preliminary Evaluation (PE) and Detailed Business Case (BC) for submission to the Infrastructure Investment Committee (IIC) for assessment.

The RRR Project will provide a western road link of the Bruce Highway to the west of Rockhampton, with key linkages into the city at the Capricorn Highway, Ridgelands Road, Alexandra Street and Yaamba Road (Rockhampton-Yeppoon Road). The RRR alignment will integrate with major infrastructure that has already been completed, including Yeppen North and Yeppen South, as well as current works in development including the Rockhampton Northern Access Upgrade and Capricorn Highway Duplication (Rockhampton – Gracemere).

This report details the flora and wetland ecological assessment of the Project, inclusive of initial works completed during the PE phase. This included documenting the flora species, vegetation communities and wetlands within and adjacent to the Project Area, with a particular focus on features of conservation significance.

The flora and wetlands assessment was undertaken as a two stage process involving a desktop assessment followed by surveys in February and October 2019.

Key findings of the flora and wetlands assessment include:

- the Project Area largely consists of non-remnant vegetation, with some areas of remnant vegetation, including the following regional ecosystems (RE):
  - RE 11.3.4 – 1.21 ha
  - RE 11.3.25 – 1.62 ha
  - RE 11.3.25a – 0.61 ha
  - RE 11.3.27a – 0.85 ha
  - RE 11.3.27c – 5.92 ha
  - RE 11.11.15 – 6.28 ha.
- high value regrowth vegetation was also present throughout the alignment including:
  - RE 11.3.1 – 0.42 ha
  - RE 11.3.3 – 0.23 ha
  - RE 11.3.4 – 16.62 ha
- a total of 0.42 ha of the Brigalow (*Acacia harpophylla* dominant and co-dominant) threatened ecological community was identified within the Project Area.
- a total of 259 flora species representing 72 families were identified. *Eucalyptus raveretiana* (black ironbox), listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was identified as occurring within the northern section of the Project Area.
- a total of 0.61 ha of known *Eucalyptus raveretiana* (black ironbox) habitat (analogous to RE 11.3.25a) is present within the Project Area.
- a total of 100 introduced flora species were identified, including 23 listed weed species.

- although the Project Area intersects areas identified as occurring below Highest Astronomical Tide (HAT), this area is not subject to tidal influence and no plants suggestive of marine influence were identified.
- a number of potential impacts to flora and wetlands may occur as a result of the Project. Mitigation and management measures are recommended to ensure the potential impact on ecological values are minimised or avoided.
- a significant impact assessment (SIA) was undertaken, which determined that the Project is unlikely to result in a significant impact on conservation significant flora species or communities under the EPBC Act.

1.0 Introduction

1.1 Project background

AECOM was commissioned by the Department of Transport and Main Roads (TMR) in November 2018 to carry out the Rockhampton Ring Road (RRR) Preliminary Evaluation (PE) and Detailed Business Case (DBC) Project. The purpose of the Project is to produce a PE and DBC utilising the Queensland Government's Project Assurance Framework (PAF) and Building Queensland's (BQ) Business Case Development Framework (BCDF) to determine a preferred option for the RRR.

The RRR is the key piece of road infrastructure recommended in the Fitzroy River Floodplain and Road Planning Study (FRFRPS) (AECOM, December 2011), which investigated long-term solutions for flooding impacts on freight, road and rail transport in and around the city of Rockhampton. The section of Bruce Highway, from the intersection with the Capricorn Highway through Rockhampton to the intersection with the Rockhampton – Yeppoon Road, has a current Annual Average Daily Traffic (AADT) between 15,760 vehicles and 24,750 vehicles with a large cross river (via Neville Hewitt Bridge) AADT of 33,050 vehicles, which includes 2,670 heavy vehicles. The state-controlled Rockhampton – Yeppoon Road which includes the other road crossing of the Fitzroy River in Rockhampton (via Fitzroy Bridge), has a current AADT across the bridge of 32,030 vehicles including 2,750 heavy vehicles. Cross river traffic on both roads shows slow average growth of 1-1.5 percent annually.

Since the completion of the FRFRPS a number of further studies have been carried out to refine the RRR alignment and to investigate issues of flood immunity and the implications of other major infrastructure proposed for the floodplain.

The Preliminary Evaluation was completed and approved by the IIC in June 2019 with the following recommendations:

- the RRR Project proceed through Gate 2, PE and commence the Detailed Business Case Development phase
- the TMR RRR Project teamwork with BQ to develop a Detailed Business Case in accordance with the Queensland Government's BCDF
- the Detailed Business Case consider the preferred RRR Project option (Option 1: two-lanes) against the Base Case and investigate options further, including:
    - flood immunities and afflux impacts to develop an optimal outcome between bridging and embankment
    - interchange requirements to determine the need for at-grade or grade separated interchanges
    - traffic model sensitivity investigation to increase benefits of the RRR usage
    - test economic assumptions in more detail through traffic modelling and explore additional RRR link benefits.

The RRR Project will provide a western road link of the Bruce Highway to the west of Rockhampton, with key linkages into the city at the Capricorn Highway, West Rockhampton, Alexandra Street and Yaamba Road (Rockhampton – Yeppoon Road).

The RRR alignment will integrate with major infrastructure already completed, including Yeppen North and Yeppen South, as well as current works in development including the Rockhampton Northern Access Upgrade and Capricorn Highway Duplication (Rockhampton – Gracemere).

The Project proposes to deliver the following on the preferred alignment which will provide a highway standard ring road:

- construction of roads and bridges to provide a fit for purpose flood immunity sealed highway
- provision of reserve allowance for the North Coast Rail Line (NCRL) across the Fitzroy River floodplain in conjunction with the road alignment

- multi-modal corridor 140 m (60 m rail, 80 m road)
- construction of a new intersection at the Capricorn Highway, approximately 2 km west of the Yeppen Roundabout
- construction of a new connection to West Rockhampton at Pink Lilly
- construction of a new connection to Parkhurst at Alexandra Street
- reconfiguration of roads and streets to implement improved access at West Rockhampton and Alexandra Street
- intersection upgrade for the connection to the intersection of the Bruce Highway (10F) and Rockhampton - Yeppoon Road (196); and
- relocation of affected Public Utility Plant (PUP).

In February 2017, the Australian and Queensland Governments announced $65 million (Australian Government $52 million and Queensland Government $13 million) to commence the planning and preservation phase of the RRR Project. Planning to preserve and protect the recommended RRR alignment as a future state-controlled road corridor is a priority and includes assessing and placing conditional agreements on any development applications for the identified corridor. The joint federal and state funded RRR (Plan and Preserve) Project will confirm the number of properties impacted by the future state-controlled road corridor.

In late 2018 the Project received a funding commitment of $1 billion for delivery, based on a split of $800 million from the Commonwealth and $200 million from the State Government.

1.2 Project Area

The Project commences on the Capricorn Highway approximately 2 km west of the intersection of the Bruce and Capricorn Highways at the Yeppen Roundabout. The alignment traverses north through the Western Yeppen Floodplain sweeping around the Rockhampton Airport at Pink Lily and intersecting the Rockhampton - Ridgelands Road before crossing the Fitzroy River north of Limestone Creek. After crossing the Fitzroy River, it intersects Alexandra Street in Parkhurst and connects with the Bruce Highway at the Bruce Highway and Rockhampton - Yeppoon Road intersection. See Figure 1 below.

As discussed in Section 1.1, the Project includes the provision of reserve allowance for the North Coast Rail Line (henceforth referred to as the rail corridor). The development of the rail corridor is not included in the Project and therefore is not discussed further in this report. The preferred RRR alignment and connection points (excluding the rail corridor) is referred to as the Project Area (Figure 2). The Project Area is inclusive of a 20 m construction buffer and is a worst-case estimate of total area to be disturbed by the Project.

Initial ecological surveying was completed in February 2019. At that time, the Project was in the PE phase and as such the RRR alignment was the primary investigation area. Following the BC phase in mid-2019, road connections were refined, and an additional day of surveying was completed in October 2019.

Clearing area calculations discussed in this report are for the Project Area, inclusive of the current connection areas.

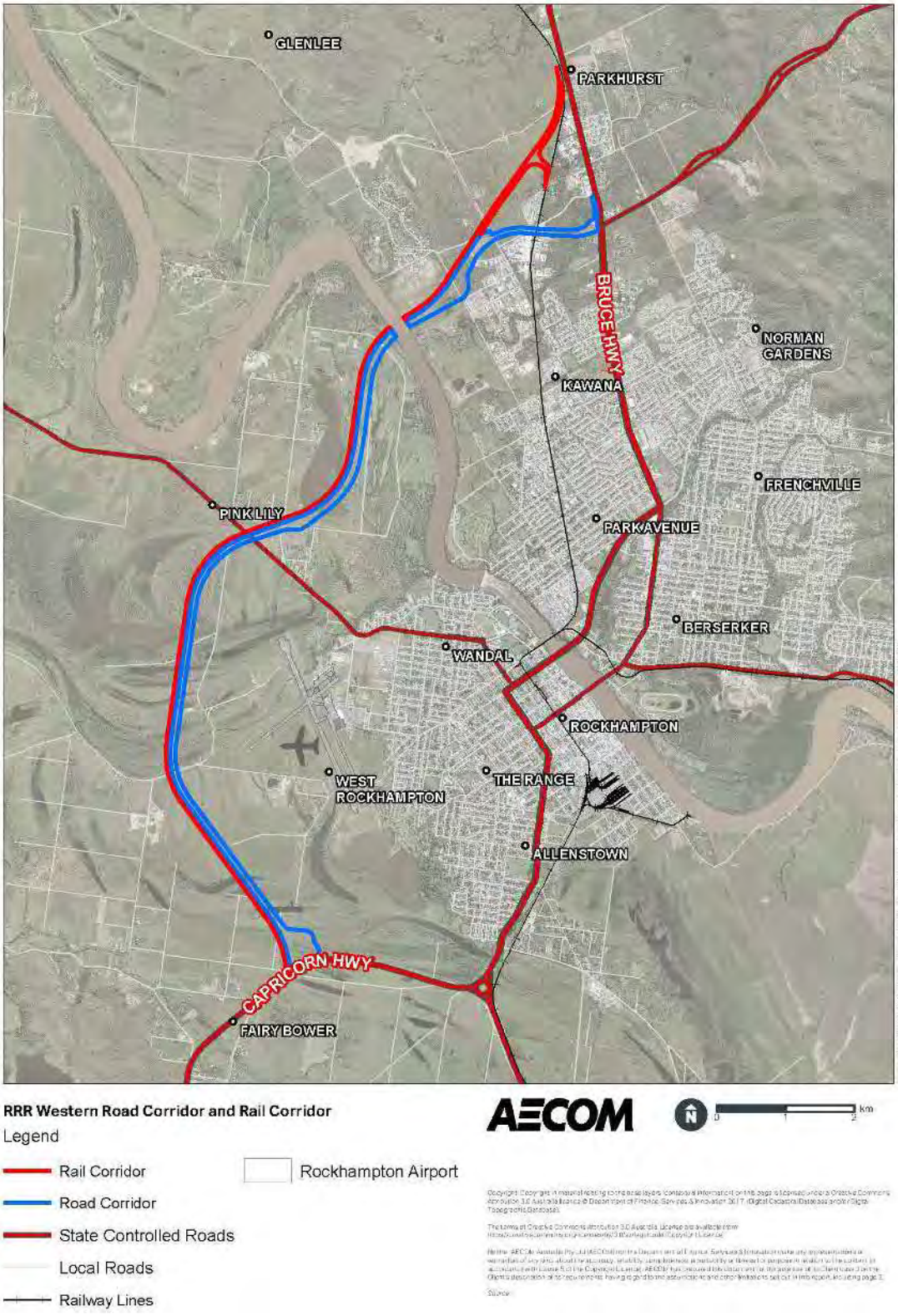

Figure 1 RRR western road and rail corridor

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N

DATUM GDA 1994, PROJECTION MGA ZONE 56

0 550 1,100 2,200

Metres

1:46,000 (when printed at A3)

LEGEND

- Project Area
- Proposed Project Bridges
- Highways
- Roads and Tracks

VM Act Watercourses and Drainage Lines

- Major
- Minor

Data sources:
Base Data: (c) State of Queensland (Department of Natural Resources, Mines and Energy) 2019,
Baseline Roads and Tracks, Railway Network.
Aecom 2019, Corridor and RRR Data

ROCKHAMPTON RING ROAD

PROJECT AREA

PROJECT ID	60593305
CREATED BY	McKeeJ2
LAST MODIFIED	05-Nov-2019
VERSION	<version number>

Figure **2**

A3 size

Filename: \\aurok1fp001\Projects\605x\60593305\900_CAD_GIS\920_GIS\920_GIS\920_02_MXDs\Ecology Report\201910 Updates\60593305_RockhamptonRingRoad_F1_ProjectArea_A3_JM.mxd

1.3 Study aim and objectives

The aim of the flora and wetlands assessment was to document the flora species and vegetation communities within and adjacent to the Project Area, with particular reference to the occurrence of conservation significant species and vegetation communities. The scope of the assessment was to:

- review existing ecology data for the Project Area and surrounding areas
- describe the diversity of flora and wetland areas found in the Project Area
- provide baseline data on Regional Ecosystems (REs) and Threatened Ecological Communities (TECs) occurring in the Project Area
- provide baseline data on Wetland Protection Areas (WPAs) occurring within and adjacent to the Project Area
- identify and map any marine plants occurring within the Project Area
- identify the occurrence or potential occurrence of conservation significant flora species
- assess the potential significance of impacts from the Project on ecological values in the context of relevant legislation
- provide measures to avoid or mitigate adverse impacts on significant ecological values at the construction and operational phases of the Project.

1.4 Assumptions

This flora and wetlands assessment has been undertaken based on the following assumptions:

- as a worst-case scenario it is assumed all vegetation within the Project Area will be cleared for construction.
- the Project Area is comprised of the main alignment and connection areas with a 20 m buffer for construction. It is noted that the timing of the initial field survey (February 2019) preceded the design of the connections. An additional day of surveying was completed in October 2019 once the connection areas had been confirmed.
- the Project Area detailed in this report is based on the BC design noting that the location of proposed bridges is final. Further refinements to the Project Area may occur throughout detailed design, however this will only reduce the proposed impact area.
- ground-truthing of vegetation, flora and wetlands within Lot 2 on SP247118, Lot 1 on RP604085 and Lot 21 on RP844280 was conducted from the roadside and adjacent properties due to access restrictions.

2.0 Legislative context

2.1 Commonwealth legislation

2.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes a process for environmental assessment and approval of proposed actions that have, will have, or are likely to have a significant impact on Matters of National Environmental Significance (MNES) or on Commonwealth land.

The nine MNES outlined in EPBC Act include:

- world heritage properties
- national heritage places
- Ramsar wetlands of international importance
- listed threatened species and ecological communities
- listed migratory species (listed under international agreements)
- Commonwealth marine areas
- Great Barrier Reef Marine Park
- nuclear actions (including uranium mining)
- a water resource, in relation to coal seam gas development and large coal mining development.

Under the EPBC Act, a referral to the Department of the Environment and Energy (DoEE) is required if the Project has the potential to cause a 'significant impact' on MNES. The determination is made with reference to the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Department of the Environment, 2013) and other EPBC Act policy statements including significant impact guidelines for individual threatened species, groups of species and threatened ecological communities.

The EPBC Act also identifies and protects Threatened Ecological Communities (TECs). Types of TECs listed under the EPBC Act include woodlands, grasslands, shrublands, forests, wetlands, marine, ground springs and cave communities. TECs are listed under the EPBC Act in the following categories:

- extinct in the wild
- critically endangered
- endangered
- vulnerable.

Conservation significant species are listed under the EPBC Act in the following categories:

- extinct
- extinct in the wild
- critically endangered
- endangered
- vulnerable.

2.1.2 Weeds of National Environmental Significance

Thirty-two (32) Weeds of National Significance (WoNS) have been identified by the Australian Government using an assessment process that prioritised these weeds based on their invasiveness, potential for spread and environmental, social and economic impacts. For the 32 WoNS, customised and targeted management plans have been developed.

2.2 State legislation

2.2.1 *Nature Conservation Act 1992*

The objective of the *Nature Conservation Act 1992* (NC Act) is “the conservation of nature” (Section 4, NC Act). In support of the NC Act, the Nature Conservation (Wildlife) Regulation 2006 lists ‘protected wildlife’ (flora and fauna species), which are considered to be ‘extinct in the wild’, endangered’, ‘vulnerable’, ‘near threatened’ and ‘least concern’ wildlife. Under Sections 88 and 89 of the NC Act, it is an offence to take or use protected wildlife, which is outside a ‘protected area’, unless exemptions apply or an approval (e.g. clearing permit) is obtained from the Department of Environment and Science (DES).

Conservation significant species are listed under the NC Act in the following categories:

- extinct in the wild
- endangered
- vulnerable
- near threatened
- special least concern (least concern species of special cultural significance).

Protected plants flora survey trigger map

In Queensland, all plants that are native to Australia are protected plants under the NC Act to prevent whole plants or protected plant parts from being illegally removed from the wild or illegally traded. The flora survey trigger mapping shows high risk areas for protected plants, and is used to help determine the flora survey and clearing permit requirements for a particular location. High risk areas represent those areas where endangered, vulnerable or near threatened plants are known to exist or are likely to exist.

Where clearing is predicted to occur within a high risk area, a flora survey is required to determine the presence of protected plants within the clearing impact area. The flora survey must then be lodged with DES to either obtain an approval, or an exemption notice (if no protected plant species are present).

2.2.2 *Vegetation Management Act 1999*

The *Vegetation Management Act 1999* (VM Act) regulates the clearing of native vegetation in Queensland. The purpose of the VM Act, outlined in Section 3(1), is to regulate the clearing of vegetation in a way that:

(a) conserves remnant vegetation

(b) conserves vegetation in declared areas

(c) ensures that clearing does not cause land degradation

(d) prevents the loss of biodiversity

(e) maintains ecological processes

(f) manages the environmental effects of the clearing to achieve the matters mentioned in paragraphs (a) to (e)

(g) reduces greenhouse gas emissions; and

(h) allows for sustainable land use.

Regulated vegetation

The VM Act protects and regulates the clearing of native vegetation including 'remnant' and 'high value regrowth' (HVR) vegetation (shown as Category B and C on the regulated vegetation management map respectively) on freehold land, Indigenous land and State tenures.

The VM Act also protects Category R vegetation; that is native woody vegetation on freehold land, Indigenous land or leasehold land granted for agriculture or grazing purposes, located within 50 m of a watercourse in the Burdekin, Mackay, Whitsunday and Wet Tropics Great Barrier Reef catchments.

A relevant purpose determination needs to be obtained in accordance with section 22A of the VM Act, otherwise the development (vegetation clearance) is considered prohibited development. Once a determination has been obtained, a development permit will need to be obtained under the *Planning Act 2016*. However, the clearing of regulated vegetation for transport infrastructure is exempt under Schedule 21, Part 1, Item 1, Section 14(b) of the Planning Regulation 2017. Therefore, a development permit is not required once the land is a state controlled road reserve.

Regional ecosystems

Regional ecosystems (REs) are vegetation communities in a bioregion that are typically associated with a particular combination of geology, landform and soil (Sattler, P, & Williams, R., 1999). The RE classification scheme is used to incorporate biodiversity into planning and management through the provisions of the VM Act.

Under the VM Act, REs are assigned a Vegetation Management class (VM class) and biodiversity status. The VM class is listed in the Vegetation Management Regulation 2012 and used in the regulation of clearing. Biodiversity status is used for a variety of planning and management applications and is based on an assessment of the condition of remnant vegetation in addition to the VM class determined under the VM Act.

Vegetation communities or REs are listed under the VM Act in the following categories:

- endangered
- of concern
- no concern at present / least concern.

Essential habitat

Essential habitat is regulated under the VM Act and is vegetation in which threatened species listed under the NC Act have been known to occur. Clearing of essential habitat is assessed through the development assessment process under the *Planning Act 2016*. Where clearing cannot be reasonably avoided or minimised, an offset may be required under the *Environmental Offsets Act 2014* (EO Act).

2.2.3 *Environmental Protection Act 1994*

The objective of the *Environmental Protection Act 1994* (EP Act) is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends (ecologically sustainable development) (refer Section 3, EP Act).

The EP Act provides the key legislative framework for the protection of the environment in Queensland. Section 319 of the EP Act imposes a 'general environmental duty', which specifies that a person must not undertake any activity that may harm the environment without taking reasonable and practical measures to prevent or minimise the harm.

There are also several issue-specific Environmental Protection Policies (EPPs) that the Project will need to comply with. These include the Environmental Protection Regulation 2008, Environmental Protection (Air) Policy 2008, Environmental Protection (Noise) Policy 2008 and Environmental Protection (Water) Policy 2009.

Environmentally relevant activities

In co-ordination with the *Planning Act 2016*, the EP Act provides for licensing and approval of Environmentally Relevant Activities (ERAs). ERAs are activities that require specific regulation because of the likelihood that they could cause environmental harm. To carry out an ERA, an Environmental Authority (EA) must be obtained prior to commencing the activity. A full list of the prescribed ERAs can be found in Schedule 2 of the Environmental Protection Regulation 2008.

Wetlands

The Environmental Protection Regulation 2008 defines referrable Wetland Protection Areas (WPAs) and wetland trigger areas. The regulation works in conjunction with the *Planning Act 2016* for regulated development within mapped referable wetlands. Schedule 10 of the Planning Regulation 2017 identifies development involving high impact earthworks within a WPA or trigger area as assessable development.

The construction of a new road falls in the definition of high impact earthwork if it involves operational works which will change the form of the land and involve the extraction of more than 100 m^2 within a wetland. High impact earthworks are prohibited development under the Planning Regulation 2017 unless the works can achieve compliance with the accepted development criteria which are detailed in Schedule 14 of the Planning Regulations 2017 for government supported transport infrastructure.

2.2.4 *Fisheries Act 1994*

Marine plants in Queensland are protected under the *Fisheries Act 1994* (Fisheries Act). This protection is provided to all marine plants, including mangroves, seagrass, salt couch, salt marshes etc. Marine plants are defined in Section 8 of the Fisheries Act as stated below.

1. *'Marine plant' includes the following –*
    a. *a plant (a 'tidal plant') that usually grows on, or adjacent to, tidal land, whether it is living, dead, standing or fallen;*
    b. *material of a tidal plant, or other plant material on tidal land;*
    c. *a plant, or material of a plant, prescribed under a regulation or management plan to be a marine plant.*
2. *'Marine plant' does not include a plant that is –*
    a. *prohibited matter or restricted matter under the Biosecurity Act 2014; or*
    b. *controlled biosecurity matter or regulated biosecurity matter under the Biosecurity Act 2014.*

Marine plant protection applies irrespective of the tenure (e.g. unallocated state land and all state tenured lands, including private freehold and leasehold lands) of the land on which the plant occurs, the duration that the plant has been growing at the location, or the degree and/or purpose of the disturbance.

2.2.5 *Environmental Offsets Act 2014*

The Queensland EO Act coordinates the delivery of environmental offsets across jurisdictions and places limits on when an environmental offset condition may be imposed. It also provides for the subsequent assessment, delivery and compliance with offset conditions once imposed.

The Environmental Offsets Regulation 2014 (EO Regulation) provides details of the prescribed activities regulated under existing legislation and the prescribed environmental matters to which the EO Act applies.

Matters of State Environmental Significance (MSES) are a component of the biodiversity state interest that is defined under the State Planning Policy (SPP) and defined under the EO Regulation.

MSES are defined as:

- regulated vegetation (Category B, Category C, Category R, essential habitat, remnant vegetation within the defined distance of a watercourse, and vegetation within 100 m of a wetland)
- connectivity areas

- wetlands and watercourses (declared high-value waters (wetlands and watercourses), high ecological significance (HES) wetlands, and WPAs)
- designated precincts in Strategic Environmental Areas
- protected wildlife habitat
- protected areas (national parks (Aboriginal land; Torres Strait Islander land; Cape York Peninsula Aboriginal land), regional parks; and nature refuges)
- declared Fish Habitat Areas and highly protected zones of State marine parks
- waterway providing for fish passage
- marine plants
- legally secured offsets areas.

An environmental offset condition may be imposed under various state assessment frameworks for an activity prescribed under the EO Act, if the activity will, or is likely to have a significant residual impact (SRI) on a prescribed environmental matter that is a MSES. Offset delivery options include:

- financial settlement offsets[1] – which are a payment made into the offsets account
- proponent driven offsets which include land based offsets and or delivery of actions in Direct Benefit Management Plan
- combinations of the above; and
- advanced offsets[2] and advanced offsets in a Strategic Offset Investment Corridor[3] which have or will be identified by DES.

2.2.6 *Biosecurity Act 2014*

The *Biosecurity Act 2014* is administered by the Department of Agriculture and Fisheries (DAF). The Act provides management measures to protect agricultural and tourism industries and the environment from pests, diseases and contaminants. Under the Act, everyone has a 'general biosecurity obligation' to manage biosecurity risks that are under their control and that they know about or should be reasonably expected to know about. Under this obligation, individuals and organisations must take all reasonable and practical steps to prevent or minimise each biosecurity risk.

Under the Act, invasive plants and animals are categorised as either a 'Prohibited Matter' or a 'Restricted Matter' and replace the 'Declared' status under the superseded *Land Protection (Pest and Stock Route Management) Act 2002*. The Biosecurity Act 2014 also requires every local government in Queensland to develop a biosecurity plan for their area.

Rockhampton Regional Council Biosecurity Plan

The *Biosecurity Plan for Pest Management: 2017 – 2021* (Rockhampton Regional Council, 2017) has been developed to satisfy local government requirements under the *Biosecurity Act 2014*. The Plan establishes local priorities and outlines actions proposed to manage biosecurity issues in the region for invasive biosecurity matters identified by the Act and other species identified as having significant local impacts within the region. The plan outlines the following six key issues and Council's commitments associated with each:

1. awareness and education
2. informed decision making
3. prevention, early detection, containment and eradiation
4. strategic planning framework and management

[1] A financial settlement offset is a payment for a significant residual impact on a prescribed environmental matter(s).
[2] Advanced offsets are put in place before any impact occurs.
[3] To date only three have been identified by DES, the Galilee Basin, the Southern Brigalow Belt and New England Tableland, and the Western Queensland, Gulf Plains, Northwest Highlands, Mitchell Grass Downs and Channel Country.

5. effective integrated management systems
6. commitment and partnership.

A prioritisation process for the management of invasive plants and animals, determined by assessing the invasiveness, impacts and potential distribution of each species coupled with the feasibility of containment underpins the plan. Species are grouped into the strategic management categories of prevention, eradication, destruction of infestations, and containment, with the plan outlining the management objectives and actions for each group.

3.0 Methods

3.1 Nomenclature

Scientific names for terrestrial flora are consistent with those used in the Census of the Queensland Flora (Bostock & Holland, 2018) and botanical binomials presently accepted by the Queensland Herbarium. An asterisk (*) preceding a species name indicates a non-native species.

3.2 Desktop assessment

A desktop assessment was undertaken to characterise and identify potential flora species and vegetation communities that may be present in the Project Area. The desktop assessment included a review of literature, searches of publicly available datasets, online mapping and aerial imagery.

3.2.1 Literature review

The desktop assessment included a literature review of previous studies undertaken in the vicinity of the Project including:

- *Rockhampton Northern Access Upgrade: Protected Plant Survey* (AECOM, 2017b)
- *Rockhampton Northern Access Upgrade: Preliminary Flora and Fauna Technical Report* (AECOM, 2017a).

3.2.2 Review of ecological data

Searches of publicly available datasets and online mapping were completed to a 10 km search area around the Project Area. A review of the following databases was completed:

- EPBC Act Protected Matters Search Tool (PMST)
- DES Wildlife Online database to identify flora species recorded from or surrounding the Project Area
- Atlas of Living Australia (ALA) database to identify locations of previously recorded conservation significant flora species within and adjacent to the Project Area
- Department of Natural Resources, Mines and Energy (DNRME) regulated vegetation management map including essential habitat, wetlands, watercourses and other protected areas under the VM Act
- Queensland Herbarium vegetation management regional ecosystems (RE) mapping
- DES protected plants flora survey trigger map
- DES wetland protection area mapping
- Queensland Herbarium regional ecosystem description database (REDD) (Queensland Herbarium, 2018a)
- Biodiversity Planning Assessment (BPA) mapping
- Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIP) development application mapping
- Great Barrier Reef WPA mapping
- Queensland wetland classification mapping
- Rockhampton Regional Council Planning Scheme 2017 mapping
- species distribution maps from various current field guides.

3.2.3 Aerial imagery

Aerial imagery was reviewed to investigate the nature and extent of vegetation communities, wetlands and suitable habitat within and adjacent to the Project Area, and to develop an understanding of site

context as part of the surrounding environment. Information collected as part of the desktop assessment was reviewed and used in the preparation of the field surveys through the identification of flora species potentially found within and/or utilising the Project Area.

3.3 Field survey method

3.3.1 Regional ecosystems

The assessment of the REs and flora within the Project Area was undertaken in accordance with the methodology developed by the Queensland Herbarium, *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner, Wilson, Dillewaard, Ryan, & Butler, 2017).

Vegetation was sampled at nine secondary and 90 quaternary level sites across the Project Area. Survey sites were selected to sample the variation in vegetation mapped, including both remnant and non-remnant areas, and targeting each RE identified across the Project Area.

At each secondary site, full floristics, structural and abundance information was collected within a 50 m by 10 m transect. This included a full species list and vegetation structural descriptions including strata, height, abundance and cover values for each species. At each quaternary site, the dominant species were recorded including a vegetation structural description of the dominant overstorey species. See Figure 3 for the location of flora assessment locations.

As per the Queensland Herbarium methodology, each survey site was attributed to an RE based on the land zone and dominant species observed. RE mapping boundaries were adjusted based on field verification. During the course of the field survey, opportunistic flora species not observed at the secondary and quaternary sites, were also recorded.

3.3.2 Threatened ecological communities

In addition to the data collected as part of the RE verification, areas identified as potential TECs were assessed in the field against the relevant conservation advice for that TEC. Specifically, potential TECs must meet key diagnostic criteria and condition thresholds outlined in the conservation advice to be considered as a TEC.

3.3.3 Conservation significant flora species

The Project Area was surveyed utilising the random meander survey technique to identify potential conservation significant flora species under the EPBC Act. A flora survey in accordance with the *Flora Survey Guidelines* under the NC Act was undertaken in areas of the alignment identified as high risk on the flora survey trigger map (Department of Environment and Science, 2019b). This was undertaken as a separate body of work and the results are presented in the *Protected Plants Survey* (AECOM, 2019b).

3.3.4 Marine plants

Where the Project Area crosses the Fitzroy River, surveying utilising the random meander survey technique was completed to identify marine plants.

3.3.5 Weed species

Local, State and Commonwealth listed weed species were recorded as incidental sightings where located within or immediately adjacent to the Project Area. Flora survey sites undertaken for RE mapping also recorded weed species present within the plot.

3.3.6 Wetlands

Wetland delineation has been undertaken in accordance with the *Queensland Wetland Definition and Delineation Guideline Part A and Part B* (Department of Environment and Resource Management, 2011; Management, 2011). The method involves assessing a variety of indicators including hydrology, vegetation, soil and fauna in a series of steps. Not all steps may be required, as a positive wetland determination and boundary delineation may be made whenever sufficient information for a positive wetland indicator has been collected (see Plate 1 below).

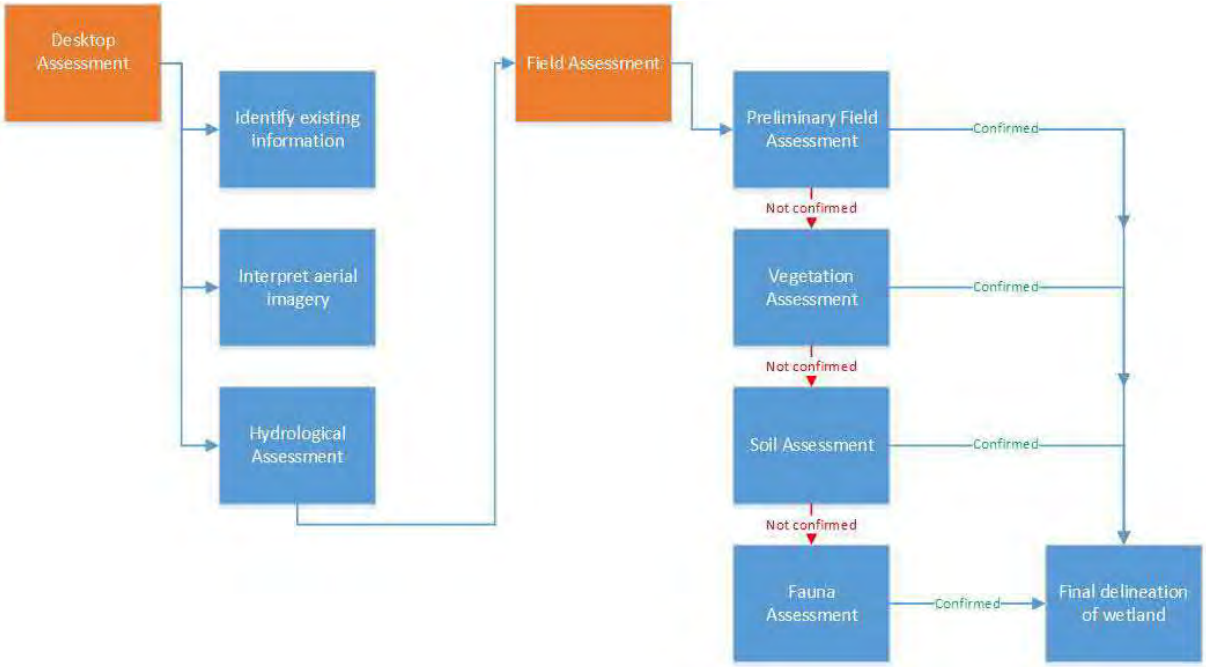


Plate 1 ***Queensland Wetland Definition and Delineation Guidelines*** **wetland methodology**

3.3.7 Specimen identification

Where flora species could not be positively identified to species level in the field, samples were pressed and dried in a plant press. Further identification was undertaken in the office or submitted to the Queensland Herbarium for identification.

3.4 Likelihood of occurrence

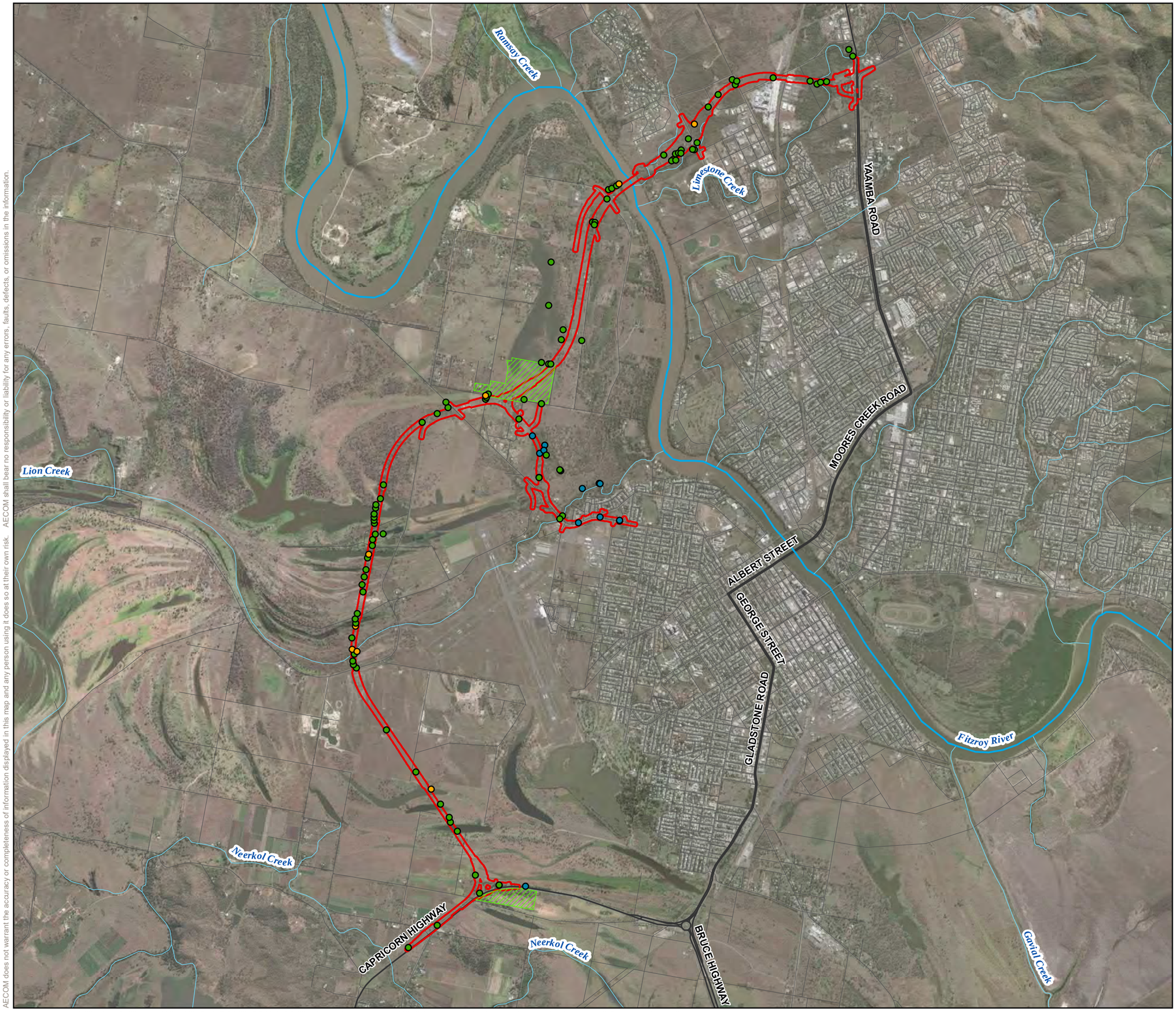
The presence or absence of flora species over time cannot be definitively determined during a single or short survey effort. The occurrence of species varies temporally, as a result of seasonal changes and between years of high rainfall and drought.

A likelihood of occurrence assessment for conservation significant flora species identified during the desktop review was undertaken. The assessment considered known habitat and ecological requirements of the species against the habitat types identified in the field surveys.

Each species was assessed against the categories defined below.

- Unlikely: The species has no recent historical records, has no preferred habitat in the Project Area and is considered unlikely to be present.
- Low: Some of the preferred habitat is present in the Project Area.
- Moderate: The Project Area contains some of the preferred habitat to support a population of the species and/or the species has been recorded within the vicinity of Project Area.
- High: Species has previously been recorded in the Project Area. The site contains significant preferred habitat which is likely to support a population of the species.
- Present: Species directly observed in the Project Area.

This process is to be used as a guide and is not to be used as indicating species presence or absence other than where observed presence is indicated.



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DATUM GDA 1994, PROJECTION MGA ZONE 56

0 550 1,100 2,200

Metres

1:46,000 (when printed at A3)

LEGEND

- Project Area
- No Access Properties - 1/RP604085, 2/SP247118 & 21/RP844280
- Highways
- Roads and Tracks

VM Act Watercourses and Drainage Lines

- Major
- Minor

Flora and Wetland Survey Sites

- Secondary
- Quaternary
- Observation Points

Data sources:
Base Data: (c) State of Queensland (Department of Natural Resources, Mines and Energy) 2019,
Baseline Roads and Tracks, Railway Network.
Aecom 2019, Corridor and RRR Data

ROCKHAMPTON RING ROAD

FLORA & WETLAND SURVEY LOCATIONS

PROJECT ID	60593305
CREATED BY	McKeeJ2
LAST MODIFIED	06-Nov-2019
VERSION	<version number>

Figure **3**

A3 size

Filename: \\aurok1fp001\Projects\605x\60593305\900_CAD_GIS\920_GIS\920_GIS\920_02_MXDs\Ecology Report\201910 Updates\60593305_FW_RockhamptonRingRoad_F3_SurveyLocations_A3_JM.mxd

3.5 Limitations

3.5.1 General

A separate standalone Protected Plants Survey Report has been prepared to address requirements under the NC Act (AECOM, 2019b). This report does not assess the requirements for any permits or approvals to clear or disturb protected plants under the NC Act. To ensure a thorough approach to flora identification, a brief summary of protected plants surveying completed for the Project has been incorporated into this report.

3.5.2 Desktop assessment

Information gained from online databases (Section 4.1) have caveats to be considered regarding the robustness or completeness of the information. Data is based on a combination of records (from various sources) combined with modelled distributions of species according to their ecological characteristics. The presence or absence of species identified from these databases is an indication of potential presence only, and not a definitive identification. The absence of any specimen record for a species from an area also does not imply that the species does not occur in the area.

3.5.3 Flora survey

A flora field survey has inherent limitations associated with the variability of vegetation communities across a survey location, and changes to the detectability and presence of species over time. Survey locations were strategically located to capture representative samples of all communities. Although the timing of the initial flora survey was within typical wet season months, the region had not received any significant rainfall events. Additionally, the October 2019 field survey was conducted following a period of unseasonably low rainfall and this may have affected the detectability of some species.

Field surveys that have timing constraints cannot always account for 100% of potential floral diversity across a survey location. Furthermore, large areas of the Project Area were heavily grazed which significantly reduced the ability of the field team to positively identify grass species.

3.5.4 Wetland survey

The guidelines for defining wetlands (Department of Environment and Resource Management, 2011; Management, 2011) allow for a broad interpretation of the presence / absence of wetland characteristics on the ground. As many wetlands are seasonal by nature this adds to the difficulties associated with definition and delineation, as the temporal and spatial variability of wetland hydrology influences observable characteristics at any one time. As a result, the methodology applied is intended to be a multiple-lines of evidence approach whereby more conclusive indicators can be used to collectively define and delineate a wetland.

3.5.5 Wetland hydrological assessment

C&R Consulting have been engaged by AECOM to complete a wetland impact assessment for the Project. The purpose of this assessment is to determine the potential impacts of the construction and operation of the Project on mapped HES wetlands within and adjacent to the Project Area. The assessment included a literature review, completed in August 2019, followed by the development of conceptual models for each wetland.

Potential impacts to wetlands detailed in this report are based on findings outlined in the draft report *Wetland Impact Assessment – Rockhampton Ring Road* (C&R Consulting Pty Ltd, 2019).

3.5.6 Data collection and mapping

Field survey data collection to inform mapping was conducted using a hand-held iPad unit with aerial imagery. The accuracy of the iPad is generally <6 metres and is not intended to be relied upon for design purposes.

In accordance with (Department of Environment and Resource Management, 2011; Management, 2011) and (Neldner et al., 2017) the wetland and RE mapping has been undertaken to a mapping scale of 1:25,000.

4.0 Results

4.1 Desktop assessment

4.1.1 Previous ecological assessments

AECOM has undertaken previous environmental assessments within northern areas of the Project Area in an earlier TMR Project:

- *Rockhampton Northern Access Upgrade: Protected Plant Survey* (AECOM, 2017b)
- *Rockhampton Northern Access Upgrade: Preliminary Flora and Fauna Technical Report* (AECOM, 2017a).

The key findings from these reports are summarised below:

- a flora survey was undertaken in February and May 2017
- RE 11.3.4 and 11.3.25a were mapped within Limestone Creek and the current Project Area
- an EPBC Act listed flora species *Eucalyptus raveretiana* (black ironbox) was identified within Limestone Creek and the current Project Area
- a likelihood of occurrence assessment was undertaken and has informed the current assessment.

4.1.2 Bioregional context

The Project Area occurs within the Brigalow Belt Bioregion which lies between the Queensland – New South Wales border in the south, to Townsville in the north. The bioregion receives between 500-759 millimetres (mm) of rainfall per annum. The Bioregion is characterised by the tree species *Acacia harpophylla* (brigalow) which forms forest and woodland on clay soils. Rather than being dominated by brigalow, the bioregion supports a range of ecosystems including eucalypt forest and woodland, grassland, dry rainforest, cypress pine woodland and riparian communities (Sattler & Williams, 1999).

Within the Brigalow Belt Bioregion, the Project Area occurs within the Marlborough Plains Province (Sattler & Williams, 1999). The landform of the area is undulating to hilly with a complex geology, and is dominated by alluvial plains and colluvial slopes, with woodlands of poplar gum (*Eucalyptus platyphylla*), ghost gum (*Corymbia dallachiana*), blue gum (*E. tereticornis*) and tea tree (*Melaleuca* spp.). Low rises carry narrow leaved ironbark (*E. crebra*). Hillier areas carry narrow-leaved ironbark, lemon scented gum (*Corymbia citriodora*), bloodwood (*Corymbia* spp.) and supplejack (*Lophostemon* spp.).

4.1.3 Geology

The DNRME digital geological mapping for Rockhampton and Ridgelands identifies the Project Area contains mainly Quaternary alluvium (Qa) throughout with Rockhampton Group present in the northern section of the alignment (Department of Natural Resources Mines and Energy, 2012). Geology units are described in detail in Table 1 below.

Table 1 Major surface geology units and soils mapped within the Project Area

Unit name	Map symbology	Age	Lithology summary
Qa/1-Yarrol/Scag	Qa/1	Quaternary	Clay, silt, sand, gravel; intermediate terraces of Boyne and Fitzroy River floodplain alluvium.
Qa/2-Yarrol/Scag	Qa/2	Quaternary	Clay, silt, sand, gravel; highest terraces of Boyne and Fitzroy River floodplain alluvium.
Qha-QLD	Qha	Holocene	Sand, gravel, silt and clay; active stream channels and low terraces.
Qa-QLD	Qa	Quaternary	Clay, silt, sand, gravel; flood-plain alluvium.

Unit name	Map symbology	Age	Lithology summary
Rockhampton Group, Mount Alma Formation	Cr, DCa	Late Devonian – Early Carboniferous	Complex zone containing fold and fault repetitions of Rockhampton Group and Mount Alma Formation.
Rockhampton Group	Cr/l	Early Carboniferous	Oolitic limestone, calcareous sandstone.

4.1.4 Land zones

Land zones are categories that describe the major geologies, the associated landforms and geomorphic processes in Queensland, and are a critical component of the RE classification scheme. Land zones have been delineated across the Project Area based on the available surface geology mapping. Three land zones have been delineated across the Project Area and are broadly consistent with the surface geology mapping. Definitions are consistent with (Wilson & Taylor, 2012).

Table 2 Land zones and associated surface geologies present within the Project Area

Land zone	Description	Associated geological unit
3	Recent Quaternary alluvial systems, including closed depressions, paleo-estuarine deposits currently under freshwater influence, inland lakes and associated wave built lunettes. Excludes colluvial deposits such as talus slopes and pediments. Includes a diverse range of soils, predominantly Vertosols and Sodosols; also with Dermosols, Kurosols, Chromosols, Kandosols, Tenosols, Rudosols and Hydrosols; and Organosols in high rainfall areas.	Qa, Qa/1, Qa/2, Qha
11	Metamorphosed rocks, forming ranges, hills and lowlands. Primarily lower Permian and older sedimentary formations which are generally moderately to strongly deformed. Includes low- to high-grade and contact metamorphics such as phyllites, slates, gneisses of indeterminate origin and serpentinite, and interbedded volcanics. Soils are mainly shallow, gravelly Rudosols and Tenosols, with Sodosols and Chromosols on lower slopes and gently undulating areas. Soils are typically of low to moderate fertility.	Cr, DCa, Cr/l
12	Mesozoic to Proterozoic igneous rocks, forming ranges, hills and lowlands. Acid, intermediate and basic intrusive and volcanic rocks such as granites, granodiorites, gabbros, dolerites, andesites and rhyolites, as well as minor areas of associated interbedded sediments. Excludes serpentinites (land zone 11) and younger igneous rocks (land zone 8). Soils are mainly Tenosols on steeper slopes with Chromosols and Sodosols on lower slopes and gently undulating areas. Soils are typically of low to moderate fertility.	-

4.1.5 Regulated vegetation

The DRNME Vegetation Management Report identified four vegetation management categories as occurring within the Project Area, as outlined in Table 3 below. In Queensland, remnant and HVR vegetation is described and mapped by the Queensland Herbarium as REs. Regulated vegetation in the Project Area is mapped in Figure 4.

Table 3 Mapped regulated vegetation within the Project Area

Category	Description
B	Remnant vegetation.
C	High value regrowth.
R	Regrowth within 50 m of a watercourse or drainage feature in the Great Barrier Reef catchment areas.
X	Non-remnant vegetation.

4.1.6 Mapped regional ecosystems

Based on the Queensland Herbarium RE mapping (Version 11), the Project Area is predominantly located within non-remnant vegetation (Category X regulated vegetation), intersecting ten REs along the Project Area (Category B and C vegetation), as listed in Table 4 below.

Table 4 Mapped REs within the Project Area

RE	Short Description[1]	VM Act Status	Biodiversity Status[2]
11.3.2	*Eucalyptus populnea* woodland on alluvial plains.	Of concern	Of concern
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains.	Of concern	Of concern
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on alluvial plains.	Of concern	Of concern
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines.	Least concern	Of concern
11.3.25f	Main river channels. Open water or exposed stream beds and bars.	Least concern	Of concern
11.3.27	Freshwater wetlands.	Least concern	Of concern
11.3.27a	Vegetation ranges from open water +/- aquatics and emergent.	Least concern	Of concern
11.3.27c	Mixed grassland or sedgeland with areas of open water +/- aquatic species.	Least concern	Of concern
11.11.15	*Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics.	Least concern	No concern at present
11.12.1	*Eucalyptus crebra* woodland on igneous rocks.	Least concern	No concern at present

[1] Full descriptions of REs contained in the Regional Ecosystem Description Database (REDD) Version 11 (Queensland Herbarium, 2018b).

[2] Biodiversity status under the VM Act.

4.1.7 Threatened ecological communities

The desktop assessment identified three TECs as potentially occurring within the Project Area. These TECs are described in Table 5 below with their status and corresponding REs. Mapped REs within the Project Area are shown in bold.

Table 5 TECs potentially occurring within the Project Area

TEC	EPBC Act Status	Analogous REs
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Endangered	11.3.1, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14, 11.12.21.
Semi-Evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	11.3.11, 11.4.1, 11.5.15, 11.8.13, 11.9.4, 11.11.18, 11.2.3, 11.8.3, 11.8.6, 11.9.8.
Weeping Myall Woodlands	Endangered	**11.3.2**, 11.3.28.

4.1.8 Conservation significant flora

The desktop assessment identified 12 conservation significant flora species with the potential to occur within the Project Area. These species and their respective conservation status under the EPBC Act and NC Act are detailed in Table 6 below.

Table 6 Conservation significant flora with potential to occur within the Project Area

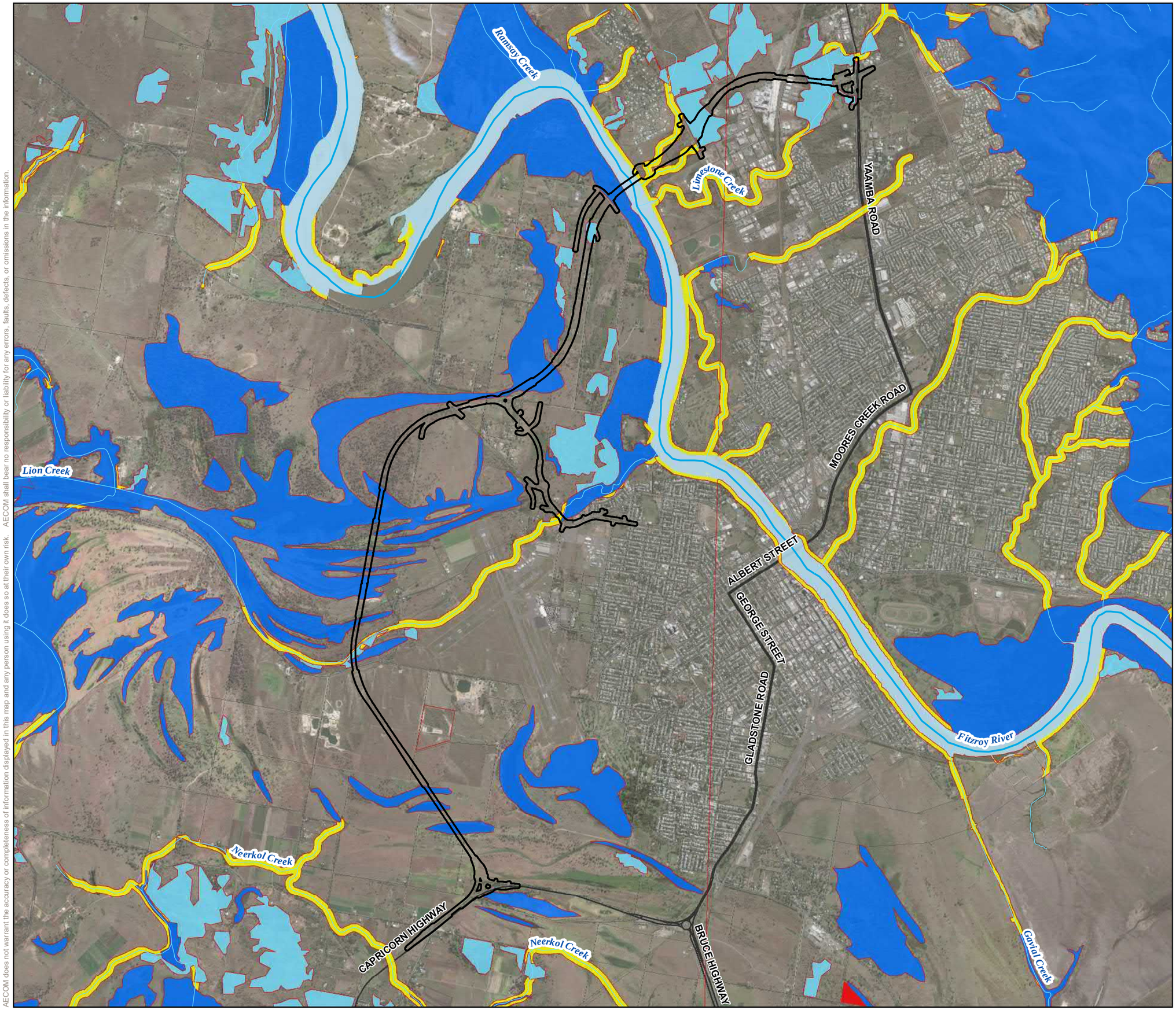
Scientific Name	Common Name	EPBC Act Status	NC Act Status
Backhousia oligantha	-	Not listed	Endangered
Callicarpa thozetii	-	Not listed	Endangered
Cycas megacarpa	Marlborough blue	Endangered	Endangered
Cycas ophiolitica	Cycad	Endangered	Endangered
Dichanthium setosum	Bluegrass	Vulnerable	Not listed
Eucalyptus raveretiana	Black ironbox	Vulnerable	Not listed
Graptophyllum excelsum	Scarlet fuchsia	Not listed	Near Threatened
Livistona drudei	Fan palm	Not listed	Vulnerable
Marsdenia brevifolia	-	Vulnerable	Vulnerable
Phaius australis	Lesser swamp orchid	Endangered	Endangered
Samadera bidwillii	Quassia	Vulnerable	Vulnerable
Stackhousia tryonii	-	Not listed	Near Threatened

4.1.9 Essential habitat

A review of DNRME Essential Habitat mapping identified that essential habitat for conservation significant flora does not occur within the Project Area.

4.1.10 Protected plants trigger area

A high risk area is mapped within the Project Area, as identified on the protected plants flora survey trigger map (Department of Environment and Science, 2019b). AECOM (2019c) outlines the full results of the desktop assessment for protected plants under the NC Act.



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DATUM GDA 1994, PROJECTION MGA ZONE 56

0 550 1,100 2,200

Metres

1:46,000 (when printed at A3)

LEGEND

- Project Area
- Highways
- Roads and Tracks

VM Act Watercourses and Drainage Lines

- Major
- Minor

Regulated Vegetation Management (RVM)

RVM Category

- A
- B
- C
- R
- X
- Water

Data sources:
Base Data: (c) State of Queensland (Department of Natural Resources, Mines and Energy) 2019,
Baseline Roads and Tracks, Railway Network.
Aecom 2019, Corridor and RRR Data

ROCKHAMPTON RING ROAD

REGULATED VEGETATION

PROJECT ID	60593305
CREATED BY	McKeeJ2
LAST MODIFIED	06-Nov-2019
VERSION	<version number>

Figure **4**

A3 size

Filename: \\aurok1fp001\Projects\605x\60593305\900_CAD_GIS\920_GIS\920_GIS\920_02_MXDs\Ecology Report\201910 Updates\60593305_FW_RockhamptonRingRoad_F4_DesktopRegulatedVeg_A3_JM.mxd

4.1.11 Marine plants

Riparian areas along the Fitzroy River intersecting the Project Area are identified as occurring at and below Highest Astronomical Tide (HAT). There are no mangrove communities mapped in this area.

4.1.12 Significant biodiversity values

An analysis of the BPA mapping for the Project Area within the Brigalow Belt is given in Table 7 and shown in Figure 5 below.

Table 7 Areas of biodiversity significance under the BPA mapping within the Project Area

Biodiversity Significance	Area (ha)
State	26.51
Regional	13.24
Local of other values	27.10

The Brigalow Belt BPA mapping indicates that the major creek systems (Limestone Creek, Fitzroy River, Lion Creek and Neerkol Creek) and their associated riparian vegetation and wetlands (outlined in Section 4.2.9) within the Project Area contribute to habitat connectivity from north to south on a state level. The northern section of the Project Area in Limestone Creek is largely mapped as significant for biodiversity at a local level. Several disjunct patches of regional significance for biodiversity are mapped throughout the southern section of the Project Area.

4.1.13 Wetlands

The Fitzroy River Floodplain and Delta (Environment Australia, 2001), which extends north-west from Rockhampton, largely consists of cleared and grazed land that generally extends to the banks of dissecting streams. In some places the floodplain is bordered by remnant woodland along drainage channels or punctuated by heavily disturbed sedgeland and aquatic macrophytes associated with lagoons (BirdLife International, 2019). The Fitzroy delta is a 15 km wide strip of wetland that extends approximately 60 km south-east from Rockhampton. The area is heavily modified, with Brennan (1994) reporting that no pristine sites were found in a survey of riparian zones and only 17.2% of lower Fitzroy catchment had > 90% of its original vegetation intact.

For the purpose of this report, wetlands have been described by their associated lagoon/s. The Project Area directly intersects or is located adjacent to the following six wetlands:

1. Pink Lily Lagoons, including the small lagoon west of Von Allmen Road
2. Lotus Lagoons, including waterbodies east and west of Nine Mile Creek Road
3. Dunganweate Lagoon, including the small lagoon directly south
4. Nelson's Lagoon
5. Black Duck Lagoon
6. Unnamed Wetland, henceforth referred to as Capricorn Highway wetland due to its proximity.

These wetlands are contiguous, forming part of the wider Fitzroy River floodplain and are recharged from the local Neerkol and Lion Creek catchments. The Pink Lily Lagoon especially is also recharged during major Fitzroy River flood events, during which significant overbank flow occurs at the Pink Lily Meander, with discharge recorded to exceed 7,500 m^3/s (~10/AEP) (AECOM, 2019). This results in flood flows spreading over the broad floodplain to the west and south of Rockhampton. This floodwater re-joins the Fitzroy River south of the city at Gavial Creek (AECOM, 2019c). Major floods can last for several weeks.

Lion and Neerkol Creek catchments are characterised by steep, rapid response upper catchments and broad, gently graded lower catchments with numerous wetlands where the lower catchment has limited channel definition and serves as a sediment deposition zone. These creeks also share the lower catchment with Fitzroy River break out flows. Lion Creek and Neerkol Creek are responsible for recharging lagoons and pastures across the local catchment and have significant flood extents in large

events, with the Neerkol Creek the dominant system. Catchment flows, and contributions are discussed in depth in (AECOM, 2019).

The desktop assessment of wetland indicators was undertaken for wetlands listed above and is presented in Table 8 below. Figure 6 outlines the locations of each wetland in relation to the Project Area.

Table 8 Wetland indicators mapped within the project area

Wetland	Hydrology	Vegetation	Soils	Fauna
Pink Lily Lagoon	The wetland has been identified on the WPA mapping at a scale of 1:100,000. The lagoon area is mapped as a HES wetland. The wetland is recharged from Fitzroy River flooding and surface runoff from rainfall in the Neerkol and Lion Creek Catchments.	The lacustrine wetland RE 11.3.27a – vegetation ranges from open water +/- aquatics and emergent, is mapped within the wetland.	Vertosols are mapped across the wetland. Vertosols are brown, grey or black clay soils which shrink and crack open when dry and swell when wet. They have a large water-holding capacity and due the position of wetland in the landscape, have the potential to remain wet for long periods of time.	The following fauna wetland indicator species have been previously sighted in the wetland (Australian Government, 2019): • Magpie goose (*Anseranus semipalmata*)
Black Duck Lagoon	The wetland has been identified on the WPA mapping at a scale of 1:100,000. The lagoon area is mapped as a HES wetland. The wetland is recharged from surface runoff from rainfall in the Neerkol and Lion Creek Catchments.	The wetland is mapped as non-remnant, however pre-clearing mapping indicates the area historically comprised of the floodplain wetland RE 11.3.3 – *Eucalyptus coolabah* woodland on alluvial plains.	Vertosols are mapped across the wetland. Vertosols are brown, grey or black clay soils which shrink and crack open when dry and swell when wet. They have a large water-holding capacity and due to the position of wetland in the landscape, have the potential to remain wet for long periods of time.	The following fauna wetland indicator species have been previously sighted in the wetland (Australian Government, 2019): • Balonne Freshwater Mussel (*Velesunio ambiguus*)^
Lotus Lagoon	The wetland has been identified on the WPA mapping at a scale of 1:100,000. The lagoon area is mapped as a HES wetland. The wetland is recharged from surface runoff from rainfall in the Neerkol and Lion Creek catchments.	The following REs are mapped throughout the wetland: • Palustrine wetland RE 11.3.27c – Mixed grassland or sedgeland with areas of open water +/- aquatic species • Fringing riverine wetland RE 11.3.25 – *Eucalyptus tereticornis* or *E.*	Vertosols are mapped across the wetland. Vertosols are brown, grey or black clay soils which shrink and crack open when dry and swell when wet. They have a large water-holding capacity and due to the position of the wetland in the landscape, have the potential to remain wet for long periods of time.	The following fauna wetland indicator species have been previously sighted in the wetland (eBird Australia, 2019): • Australasian darter (*Anhinga novaehollandiae*) • Australasian shoveler (*Anas rhynchotis*) • Australian pelican (*Pelecanus conspicillatus*) • Black swan (*Cygnus atratus*) • Black-tailed godwit (*Limosa limosa*) • Caspian tern (*Hydroprogne caspia*) • Comb-crested jacana (*Irediparra gallinacea*)

Wetland	Hydrology	Vegetation	Soils	Fauna
		camaldulensis woodland fringing drainage lines.		• Cotton pygmy-goose (*Nettapus membranaceus*) • Dusky moorhen (*Gallinula tenebrosa*) • Eurasian coot (*Fulica atra*) • Great egret (*Ardea alba*) • Glossy ibis (*Plegadis falcinellus*) • Great cormorant (*Phalacrocorax carbo*) • Grey teal (*Anas gracilis*) • Hardhead (*Aythya australis*) • Intermediate egret (*Ardea intermedia*) • Little black cormorant (*Phalacrocorax sulcirostris*) • Little egret (*Egretta garzetta*) • Little pied cormorant (*Microcarbo melanoleucos*) • Magpie goose (*Anseranus semipalmata*) • Marsh sandpiper (*Tringa stagnatilis*) • Pacific black duck (*Anas superciliosa*) • Pied cormorant (*Phalacrocorax varius*) • Royal spoonbill (*Platalea regia*) • Sharp-tailed sandpiper (*Calidris acuminata*) • Whiskered tern (*Chlidonias hybrida*) • White-winged black tern (*Chlidonias leucopterus*) • Yellow-billed spoonbill (*Platalea flavipes*)
Dunganweate Lagoon	The wetland has been identified on the WPA mapping at a scale of 1:100,000. The lagoon area is mapped as a HES wetland. The wetland is recharged from surface runoff from	The palustrine wetland RE 11.3.27c – Mixed grassland or sedgeland with areas of open water +/- aquatic species is mapped. The following flora wetland indicator species have been previously sighted in the wetland: • *Bacopa monnieri* • *Ceratophyllum demersum*	Vertosols are mapped across the wetland. Vertosols are brown, grey or black clay soils which shrink and crack open when dry and swell when wet. They have a large water-holding capacity and due to the position of the wetland in the landscape,	The following fauna wetland indicator species have been previously sighted in the wetland (Australian Government, 2019; eBird Australia, 2019): • Eastern rainbowfish (*Melanotaenia splendida splendida*) • Freshwater longtom (*Strongylura kreftii*) • Gudgeon (*Hypseleotris* spp.) • Magpie goose (*Anseranus semipalmata*)

Wetland	Hydrology	Vegetation	Soils	Fauna
	rainfall in the Neerkol and Lion Creek catchments.	• *Cyperus* spp. • *Ludwigia peploides* • *Nelumbo nucifera* • *Nymphaea* sp. • *Nymphoides indica* • *Urochloa mutica** • *Vallisneria nana*	have the potential to remain wet for long periods of time.	
Nelson Lagoon	The wetland has been identified on the WPA mapping at a scale of 1:100,000. The lagoon area is mapped as a HES wetland. The wetland is recharged from surface runoff from rainfall in the Neerkol and Lion Creek catchments.	The palustrine wetland RE 11.3.27c – Mixed grassland or sedgeland with areas of open water +/- aquatic species is mapped.	Vertosols are mapped across the wetland. Vertosols are brown, grey or black clay soils which shrink and crack open when dry and swell when wet. They have a large water-holding capacity and due to the position of the wetland in the landscape, have the potential to remain wet for long periods of time.	The following fauna wetland indicator species have been previously sighted in the wetland (Australian Government, 2019): • Little mussel (*Corbicula australis*)^
Capricorn Highway Wetland	The wetland has been identified on the WPA mapping at a scale of 1:100,000. The lagoon area is mapped as a HES wetland. The wetland is recharged from surface runoff from rainfall in the Neerkol and Lion Creek catchments.	The palustrine wetland RE 11.3.27c – Mixed grassland or sedgeland with areas of open water +/- aquatic species is mapped.	Vertosols are mapped across the wetland. Vertosols are brown, grey or black clay soils which shrink and crack open when dry and swell when wet. They have a large water-holding capacity and due to the position of the wetland in the landscape, have the potential to remain wet for long periods of time.	The following fauna wetland indicator species have been previously sighted in the wetland: • Mid-eastern velvet snail (*Neveritis misella*)

^ This species is not listed as a Wetland Indicator Species in WetlandInfo (Department of Environment and Science, 2019a), however relies on wetlands for the entirety of their lifecycle, and has therefore been classified as a Wetland Indicator Species.

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0 550 1,100 2,200

Metres

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LEGEND

- Project
- Highways
- Roads and Tracks

VM Act Watercourses and Drainage

- Major
- Minor

BPA Mapping

Biodiveristy Significance

- Local or Other Values
- Regional
- State
- State Habitat for EVNT taxa

Data sources:
Base Data: (c) State of Queensland (Department of Natural Resources, Mines and Energy) 2019,
Baseline Roads and Tracks, Railway Network.
Aecom 2019, Corridor and RRR Data

ROCKHAMPTON RING ROAD

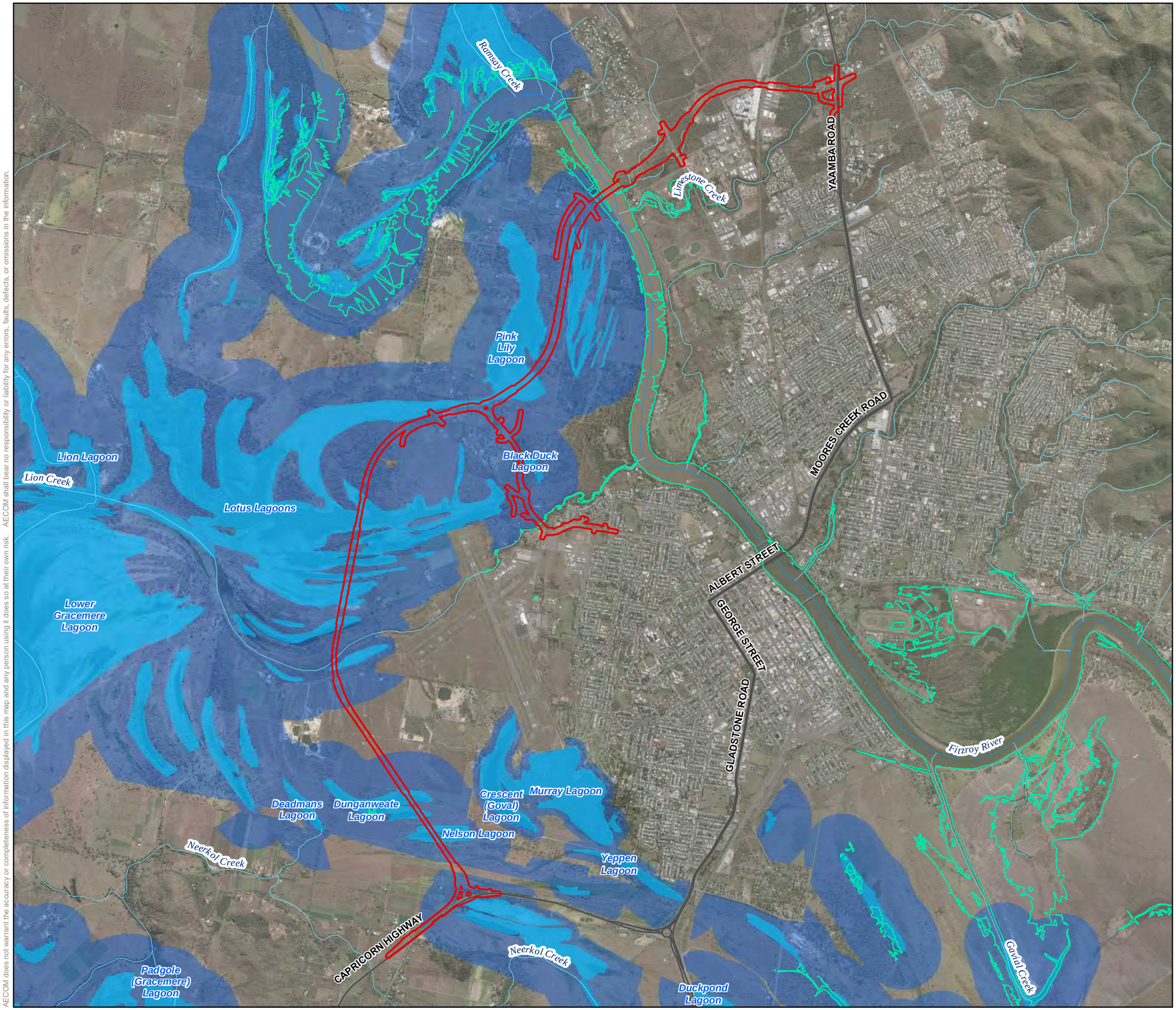
BPA BIODIVERSITY SIGNIFICANCE

PROJECT ID	60593305
CREATED BY	McKeeJ2
LAST MODIFIED	06-Nov-2019
VERSION	<version number>

Figure 5

A3 size

Filename: \\aurok1fp001\Projects\605x\60593305\900_CAD_GIS\920_GIS\920_GIS\920_02_MXDs\Ecology Report\201910 Updates\60593305_FW_RockhamptonRingRoad_F2_BPA_A3_JM.mxd



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DATUM GDA 1994, PROJECTION MGA ZONE XX

0 550 1,100 2,200

Metres

1:46,000 (when printed at A3)

LEGEND

- Project Area
- Highway
- Highest Astronomical
- Wetland Protection Area - Trigger
- MSES High Ecological Significance Wetlands

VM Act Watercourses and Drainage Lines

- Major
- Minor

Data sources:
Base Data: (c) State of Queensland (Department of Natural Resources, Mines and Energy) 2019,
Baseline Roads and Tracks, Railway Network.
Aecom 2019, Corridor and RRR Data

ROCKHAMPTON RING ROAD

WETLAND PROTECTION AREAS

PROJECT ID	60593305
CREATED BY	McKeeJ2
LAST MODIFIED	06-Nov-2019
VERSION	<version number>

Figure **6**

A3 size

Filename: \\aurok1fp001\Projects\605x\60593305\900_CAD_GIS\920_GIS\920_GIS\920_02_MXDs\Ecology Report\201910 Updates\60593305_FW_RockhamptonRingRoad_F6_WetlandProtectionArea_A3_JM.mxd

4.2 Field survey

The initial field survey (PE Phase) was undertaken by two AECOM ecologists from 11 to 14 February 2019. An additional day of surveying was completed by two AECOM ecologists on 8 October 2019, which focused on the connection areas which were finalised during the BC Phase.

4.2.1 Climate and survey timing

A review of daily weather observations sourced from the Bureau of Meteorology (BOM) Rockhampton Aero Station (Station 39083) is provided below. December to March is generally considered the wet season in Rockhampton. However, rainfall over the 2018/2019 wet and dry season was low compared with the historical average, with the exemption of December 2018, which received above average rainfall. Rainfall prior to and during the survey period is provided in Figure 7 below.

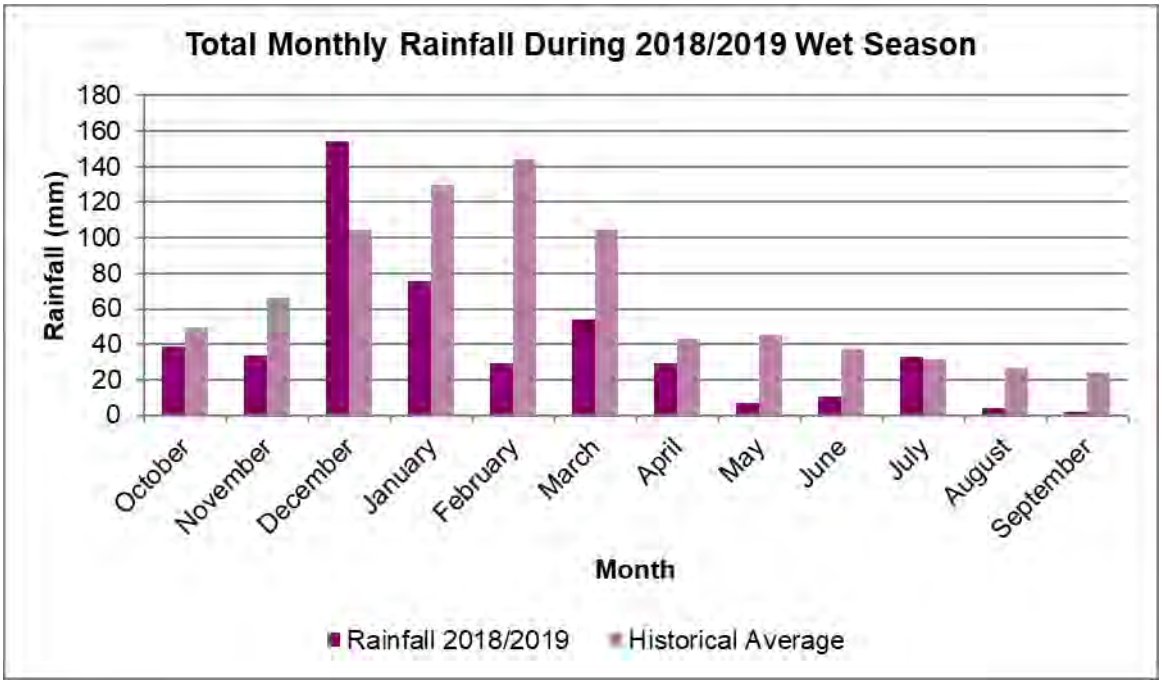


Figure 7 Monthly rainfall in Rockhampton across the survey periods against historical average monthly rainfall

4.2.2 Species diversity

The field surveys identified the presence of 259 taxa representing 72 families, with the full species list provided in Appendix B. The dominant families present were Poaceae (43 species), Fabaceae (22 species) and Myrtaceae (17 species).

4.2.3 Regulated vegetation

Four types of regulated vegetation were ground-truthed and confirmed as occurring within the Project Area as outlined in Table 9 below.

Table 9 Regulated vegetation mapped within the Project Area

Category	Description	Flora site
B	Remnant vegetation.	T1, T2, T3, T4, T5, T6
C	High value regrowth.	T3, T8
R	Regrowth within 50 m of a watercourse or drainage feature in the Great Barrier Reef catchment areas.	T8
X	Non-remnant vegetation.	T7, T8

4.2.4 Regional ecosystems

Six REs were mapped as occurring within the Project Area and are outlined below in Table 10 below. Ground-truthed RE mapping is shown in Figure 8.

Table 10 REs mapped within the Project Area

RE	Description	VM Act status	Biodiversity status	Flora site	Area (ha)
11.3.1 HVR	Open forest dominated by *Acacia harpophylla*. A low tree layer dominated by *Casuarina cristata, Lysiphyllum carronii* and *Alectryon diversifolius.* Tree height is 5-9m with 74% crown cover. This does not reach the required 10.6m height that is 70% of the 15.1m average canopy of remnant vegetation. Satellite imagery indicates this vegetation has not been cleared since before 2003, therefore it meets the HVR criteria. The low tree understorey layer is between 2 m and 5 m high with a very sparse ground cover. Landform is alluvial flats with black clayey loam soils. (BVG1M: 25a)	Endangered	Endangered	T8, Q60, Q61, Q62, Q63, Q64	0.42
11.3.3 HVR	*Eucalyptus coolabah* open woodland to woodland with a grassy understorey. The T1 canopy averages 12.0m height with 18.8% crown cover. This does not reach the required 12.6m height that is 70% of the 18m average canopy of remnant vegetation, and therefore remains non-remnant. However, satellite imagery indicates this vegetation has not been cleared since before 2003, therefore it meets the HVR criteria. A mid layer of *Acacia salicina* and *Lysiphyllum hookeri* is present. A shrub layer is dominated by *Acacia salicina* and the exotic *Vachellia nilotica*. (BVG1M:16c)	Of concern	Of concern	T3, Q12	0.23
11.3.4	*Eucalyptus tereticornis* woodland to open forest. Other tree species that may be present and locally dominant include *E. camaldulensis, Corymbia tessellaris, E. coolabah, C. clarksoniana, E. populnea* or *E. brownii, E. melanophloia, E. platyphylla* or *Angophora floribunda*. *E. crebra* and *Lophostemon suaveolens* may be locally dominant (subregion 14). A shrub layer is usually absent, and a tall grassy ground layer is often prominent, and may include any of *Bothriochloa bladhii* subsp. *bladhii*, *Aristida* spp., *Heteropogon contortus*, *Dichanthium* spp. and *Themeda triandra*. Heavily grazed areas tend to have shorter or annual grasses such as *Dactyloctenium radulans* or *Bothriochloa* spp. (BVG1M: 16c)	Of concern	Of concern	Q43, Q44	1.21

RE	Description	VM Act status	Biodiversity status	Flora site	Area (ha)
11.3.4 HVR	*Eucalyptus tereticornis* woodland with *E. coolabah* and *Corymbia tessellaris*. A shrub layer usually includes the weed species *Leucaena leucocephala* and *Cryptostegia grandiflora.* The grass layer is typically dominated by introduced grasses, especially *Megathyrsus maximus*. Wetter sites include the weed species *Hymenachne amplexicaulis*. (BVG1M:16c)	Of concern	Of concern	Q22, Q33, Q47, Q48, Q56, Q57, Q65, Q66, Q73, Q75, Q77	16.62
11.3.25	This RE grows on the banks of creeks and the Fitzroy River. It is dominated by a 20 m tall canopy of *Eucalyptus tereticornis*. Other tree species include *Casuarina cunninghamiana, E. coolabah* and *Melaleuca leucadendra.* Shrubs include *Acacia salicina* and *Melaleuca bracteata.* The ground layer is open to sparse and dominated by perennial grasses, sedges or forbs such as *Imperata cylindrica, Bothriochloa bladhii, B. ewartiana, Chrysopogon fallax, Cyperus* spp. and often the aquatic weed species *Eichhornia crassipes*. (BVG1M: 16a)	Least concern	Of concern	T2, T4, T6, Q89, Q90	1.62
11.3.25a	*Eucalyptus raveretiana* (sometimes emergent), *Melaleuca fluviatilis* woodland. A range of other species may be present including *Melaleuca leucadendra*, *Corymbia clarksoniana*, *Casuarina cunninghamiana*, *Melaleuca viminalis* and *Nauclea orientalis*. There is often a dense low tree layer dominated by species such as *Acacia salicina*, *Geijera salicifolia*, *Diospyros humilis* and *Mallotus philippensis*. Riverine wetland or fringing riverine wetland. (BVG1M: 22c)	Least concern	Of concern	Q76	0.61
11.3.27a	Lacustrine wetland. Vegetation ranges from open water +/- aquatics and emergents such as *Chara* spp. *Nitella* spp., *Myriophyllum verrucosum, Nymphaea violacea, Pyrgillus javanicus, Potamogeton crispus, P. tricarinatus, Ottelia ovalifolia, Vallisneria caulescens* and *Nymphoides indica*. A narrow fringing woodland commonly dominated by *E. camaldulensis* or *E. coolabah* but also a range of other tree species may be present. In dry seasonal conditions, non-woody vegetation may be completely absent from ephemeral waterbodies, with only bare claypans present. During drying-off periods, herbaceous species such as *Sesbania cannabina, Glinus lotoides* and	Least concern	Of concern	Q49, Q50, Q86, Q87	0.85

RE	Description	VM Act status	Biodiversity status	Flora site	Area (ha)
	Cullen spp. may be present and dominant on drying lake margins. Larger ephemeral - permanent water bodies (lakes). (BVG1M: 34a)				
11.3.27c	Palustrine wetland (e.g. vegetated swamp). Mixed grassland or sedgeland with areas of open water +/- aquatic species. Dominated by a range of species especially *Glinus lotoides, Eleocharis* spp., *Nymphoides* spp. and sometimes *Phragmites australis*. Occurs on closed depressions on alluvial plains that are intermittently flooded in inlands parts of the bioregion. (BVG1M: 34d)	Least concern	Of concern	T1, T5, Q3, Q4, Q6, Q11, Q14, Q18, Q20, Q25, Q29, Q32, Q54	5.92
11.11.15	*Eucalyptus crebra* and *Corymbia dallachiana* woodland, previously mapped as non-remnant. A shrub layer is present and includes *Acacia decora, Alphitonia* excelsa and *Vachellia bidwillii*. The ground layer contains native grasses including *Themeda triandra, Chrysopogon fallax* and *Heteropogon contortus*. Data collected during the field survey indicates the patch has returned to remnant status, having reached 14m canopy height and 22% crown cover. (BVG1M: 13c)	Least concern	No concern at present	T9, Q67	6.28

4.2.5 Threatened ecological communities

4.2.5.1 Brigalow (*Acacia harpophylla* dominant and co-dominant)

One threatened ecological community was mapped within the Project Area, Brigalow (*Acacia harpophylla* dominant and co-dominant), as a patch of non-remnant RE 11.3.1 (see Table 11 below).

Table 11 TECs mapped within the Project Area

TEC	EPBC Act Status	Flora Site	Area (ha)
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Endangered	T8	0.42

The Brigalow TEC includes regrowth vegetation mapped as non-remnant under state mapping (particularly regrowth more than 15 years old), provided that the vegetation meets key diagnostic criteria and condition thresholds detailed in the conservation advice for the TEC (Threatened Species Scientific Committee, 2013). Table 12 below outlines how the TEC mapped within the Project Area meets definition as a Brigalow TEC.

Table 12 Key diagnostic characteristics and condition thresholds for the Brigalow TEC

Criteria	Outcome of assessment	Justification
Key diagnostic criteria		
The presence of *Acacia harpophylla* as one of the most abundant tree species in the patch. *A. harpophylla* is either dominant in the tree layer, or co-dominant with other species (notably *Casuarina cristata*, other species of *Acacia*, or species of *Eucalyptus*.	**TEC present**	*Acacia harpophylla* is dominant in the tree layer within the patch. Over 99% of the stem count within the site was contributed by *A. harpophylla.*
In Queensland, the patch is in one of the following Queensland bioregions (including outliers) and it meets the description of one of 16 Queensland REs prescribed: **Brigalow Belt Bioregion:** REs **11.3.1**, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14, 11.12.21. **Southeast Queensland Bioregion:** REs 12.8.23, 12.9-10.6, 12.12.26. **Mulga Lands Bioregion:** RE 6.4.2.	**TEC present**	The patch occurs within the Brigalow Belt Bioregion and meets the description of RE 11.3.1: *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains.
The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of one of the identified Queensland REs or NSW vegetation communities (although species density may be reduced). This can be assumed to be the case where it has been at least 15 years since it was last comprehensively cleared (not just thinned); unless direct evidence proves otherwise.	**TEC present**	The vegetation in the patch is brigalow regrowth with species composition and structural elements broadly typical of RE 11.3.1: *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains. Tree height is 5-9m with 74% crown cover. This does not reach the required 10.6m height that is 70% of the 15.1m average canopy of remnant vegetation. However, satellite imagery indicates this vegetation has not been cleared for at least 15 years, therefore it meets the diagnostic criteria as a TEC.

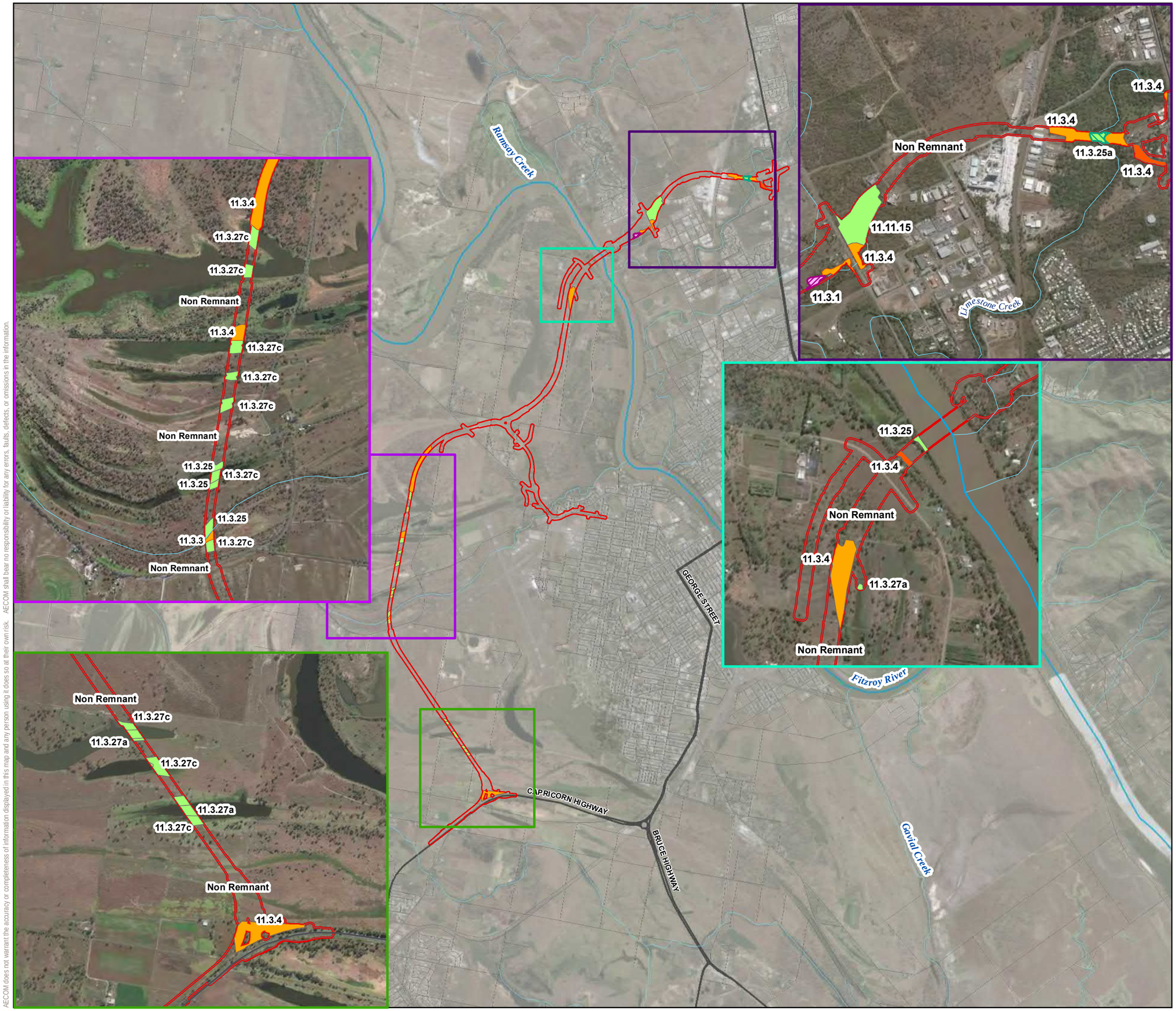
Criteria	Outcome of assessment	Justification
Condition thresholds		
The patch is 0.5 ha or more in size.	**TEC present**	The patch is 0.71 ha in size, however only 0.42 ha would be potentially impacted.
Exotic perennial plants comprise less than 50 % of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha (100 m by 50 m), that is representative of the patch.	**TEC present**	Exotic perennial plants comprise less than 1 % of the total vegetation cover of the patch and are mainly concentrated on the edge of the patch.

4.2.5.2 Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions

HVR comprised of RE 11.3.3 was mapped within the alignment. This RE corresponds with the Coolibah – Black Box Woodlands of the Darling Riverine Plains TEC and Briglaow Belt South Bioregions. This patch of HVR RE 11.3.3 was mapped outside the Brigalow Belt South Bioregion, north of the Fitzroy River, and therefore does not meet the criteria of a TEC.

4.2.6 Conservation significant flora

One EPBC Act listed flora species, *Eucalyptus raveretiana* (black ironbox), was identified within the Project Area, along with a total of 0.61 ha of known habitat for the species. Naturally occurring *E. raveretiana* trees are present in varying densities along Limestone Creek within the mapped habitat. Approximately eight planted trees are also present within the Project Area adjacent to Limestone Creek. It is likely that the construction of the Project will impact both the naturally-occurring and planted trees within the Project Area.



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N

DATUM GDA 1994, PROJECTION MGA ZONE 56

0 700 1,400 2,800

Metres

1:60,000 (when printed at A3)

LEGEND

- Project Area
- Highway
- Roads and Tracks

VM Act Watercourses and Drainage Lines

- Major
- Minor

Ground-truthed Vegetation

VM Act Status

- Category B area containing Of Concern
- Category B area containing Least Concern
- Category C area containing Endangered
- Category C area containing Of Concern
- Category X, Non-remnant
- Black Ironbox Habitat
- Brigalow TEC

Data sources:
Base Data: (c) State of Queensland (Department of Natural Resources, Mines and Energy) 2019,
Baseline Roads and Tracks, Railway Network.
Aecom 2019, Corridor and RRR Data

ROCKHAMPTON RING ROAD

GROUND-TRUTHED VEGETATION

PROJECT ID	60593305
CREATED BY	McKeeJ2
LAST MODIFIED	12-Nov-2019
VERSION	<version number>

Figure 8

A3 size

Filename: \\aurok1fp001\Projects\605x\60593305\900_CAD_GIS\920_GIS\920_GIS\920_02_MXDs\Ecology Report\201910 Updates\60593305_FW_RockhamptonRingRoad_F7_GroundtruthedRE_A3_JM_V2.mxd

4.2.7 Marine plants

No marine plants were identified within the Project Area, including areas below HAT (as relevant to permit requirements under the *Fisheries Act 1994*). The Project Area crosses the Fitzroy River on the northern side of the Fitzroy River barrage, and is therefore no longer subject to tidal influence.

4.2.8 Weed species

A total of 100 introduced species were recorded within the Project Area. Of these, 23 listed weed species were identified, including 11 WONS, 19 restricted species and 23 declared species under the Rockhampton Regional Council Biosecurity Plan (Rockhampton Regional Council, 2017).

Table 13 Weed species identified within the Project Area

Scientific name	Common name	WONS status[1]	B Act status[2]	RRC BP[3]
Bryophyllum delagoense	Mother of millions	-	Restricted	Declared
Cardiospermum grandiflorum	Balloon vine	-	Restricted	Declared
Cascabela thevetia	Yellow Oleander	-	Restricted	Declared
Cryptostegia grandiflora	Rubber vine	WONS	Restricted	Declared
Eichhornia crassipes	Water hyacinth	WONS	Restricted	Declared
Harrisia martinii	Harrisia cactus	-	Restricted	Declared
Hymenachne amplexicaulis	Hymenachne	WONS	Restricted	Declared
Lantana camara	Lantana	WONS	Restricted	Declared
Lantana montevidensis	Creeping lantana	-	Restricted	Declared
Leonotis nepetifolia	Lion tail	-	-	Declared
Leucaena leucocephala	Leucaena	-	-	Declared
Opuntia streptacantha	Westwood pear	WONS	Restricted	Declared
Opuntia stricta	Prickly pear	WONS	Restricted	Declared
Opuntia tomentosa	Velvety tree pear	WONS	Restricted	Declared
Parkinsonia aculeata	Parkinsonia	WONS	Restricted	Declared
Parthenium hysterophorus	Parthenium	WONS	Restricted	Declared
Ricinus communis	Castor oil plant	-	-	Declared
Salvinia molesta	Salvinia	WONS	Restricted	Declared
Schinus terebinthifolius	Broad-leaved pepper tree	-	Restricted	Declared
Sporobolus pyramidalis / natalensis	Giant rat's tail grass	-	Restricted	Declared
Stachytarpheta jamaicensis	Snake weed	-	-	Declared
Vachellia nilotica	Prickly acacia	WONS	Restricted	Declared
Ziziphus mauritiana	Chinee apple	-	Restricted	Declared

[1] WONS – Weeds of National Environmental Significance

[2] B Act – *Biosecurity Act 2014*

[3] RRC BP – Rockhampton Regional Council Biosecurity Plan for Pest Management: 2017 – 2021

4.2.9 Wetlands

As per the *Queensland Wetland Definition and Delineation Guideline Part A and Part B* (Department of Environment and Resource Management, 2011; Management, 2011), results of the field surveying confirmed the presence of five of the six mapped HES wetlands within and adjacent to the Project Area. Although Black Duck Lagoon was observed to be holding water, the presence of wetland vegetation could not be confirmed due to lack of direct access to the property. Table 14 below outlines the determination of each mapped lagoon as a wetland.

All wetlands were in poor ecological condition, with the exception of Pink Lily Lagoon. Much of the wetland area and surrounds has been subject to extensive vegetation clearing, high density grazing and the construction of levees for ponded pasture and stock watering points. Significant terrestrial and aquatic weed infestations have also proliferated in the area over decades, which have reduced the floral diversity and quality of the wetlands over time. The areas which surround the HES wetlands within WPAs (Section 2.2.3) were found to be in a similar degraded condition. Nonetheless, wetlands may provide habitat value to a number of fauna species. Refer to the *Fauna and Migratory Birds Technical Report* (AECOM, 2019a) for further details.

Table 14 Wetland determination

Wetland	Hydrology	Vegetation	Soils	Fauna	Outcome of assessment	Area (ha)
Pink Lily Lagoon	The wetland was confirmed as present due to the direct observation of water inundation. Water levels in the wetland were low, given the limited rainfall experienced within the Neerkol catchment in the 2019 wet season. However, it was determined that water-logging within the wetland is of sufficient duration and frequency to create conditions that support wetland indicator flora and fauna, and potentially soil types (not sampled).	The wetland RE 11.3.27a was confirmed as present within the mapped wetland adjacent to the Project Area and was described as a lacustrine wetland system due to the permanent presence of water. The palustrine vegetated margins were mapped as RE 11.3.27c and likely a result of the low water level in the wetland. They are expected to be temporarily inundated in post-wet season months. Southern areas of the wetland were not mapped as remnant RE 11.3.27 due to the presence of *Urochloa mutica* (para grass) as the dominant species. The following flora wetland indicator species were present: • *Persicaria orientalis* (dominant) • *Urochloa mutica* (dominant)	Black cracking clay soils, consistent with Vertosols were present on the margins of the wetland. Soils were not sampled for the presence of Organosols (wetland soils), due to the conclusive evidence provided by other indicators.	A total of 26 fauna wetland indicator species were present. The species list is presented in Appendix C.	**Wetland present.** The wetland has been confirmed as present due to the following factors: • direct observation of inundation despite the limited rainfall experienced in the 2019 wet season • presence of the wetland RE 11.3.27a • presence of two flora wetland indicator species as the dominant flora • presence of 29 fauna wetland indicator species.	0.07
Black Duck Lagoon	The wetland was confirmed as present due to the direct observation of water inundation. Water levels in the wetland were low, given the limited rainfall experienced within the Neerkol catchment in the 2019 wet season. However, it was determined that water-logging within the wetland is of sufficient duration and frequency to create conditions that support wetland indicator flora and fauna, and potentially soil types (not sampled).	The wetland RE 11.3.27a was confirmed as present within the mapped wetland within and adjacent to the Project Area and was described as a lacustrine wetland system due to the permanent presence of water. The following flora wetland indicator species were present: • *Eichhornia crassipes* (dominant) • *Ludwigia peploides* (abundant) • *Cyperus* sp. (abundant) • *Salvinia molesta* (occasional) • *Melaleuca leucadendra* (occasional)	Black cracking clay soils, consistent with Vertosols were present on the margins of the wetland. Soils were not sampled for the presence of Organosols (wetland soils), due to the conclusive evidence provided by other indicators.	A total of 5 fauna wetland indicator species were present. The species list is presented in Appendix C.	**Wetland present.** The wetland has been confirmed as present due to the following factors: • direct observation of inundation despite the limited rainfall experienced in the 2019 wet season • presence of the wetland RE 11.3.27a • presence of five flora wetland indicator species which were the dominant flora • presence of 5 fauna wetland indicator species.	0.00
Lotus Lagoon	The wetland was confirmed as present due to the direct observation of water inundation within the wetland, but adjacent to the Project Area. Water levels were extremely low, given the limited rainfall experienced within the Neerkol catchment in the 2019 wet season. However, it was determined that water-logging within the wetland is of sufficient duration and frequency to create conditions that support wetland indicator flora and fauna, and potentially soils (not sampled).	The following wetland REs are confirmed as present throughout the wetland: • RE 11.3.27c Mixed grassland or sedgeland with areas of open water +/- aquatic species • RE 11.3.25 Riverine wetland or fringing riverine wetland. Parts of the northernmost section of the wetland was not mapped as remnant RE 11.3.27c due to the presence of *Urochloa mutica* (para grass) as the dominant species. The following flora wetland indicator species were present: • *Hymenachne amplexicaulis* (dominant) • *Urochloa mutica* (dominant) • *Eichhornia crassipes* (abundant) • *Persicaria attenuata* (abundant) • *Persicaria orientalis* (abundant)	Black cracking clay soils, consistent with Vertosols were present on the margins of the wetland. Soils were not sampled for the presence of Organosols (wetland soils), due to the conclusive evidence provided by other indicators.	A total of 25 fauna wetland indicator species were present. The species list is presented in Appendix C.	**Wetland present.** The wetland has been confirmed as present due to the following factors: • direct observation of inundation despite the limited rainfall experienced in the 2019 wet season • presence of the wetland REs 11.3.25 and 11.3.27c • presence of 12 flora wetland indicator flora species • presence of 26 fauna wetland indicator species.	3.95

Wetland	Hydrology	Vegetation	Soils	Fauna	Outcome of assessment	Area (ha)
		• *Marsilea mutica* (abundant) • *Melaleuca dealbata* (occasional) • *Cyperus scariosus* (occasional) • *Cyperus* sp. (occasional) • *Ludwigia perennis* (occasional) • *Panicum larcomianum* (rare) • *Eleocharis* sp. (rare)				
Dunganweate Lagoon	The wetland was confirmed as present due to the direct observation of water inundation within the wetland, but adjacent to the Project Area. Water levels were low, given the limited rainfall experienced within the Neerkol catchment in the 2019 wet season.	The wetland RE 11.3.27c was confirmed as present within the mapped wetland and was described as a palustrine wetland system. Areas of open water RE 11.3.27a was present in the middle of the lagoon. The following flora wetland indicator species were present: • *Suaeda australis* (abundant) • *Persicaria attenuata* (occasional) • *Eichhornia crassipes* (occasional) • *Cyperus scariosus* (occasional) • *Ludwigia perennis* (occasional) • *Marsilea mutica* (occasional) • *Cyperus scariosus* (occasional)	Black cracking clay soils, consistent with Vertosols were present on the margins of the wetland. Soils were not sampled for the presence of Organosols (wetland soils), due to the conclusive evidence provided by other indicators.	A total of 13 fauna wetland indicator species were present. The species list is presented in Appendix C.	**Wetland present.** The wetland has been confirmed as present due to the following factors: • direct observation of inundation despite the limited rainfall experienced in the 2019 wet season • presence of the wetland RE 11.3.27c • presence of seven flora wetland indicator species • presence of 13 fauna wetland indicator species.	1.56
Nelson Lagoon	The wetland was confirmed as present due to the direct observation of water inundation within the wetland, but adjacent to the Project Area. Water levels were low, given the limited rainfall experienced within the Neerkol catchment in the 2019 wet season.	The wetland RE 11.3.27c was confirmed as present within the mapped wetland and was described as a palustrine wetland system. Areas of open water RE 11.3.27a was present in the middle of the lagoon. The following flora wetland indicator species were present: • *Urochloa mutica* (abundant) • *Ludwigia perennis* (occasional) • *Stuckenia pectinata*^ (occasional)	Black cracking clay soils, consistent with Vertosols were present on the margins of the wetland. Soils were not sampled for the presence of Organosols (wetland soils), due to the conclusive evidence provided by other indicators.	A total of 13 fauna wetland indicator species were present. The species list is presented in Appendix C.	**Wetland present.** • direct observation of inundation despite the limited rainfall experienced in the 2019 wet season • presence of the wetland RE 11.3.27c • presence of three flora wetland indicator species • presence of 13 fauna wetland indicator species.	1.19
Capricorn Highway Wetland	The wetland was confirmed as present due to the direct observation from the adjacent road of water inundation within the wetland. Water levels were very low, given the limited rainfall experienced within the Neerkol catchment in the 2019 wet season.	This property was inaccessible and could only be viewed from the road. The area was heavily grazed and flora was largely absent. This may be a result of the lack of rainfall in the past 12 months. Field survey within the property is required to be undertaken to confirm the presence of wetland indicator species.	Black cracking clay soils, consistent with Vertosols were present on the margins of the wetland. Soils were not sampled for the presence of Organosols (wetland soils), due to the conclusive evidence provided by other indicators.	No fauna wetland indicator species were identified. Field survey within the property required to be undertaken to confirm the presence of wetland indicator.	**Unconfirmed.** The desktop assessment and field survey (from the adjacent road reserve) indicates that the site is likely to be a wetland due to the following factors: • mapped as a HES wetland within a WPA • direct observation of inundation despite the limited rainfall experienced within the Neerkol catchment in the 2019 wet season • mapped as the wetland RE 11.3.27 (unconfirmed on ground) • records of one previous sighting of a fauna wetland indicator species.	0.00

^Species unconfirmed due to the absence of fertile material.

4.3 Likelihood of occurrence

The likelihood of occurrence assessment performed during the desktop assessment was refined following confirmation of vegetation communities and habitat values during the field surveys. Results of the likelihood of occurrence assessment identified one flora species and one vegetation community as present, with no other species or communities identified as having a moderate or high likelihood of occurring, as outlined in Table 15 below. The full assessment is presented in Appendix D.

Table 15 Likelihood of occurrence assessment summary

Value	Present
Vegetation community	• Brigalow (*Acacia harpophylla* dominant and co-dominant)
Conservation significant flora	• *Eucalyptus raveretiana* (Black ironbox)

5.0 Potential impacts

Potential impacts to flora and wetland values may occur in the following phases of the Project:

1. construction phase
2. operation and maintenance phase.

Potential impacts associated with the Project are outlined in the following sections. A SIA has been undertaken for identified values and is presented in Appendix E.

5.1 Construction phase

5.1.1 Vegetation clearing

As a worst-case scenario, it has been assumed that the entire Project Area will be cleared of all vegetation to allow for construction. This is highly unlikely to occur, especially where the Project Area intersects wetlands and waterways as the Project includes 24 bridges as shown on Figure 2.

Large areas of the Project Area contain non-remnant vegetation. However, remnant and HVR vegetation communities on alluvial sediments, including wetland communities, also comprise a component of the vegetation clearing to be undertaken within the Project Area. These communities are considered as least concern and of concern vegetation under the VM Act.

Clearing activities will occur within the small area of Brigalow TEC located in the northern section of the Project Area. The Brigalow TEC identified is a fragmented patch occurring in a significantly modified landscape. Locally, the TEC has been heavily cleared and degraded, although regrowth is present in the area. As a result, there is little connectivity with adjacent vegetation, and it has relatively low value within the context of the broader landscape.

Vegetation clearing may also extend to Black ironbox (*Eucalyptus raveretiana*), present as a co-dominant species within Limestone Creek. A number of naturally-occurring and planted trees may be removed, which may have an impact on the persistence of the population in addition to fauna habitat values the species provides in the area. Impacts to fauna is further discussed in *Fauna and Migratory Birds Technical Report* (AECOM, 2019a).

Habitat fragmentation is an additional consideration as increased edge effects of dissected patches of vegetation may occur as a result of the linear clearing pattern required for the Project. Smaller patches are more susceptible to ecological edge effects and are less likely to sustain viable populations of native flora and fauna. Edge effects include altering the vegetation composition and structure between the edge and interior of the patch. This can also impact the microclimate of the habitat which may have implications for fauna using the habitat. Large perimeter to patch area ratios also leaves vegetation more susceptible to seed dispersal pressure from introduced flora species.

The potential impacts to vegetation communities present across the Project Area are outlined in Table 16 below.

Table 16 Potential disturbance to vegetation communities within the Project Area

Vegetation community	EPBC Act status	VM Act status	Clearing area (ha)
Category B remnant vegetation			
RE 11.3.4	-	OC	1.21
RE 11.3.25	-	LC	1.62
RE 11.3.25a	-	LC	0.61
RE 11.3.27a	-	LC	0.85
RE 11.3.27c	-	LC	5.92
RE 11.11.15	-	LC	6.28
Total clearing area			**16.49**

Vegetation community	EPBC Act status	VM Act status	Clearing area (ha)
Category C high value regrowth			
RE 11.3.1 Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC	E	E	0.42
RE 11.3.3	NL	OC	0.23
RE 11.3.4	NL	OC	16.62
Total clearing area			**17.26**
Category X non-remnant vegetation			
Non-remnant	-	-	165.31
Total clearing area			**199.07**

5.1.2 Impacts to wetlands

Wetlands and floodplains are sensitive communities which often support high biodiversity and species richness[4]. They are also highly susceptible to changes in the immediate and broader landscape.

The construction of bridges, culverts, embankments and other water way barriers within the Project Area may require the removal of vegetation and filling of wetland boundary areas to establish hardstand areas. These types of construction activities may cause:

- direct impact to wetlands resulting in the direct loss of wetland and riparian habitat. Wetland clearing extents are detailed below in Table 17.
- temporary changes to wetland hydropatterns (the typical behaviour of a wetland's water level time series and can be expressed generally as a hydroperiod -the seasonal pattern of the water level of a wetland (Mitsch, W. J and J. G Gosselink, 2000), which is considered to play significant role in the ecological function of a wetland).
- reduced water quality from point and non-point sources:
  - direct influx of sediment from disturbed areas and stockpiles reducing water quality and primary productivity
  - increased nutrient input influencing species' composition in downstream reaches and increasing the risk of eutrophication
  - hydrocarbons and other chemicals due to spills within the Project Area which can prevent oxygenation of the water column, reducing the health of aquatic macrophytes and adjacent riparian vegetation
  - stratification of temperature, dissolved oxygen and nutrients in the water column
  - disturbance of acid sulfate soils (ASS) during pylon installation causing reduced water quality
- changes to soil chemistry due to:
  - importation of foreign soils
  - exposure of hyporeic zone, alluvial aquifer and subsoils
  - exposure of ASS.
- the establishment of terrestrial and aquatic weed species in areas previously free from weeds.

Consideration must also be given to the cumulative impacts of this Project in conjunction with other Projects occurring within Fitzroy River floodplain such as the two levee development proposals.

[4] Note the nearest mapped groundwater dependant ecosystem is 14 km distance from the Project Area (Qld Globe, 2019)

Table 17 Potential disturbance to wetlands within the Project Area.

Wetland	EP Act Status	Clearing Area (ha)*
Pink Lily Lagoons	HES Wetland	0.07
Black Duck Lagoon	HES Wetland	0.00
Lotus Lagoons	HES Wetland	3.95
Dunganweate Lagoon	HES Wetland	1.56
Nelson Lagoon	HES Wetland	1.19
Capricorn Highway Wetland	HES Wetland	0.00
Total Clearing Area		**6.77**

* Clearing areas detailed are considered worst-case as they do not take into account the bridges planned as part of the Project.

Potential impacts to each wetland during the construction phase are detailed in Table 18 below.

Table 18 Potential impacts to wetlands – construction phase

Wetland	Loss of Wetland Habitat during Construction
Pink Lily Lagoon	The Project is predicted to directly impact (via vegetation clearing and potentially cut and fill works) 0.07 ha of Pink Lily Lagoon palustrine wetland vegetation (worst-case scenario and inclusive of the small lagoon located east of Von Allmen Road). These impacts will primarily occur in the south-eastern extent of the lagoon where a proposed bridge is located, away from the main permanent waterbody. Some increased erosion and sedimentation in the south-eastern area may occur as a result of cut and fill works. Impacts to water quality are considered unlikely. Where the Project Area runs parallel to the lagoons, removal of large trees in riparian zones may lead to a rise in the water table, potentially resulting in increased ground water availability and salinization effects (Government of Western Australia, 2001). Removal of riparian vegetation is likely to lead to increased erosion potential in these areas, and where possible should be rehabilitated immediately.
Black Duck Lagoon	The Project Area does not overlap Black Duck Lagoon directly, and as such no direct impacts are predicted.
Lotus Lagoons	The Project Area directly dissects the wetland areas and adjacent riparian habitat of Lotus Lagoons. It is predicted the Project will require the clearing of 3.95 ha of mapped wetland (worst-case scenario). At the bridge construction locations, increased erosion and sedimentation in connecting areas is likely to occur as a result of cut and fill works. Removal of large trees in riparian zones may lead to a small rise in the water table, potentially resulting in increased ground water availability and salinization effects (Government of Western Australia, 2001). Removal of riparian vegetation is likely to lead to increased erosion potential in these areas. Where possible areas of bare ground should be rehabilitated immediately.
Dunganweate Lagoon	The Project Area directly dissects Dunganweate Lagoon. It is predicted the Project will require the clearing of 1.56 ha of palustrine and lacustrine wetland (worst-case scenario). There is potential for works at this location to reduce the eastern extent of this wetland via clearing and cut and fill impacts, as this will be where a large bridge ends (Figure 2). Increased erosion and sedimentation impacts are expected. Temporary impacts to water quality may also occur.
Nelson Lagoon	The Project Area directly dissects Nelson Lagoon. It is predicted the Project will require the clearing of 1.19 ha of palustrine and lacustrine wetland (worst-case scenario). Other than disturbance during construction, it is expected that direct impacts at this location should be minimal due to a proposed bridge covering north and south of the lagoon.
Capricorn Highway Lagoon	The Project Area terminates north of the Capricorn Highway Lagoon. As such, no direct impacts are predicted.

5.1.3 Soil disturbance, erosion and dust

Vegetation clearing and soil disturbance are anticipated to cause a number of impacts including:

- direct influx of sediment in the surface water runoff from the Project Area, particularly from areas of vegetation cleared for construction
- altered sedimentation regimes in wetlands adjacent to the Project Area. The lower Lion and Neerkol Creek catchments report to the wetlands adjacent to the Project Area and are sediment deposition zones following flood flow (AECOM, 2019c)
- compaction of soils causing reduction in soil health and associated microbial processes
- potential disturbance of ASS
- deposition of construction-generated dust settling on vegetation.

5.1.4 Introduced species

A total of 100 introduced flora species were identified during the field survey, including 24 listed weed species. Activities that may increase the risk of establishment of new infestations and exacerbation of existing infestations include:

- soil disturbance through vegetation clearance and construction activities
- areas of ground remaining bare for extended periods will establish weed species where there is little competition from other species
- increased pedestrian and vehicular traffic through the area
- importation of construction materials to the site which may harbour introduced species
- clearing and construction may facilitate the establishment of aquatic weed infestations around built infrastructure and in new areas not previously subject to infestations, as a result of altered hydrology.

A number of introduced fauna species were identified within the Project Area. The *Fauna and Migratory Birds Technical Report* (AECOM, 2019a) provides a detailed description of potential pest fauna impacts and proposed mitigation measures.

5.2 Operation and maintenance phase

5.2.1 Hydrological disturbance

The main impacts expected during the operation and maintenance phase of the Project is to mapped wetlands adjacent to the Project Area. (C&R Consulting Pty Ltd, 2019) quantified the potential hydrological impacts for the Project which involves the development of site-specific conceptual modelling for each wetland. The assessment indicated that the operation of the Project is unlikely to significantly alter surface and sub-surface flow and water quality across the Fitzroy floodplain.

Wetlands within and adjacent to the Project Area rely primarily on low-flow recharge from the Lion and Neerkol Creek systems. The detailed design has incorporated numerous bridges and culverts in watercourses and wetlands where maintaining low flow connectivity is essential. As hydrological patterns across the floodplain will be mostly unchanged, no significant changes to nutrient levels and water quality are expected to occur.

Some temporary and localised impacts to wetlands may occur including:

- altered species composition and loss of biodiversity due to reduction in habitat connectivity as a result of direct impacts to vegetation and wetlands
- altered drainage pathways and sedimentation patterns
- an increase in surfaces impervious to water (the road surface). Increased runoff and delivery of pollutants to adjacent watercourses and wetlands may occur. However, the proposed design allows high frequency events to be maintained during the wet season to allow flushing of the wetlands limiting the risk associated with water quality impacts from vehicles.

The wetlands are recharged from the local catchment, including the Fitzroy River and its tributaries. During Fitzroy River flood events, changes in the streamflow distribution and rate may also occur.

Further an assessment to identify potential sources of construction water within the surrounding area and determine whether water extraction will have an impact on the surrounding environmental values is suggested. As detailed in Section 3.5.5, potential impacts to wetlands discussed in this report may change with the finalisation of the C&R Consulting Wetlands Assessment.

5.3 Significant impact assessment

5.3.1 Conservation significant flora and threatened ecological communities

The potential impacts outlined above have the potential to significantly impact on conservation significant flora and TECs due to habitat loss. An assessment to determine whether the Project is likely to have a significant impact on any conservation significant flora species or TECs protected under the EPBC Act was undertaken in accordance with the EPBC Act Policy Statement 1.1 *Significant Impact Guidelines: Matters of National Environmental Significance* (Department of the Environment Water Heritage and the Arts, 2013). Matters assessed in this report are:

- *Eucalyptus raveretiana* (Black ironbox) (vulnerable)
- Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC (endangered).

The full assessment is provided in Appendix E.

The SIA determined that a significant impact to Black ironbox and Brigalow TEC are not anticipated as a result of the Project (Appendix E).

6.0 Mitigation measures

The application of mitigation measures will minimise impacts from the Project on flora, vegetation communities and wetlands. Where impacts are unable to be avoided or mitigated (e.g. clearing of vegetation), offsets may be required. Mitigation measures associated with the potential impacts from each activity are presented below.

6.1 Hydrological regime and water quality

The hydrological impact of the Project has been minimised through appropriate design, including the preferencing of the use of bridges rather than trenches, culverts, and other barriers to water flow that can significantly inhabit the natural groundwater pathway.

The following mitigation measures are recommended:

- stormwater discharge will be appropriately managed to avoid significant local changes in the volume and velocity of surface runoff into the wetland systems
- water required for construction activities should not be sourced from wetlands or groundwater sources where practical
- install appropriate erosion and sediment control measures
- rehabilitation works will be undertaken in accordance with TMR specification for Landscape and Revegetation Works and include a revegetation strategy
- there is potential for acid sulfate soil (ASS) to be present at some proposed wetland crossings. Targeted ASS sampling will be undertaken at these areas. If present, an ASS Management Plan will be implemented.

6.2 Vegetation clearing and construction site management

Prior to construction beginning, a Construction Environmental Management Plan (CEMP) will be developed for the Project. The clearing of vegetation within the Project Area will be managed through the CEMP and the following mitigation measures will be utilised:

- areas for clearing will be clearly delineated to avoid inadvertent clearing
- utilise fauna spotter catchers to undertake a pre-clearance assessment within remnant and HVR vegetation or any areas with habitat trees
- habitat features such as felled trees and logs will be considered for relocation to other areas where practical to provide microhabitat
- retain trees with obvious habitat features (i.e. hollows) where possible
- implement appropriate weed hygiene measures
- install appropriate erosion and sediment control measures
- where possible, grasses and other groundcover will be slashed rather than cleared to allow access and retain sediment
- the Project team will undertake environmental inductions prior to commencing work.

Throughout construction, the following mitigation measures will be utilised to manage impacts from construction activities:

- topsoil will be removed and managed appropriately, before using to rehabilitate existing disturbed areas
- erosion and sediment control measures will be installed and maintained
- dust suppression measures will be utilised to minimise deposition of dust on adjacent vegetation.

Following construction in each area, disturbed areas no longer required should be stabilised and rehabilitated.

6.3 Weed and pest management

A Weed and Pest Management Plan will be developed and implemented prior to construction commencing to manage the spread of weeds and potential proliferation of pest fauna. Weed and pest management measures will include:

- identification of the origin of construction materials, machinery and equipment to mitigate introduction of weed species
- construction of vehicle and machinery wash down facilities within the Project Area at designated entry and exits to the construction site/s
- vehicle wash downs will be required when entering and leaving site and when moving from a weed infested area to a clean area. Vehicle hygiene practices (including records) will be undertaken applying risk management principles in consultation with landholders
- staff and contractors must be equipped with information on the location of biosecurity threats through inductions and toolbox talks
- appropriate weed monitoring to identify any new incidence of weeds.

7.0 Conclusion

Based on the field surveys, the following ecological values have been identified within the Project Area:

- the Project Area largely consists of non-remnant vegetation, with some areas of remnant vegetation including:
  - RE 11.3.4 – 1.21 ha
  - RE 11.3.25 – 1.62 ha
  - RE 11.3.25a – 0.61 ha
  - RE 11.3.27a – 0.85 ha
  - RE 11.3.27c – 5.92 ha
  - RE 11.11.15 – 6.28 ha.
- HVR vegetation was also present throughout the Project Area including:
  - RE 11.3.1 – 0.42 ha
  - RE 11.3.3 – 0.23 ha
  - RE 11.3.4 – 16.62 ha
- a total of 0.42 ha of the Brigalow (*Acacia harpophylla* dominant and co-dominant) threatened ecological community was identified in the northern section of the Project Area.
- a total of 0.61 ha of known *Eucalyptus raveretiana* (black ironbox) habitat is present in Limestone Creek within the Project Area.
- a total of 259 flora species representing 72 families were identified. *Eucalyptus raveretiana* (black ironbox), listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* was identified are occurring within the northern section of the Project Area.
- a total of 100 introduced flora species were identified, including 23 listed weed species.
- although the Project Area intersects areas identified as occurring below HAT, this area is not subject to tidal influence and no marine plants were identified.
- a number of potential impacts to flora and wetlands may occur as a result of the Project. Mitigation and management measures are recommended to ensure the potential impact on flora and wetland ecological values are avoided or minimised.
- The SIA determined that a significant impact to Black ironbox and Brigalow TEC are not anticipated as a result of the Project

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Appendix A

Field data sheets

Detailed Flora Datasheet

SITE INFORMATION

Project Name	RRR	**Erosional Pattern**	
Site No.	T1	**Landform Pattern**	
Site Type	Secondary	**Landform Element**	
Date	11/02/2019	**EDL**	Ground
Observers	PW, EO	**Geology**	
Bioregion	11	**Altitude**	11
Mapped RE	11.3.27c	**Aspect**	None
Confirmed RE	11.3.27c	**Slope (°)**	
Landzone	3	**Soil Colour**	Black
Start GPS Location	23.39916, 150.46478	**Soil Texture**	Black clay
End GPS Location	23.39915, 150.46429	**Soil Type**	Cracking clay

VEGETATION STRUCTURAL DESCRIPTION (Modified Specht)

Mixed sedgeland / wetland domianted by *Glinus lotoides* and *Sueda australis* .

GENERAL SITE COMMENTS/VEGETATION CONDITION/DISTURBANCES

VEGETATION STRUCTURAL SUMMARY

Strata	Height range (m)	Median height (m)	Crown Cover (%)				
E							
T1							
T2							
T3							
S1							
S2							

TREE AND SHRUB SPECIES

Species	Stratum	Crown Cover (%) calculations* Crown cover of each individual (m)								Total Cover	Stem count
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
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										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0

GROUND SPECIES (PFC measured in 5, 1 x 1 m plots)

Coll. No.	Species	G1	G2	G3	G4	G5	Average
	Suaeda australis	40.5	45	10	3		24.625
	Glinus lotoides	15	10	15	33.5	73	29.3
	Abutilon guineense	1		7	3	5	4
	Sida acuta	1	10	25	15	1	10.4
	Alternanthera nana	0.5					0.5
	Ludwigia perinnis	2		1	5	2	2.5
	Indigofera pratensis				0.5	1	0.75
	Sesbania cannabina					1	1
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
	Extra species						#DIV/0!
	Macroptilium lathyroides						#DIV/0!
	Persicaria attenuata						#DIV/0!
	Heliotropium indicum						#DIV/0!
	Conyza bonariensis						#DIV/0!
	Eichhornia crassipes						#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
Bare Ground		10	20	37	30	15	22.4
Litter		30	15	5	10	2	22.4
Rock							12.4
Timber							#DIV/0!
Cryptogram							#DIV/0!

* Shrub and Tree species cover measured within a 50 x 10 m plot using the line-intercept method

PHOTOS

Detailed Flora Datasheet

SITE INFORMATION

Project Name	RRR	**Erosional Pattern**	
Site No.	T2	**Landform Pattern**	Dry creek
Site Type	Secondary	**Landform Element**	
Date	12/02/2019	**EDL**	Tree
Observers	PW, EO	**Geology**	Creek alluvial
Bioregion	11	**Altitude**	8
Mapped RE	Non-remnant	**Aspect**	South
Confirmed RE	11.3.25	**Slope (°)**	8
Landzone	3	**Soil Colour**	Black
Start GPS Location	23.38307, 150.45438	**Soil Texture**	
End GPS Location	23.38276, 150.45471	**Soil Type**	Clay

VEGETATION STRUCTURAL DESCRIPTION (Modified Specht)

Eucalyptus coolibah and *Eucalyptus tereticornis* open forest to 22m on black clay soils.

GENERAL SITE COMMENTS/VEGETATION CONDITION/DISTURBANCES

Some weed species are present in the ground layer.

VEGETATION STRUCTURAL SUMMARY

Strata	Height range (m)	Median height (m)	Crown Cover (%)				
E							
T1	17 to 22	19	71				
T2	6 to 8	7					
T3							
S1	2 to 5	3					
S2	0 to 2	1					

TREE AND SHRUB SPECIES

Species	Stratum	Crown Cover (%) calculations* Crown cover of each individual (m)								Total Cover	Stem count
Eucalyptus coolabah	T1	21.4	6.1	3	3.6					68.2	7
Eucalyptus tereticornis	T1	1.4								2.8	1
Eucalyptus coolabah	T2									0	1
Acacia salicina	S2									0	4
Vachellia nilotica	S1									0	1
Eucalyptus coolabah	S2									0	2
Vachellia nilotica	S2									0	9
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	
										0	

GROUND SPECIES (PFC measured in 5, 1 x 1 m plots)

Coll. No.	Species	G1	G2	G3	G4	G5	Average
	Euphorbia drummondi	3		5	2	2	3
	Dichanthium fecundum	7	5	3		10	6.25
	Rynchosia minima			1			1
	Cardiospermum grandiflorum			3		2	2.5
	Sida acuta			1	2		1.5
	Bothriochloa pertusa				1		1
	Cyperus fulvus					2	2
	Rostellularia ascendens					1	1
	Eustrephus latifolius					3	3
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
	Extra species						#DIV/0!
	Marsilea mutica						#DIV/0!
	Aeschynomene indica						#DIV/0!
	Urochloa mutica						#DIV/0!
	Gomphrena celsiodes						#DIV/0!
	Alternanthera nana						#DIV/0!
	Cucumis sp.						#DIV/0!
	Cardiospermum grandiflorum						#DIV/0!
	Phyllanthus madagascariensis						#DIV/0!
	Senna barclayana						#DIV/0!
	Cynodon dactylon						#DIV/0!
	Glandularia aristida						#DIV/0!
	Tribulus terrestris						#DIV/0!
	Epaltes sp.						#DIV/0!
	Neptunia sp.						#DIV/0!
Bare Ground		60	40	40	40	30	42
Litter		30	45	47	55	50	42
Rock							45.4
Timber			10				#DIV/0!
Cryptogram							10

* Shrub and Tree species cover measured within a 50 x 10 m plot using the line-intercept method

PHOTOS

Detailed Flora Datasheet

SITE INFORMATION

Project Name	RRR	**Erosional Pattern**	
Site No.	T3	**Landform Pattern**	
Site Type	Secondary	**Landform Element**	
Date	12/02/2019	**EDL**	Tree
Observers	PW, EO	**Geology**	Alluvial
Bioregion	11	**Altitude**	12
Mapped RE	11.3.3 HVR	**Aspect**	
Confirmed RE	11.3.3	**Slope (°)**	0
Landzone	3	**Soil Colour**	
Start GPS Location	23.38306, 150.4543	**Soil Texture**	Clay
End GPS Location	23.38275, 150.4547	**Soil Type**	

VEGETATION STRUCTURAL DESCRIPTION (Modified Specht)

Eucalyptus coolibah open woodland to 13m with grassy ground cover on clay soils.

GENERAL SITE COMMENTS/VEGETATION CONDITION/DISTURBANCES

Some woody, herbaceous and grassy weeds present, particularly *Vachellia nilotica* .

VEGETATION STRUCTURAL SUMMARY

Strata	Height range (m)	Median height (m)	Crown Cover (%)				
E							
T1	10 to 13	12	18.8				
T2	5 to 7	6					
T3							
S1	2 to 5	3					
S2	0 to 2	1	3.8				

TREE AND SHRUB SPECIES

Species	Stratum	Crown Cover (%) calculations* Crown cover of each individual (m)								Total Cover	Stem count
Eucalyptus coolabah	T1	2.3	7.1							18.8	5
Eucalyptus coolabah	T2									0	0
Lysiphyllum hookeri	T2									0	1
Acacia salicina	S2									0	7
Myoporum acuminatum	S2									0	1
Vachellia nilotica	S2	0.7	0.5	0.7						3.8	15
Vachellia nilotica	S1									0	4
Desmanthus pernambucanus	S2									0	4
Acacia salicina	T2									0	1
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0

GROUND SPECIES (PFC measured in 5, 1 x 1 m plots)

Coll. No.	Species	G1	G2	G3	G4	G5	Average
	Dichanthium fecundum	60	94	30	30	20	46.8
	Sida acuta	2				10	6
	Gomphrena celsiodes			0.5			0.5
	Chloris divaricata			2		15	8.5
	Aeschynomene indica			0.5			0.5
	Cyperus fulvus			2			2
	Vachellia nilotica				20		20
	Ocimum americanum				7	15	11
	Rynchosia minima				1		1
	Urochloa mosambicensis				5		5
	Bothriochloa pertusa			30	31	35	32
	Desmanthus pernambucanus				1		1
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
	Extra species						#DIV/0!
	Alternanthera nana						#DIV/0!
	Dendrophthoe glabrescens						#DIV/0!
EO16	*Panicum larcomianum*						#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
Bare Ground		33		30		2	21.66666667
Litter		5	5	5		3	21.66666667
Rock					5		4.5
Timber			1				5
Cryptogram							1

* Shrub and Tree species cover measured within a 50 x 10 m plot using the line-intercept method

PHOTOS

Detailed Flora Datasheet

SITE INFORMATION

Project Name	RRR	**Erosional Pattern**	
Site No.	T4	**Landform Pattern**	
Site Type	Secondary	**Landform Element**	
Date	12/02/2019	**EDL**	Tree
Observers	PW, EO	**Geology**	
Bioregion	11	**Altitude**	13
Mapped RE	11.3.25	**Aspect**	North
Confirmed RE	11.3.25	**Slope (°)**	5
Landzone	3	**Soil Colour**	
Start GPS Location	23.38035, 150.4547	**Soil Texture**	
End GPS Location	23.38019, 150.4552	**Soil Type**	Clay

VEGETATION STRUCTURAL DESCRIPTION (Modified Specht)

Eucalyptus tereticornis and *Eucalyptus coolibah* woodland with grassy ground cover on clay soils.

GENERAL SITE COMMENTS/VEGETATION CONDITION/DISTURBANCES

Some grassy weed species present.

VEGETATION STRUCTURAL SUMMARY

Strata	Height range (m)	Median height (m)	Crown Cover (%)				
E							
T1	17 to 22	20	58.4				
T2	9 to 15	12	24.2				
T3							
S1	2 to 5	3					
S2	0 to 2	1					

TREE AND SHRUB SPECIES

Species	Stratum	Crown Cover (%) calculations* Crown cover of each individual (m)								Total Cover	Stem count
Eucalyptus tereticornis	T1	1	15							32	4
Eucalyptus tereticornis	T2	6.4								12.8	2
Eucalyptus coolabah	T1	13.2								26.4	2
Melaleuca dealbata	T2	5.7								11.4	1
Rauvolfia tetraphylla	S2									0	3
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0

GROUND SPECIES (PFC measured in 5, 1 x 1 m plots)

Coll. No.	Species	G1	G2	G3	G4	G5	Average
	Cynodon dactylon						#DIV/0!
	Cyperus fulvus	2					2
	Sporobolus caroli	11					11
	Bothriochloa pertusa	35					35
	Panicum larcomianum	2					2
	Macroptilium lathyroides					1	1
	Dichanthium aristatum		25				25
	Dichanthium fecundum		35	60	30	20	36.25
	Sida acuta			2	2		2
	Panicum decompositum					2	2
	Urochloa subquadripara					2	2
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
	Extra species						#DIV/0!
	Phyla nodiflora						#DIV/0!
	Phyllanthus virgatus						#DIV/0!
	Rauvolfia tetraphylla						#DIV/0!
	Chloris gayana						#DIV/0!
	Crotalaria montana						#DIV/0!
	Vigna lanceolata						#DIV/0!
	Senna barclayana						#DIV/0!
	Marsilea mutica						#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
Bare Ground		15	30	5	43	25	23.6
Litter		35		33	25	50	23.6
Rock							35.75
Timber			10				#DIV/0!
Cryptogram							10

* Shrub and Tree species cover measured within a 50 x 10 m plot using the line-intercept method

PHOTOS

Detailed Flora Datasheet

SITE INFORMATION

Project Name	RRR	**Erosional Pattern**	
Site No.	T5	**Landform Pattern**	
Site Type	Secondary	**Landform Element**	
Date	12/02/2019	**EDL**	Ground
Observers	PW, EO	**Geology**	
Bioregion	11	**Altitude**	11
Mapped RE	11.3.27c	**Aspect**	
Confirmed RE	11.3.27c	**Slope (°)**	
Landzone	3	**Soil Colour**	Black
Start GPS Location	23.37192, 150.45617	**Soil Texture**	Clay loam
End GPS Location	23.37189, 150.45663	**Soil Type**	Cracking clay with some loam

VEGETATION STRUCTURAL DESCRIPTION (Modified Specht)

Mixed sedgeland / wetland domianted by *Glinus lotoides* and *Abutilon guineense* on black cracking clay soils.

GENERAL SITE COMMENTS/VEGETATION CONDITION/DISTURBANCES

Site is heavily grazed, however weed cover remains low due to high cover of native wetland species.

VEGETATION STRUCTURAL SUMMARY

Strata	Height range (m)	Median height (m)	Crown Cover (%)				
E							
T1	None		0				
T2							
T3							
S1	None						
S2							

TREE AND SHRUB SPECIES

Species	Stratum	Crown Cover (%) calculations* Crown cover of each individual (m)								Total Cover	Stem count
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0

GROUND SPECIES (PFC measured in 5, 1 x 1 m plots)

Coll. No.	Species	G1	G2	G3	G4	G5	Average
	Glinus lotoides	84	60	90	20	27	56.2
	Sida acuta	5	20		20		15
	Persicaria attenuata	10			10		10
	Macroptilium lathyroides	1				3	2
EO5	*Abutilon guineense*		20		50	70	46.66666667
	Desmanthus percambucanus			10			10
							#DIV/0!
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							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
	Extra species						#DIV/0!
	Persicaria orientalis						#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
Bare Ground							#DIV/0!
Litter							#DIV/0!
Rock							#DIV/0!
Timber							#DIV/0!
Cryptogram							#DIV/0!

* Shrub and Tree species cover measured within a 50 x 10 m plot using the line-intercept method

PHOTOS

Detailed Flora Datasheet

SITE INFORMATION

Project Name	RRR	**Erosional Pattern**	
Site No.	T6	**Landform Pattern**	River bank
Site Type	Secondary	**Landform Element**	
Date	12/02/2019	**EDL**	Tree
Observers	PW, EO	**Geology**	
Bioregion	11	**Altitude**	5
Mapped RE	11.3.25f	**Aspect**	
Confirmed RE	11.3.25	**Slope (°)**	
Landzone	3	**Soil Colour**	
Start GPS Location	23.32797, 150.48672	**Soil Texture**	
End GPS Location	23.32764, 150.48643	**Soil Type**	

VEGETATION STRUCTURAL DESCRIPTION (Modified Specht)

Melaleuca leucadendra woodland black clay soils on river bank.

GENERAL SITE COMMENTS/VEGETATION CONDITION/DISTURBANCES

Site is situated on the banks of the Fitzroy River with floating exotic macrophytes present including *Eichhornia crassipes, Hymenachne amplexicaulis* and *Salvinia molesta*. Weed species present on the bank include dense patches of very tall *Urochloa mutica* and *Megathyrsus maximus.* Species diversity is quite high, however most species are exotic.

VEGETATION STRUCTURAL SUMMARY

Strata	Height range (m)	Median height (m)	Crown Cover (%)				
E							
T1	**17 to 20**	**18**	**31.2**				
T2	**10 to 14**	**13**					
T3							
S1	**2 to 5**	**3**					
S2	**0 to 2**	**1**					

TREE AND SHRUB SPECIES

Species	Stratum	Crown Cover (%) calculations* Crown cover of each individual (m)								Total Cover	Stem count
Eucalyptus tereticornis	T1									0	2
Melaleuca leucadendra	T1	*11.8*								23.6	10
Eucalyptus coolabah	T1									0	3
Melaleuca leucadendra	T2	*1.2*								2.4	4
Acacia salicina	T2									0	2
Melaleuca bracteata	S2									0	1
Eucalyptus tereticornis	T2									0	2
Cryptostegia grandiflora	T2									0	14
Cryptostegia grandiflora	S1									0	5
Eucalyptus tereticornis	S2									0	3
Eucalyptus tereticornis	S1									0	1
Acacia salicina	S1									0	1
Cordia dichotoma	T2									0	1
Casuarina cunninghamiana	T2									0	1
Casuarina cunninghamiana	T1	*3.8*								7.6	1
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0

GROUND SPECIES (PFC measured in 5, 1 x 1 m plots)

Coll. No.	Species	G1	G2	G3	G4	G5	Average
	Praxelis clematidea	2					2
	Passiflora foetida	3					3
	Gymnanthera oblongata	3	3				3
	Megathyrsus maximus var. publiglumis	65	20			70	51.66666667
	Urochloa mutica			98	90	30	72.66666667
	Eucalyptus coolibah	1					1
	Verbena bonariensis	2					2
	Macroptilium atropurpureum	2					2
	Euphorbia drummondii		2				2
	Cryptostegia grandiflora		3	2			2.5
	Phragmites australis				10		10
							#DIV/0!
							#DIV/0!
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							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
	Extra species						#DIV/0!
	Alternanthera bettickiana						#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
Bare Ground			12				12
Litter		22	60				12
Rock							41
Timber							#DIV/0!
Cryptogram							#DIV/0!

* Shrub and Tree species cover measured within a 50 x 10 m plot using the line-intercept method

PHOTOS

Detailed Flora Datasheet

SITE INFORMATION

Project Name	RRR	**Erosional Pattern**	
Site No.	T7	**Landform Pattern**	
Site Type	Secondary	**Landform Element**	
Date	13/02/2019	**EDL**	
Observers	PW, EO	**Geology**	
Bioregion	11	**Altitude**	15
Mapped RE	11.3.27c	**Aspect**	
Confirmed RE	Non-remnant	**Slope (°)**	
Landzone	3	**Soil Colour**	
Start GPS Location	23.35305, 150.4704	**Soil Texture**	
End GPS Location	23.35319, 150.4700	**Soil Type**	

VEGETATION STRUCTURAL DESCRIPTION (Modified Specht)

Urochloa mutica wetland.

GENERAL SITE COMMENTS/VEGETATION CONDITION/DISTURBANCES

Dominated by *Urochloa mutica* with native species extremely limited in their ability to germinate due to dense cover of exotics.

VEGETATION STRUCTURAL SUMMARY

Strata	Height range (m)	Median height (m)	Crown Cover (%)				
E							
T1							
T2							
T3							
S1							
S2							

TREE AND SHRUB SPECIES

Species	Stratum	Crown Cover (%) calculations* Crown cover of each individual (m)								Total Cover	Stem count
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0

GROUND SPECIES (PFC measured in 5, 1 x 1 m plots)

Coll. No.	Species	G1	G2	G3	G4	G5	Average
	Urochloa mutica	60	65	60	67	50	60.4
	Yellow flower herb	2					2
	Aeschynomene indica	0.5		3	1		1.5
	Sida acuta	0.5				1	0.75
	Macroptilium lathyroides			1		1	1
	Sesbania cannabina			1			1
	Marsilea mutica				2	1	1.5
	Panicum decompositum						#DIV/0!
	Crotalaria montana					1	1
	Cyperus scariosus					1	1
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
Bare Ground		22	5	15	15	15	14.4
Litter		15	30	20	15	30	14.4
Rock							22
Timber							#DIV/0!
Cryptogram							#DIV/0!

* Shrub and Tree species cover measured within a 50 x 10 m plot using the line-intercept method

PHOTOS

Detailed Flora Datasheet

SITE INFORMATION

Project Name	RRR	**Erosional Pattern**	
Site No.	T8	**Landform Pattern**	
Site Type	Secondary	**Landform Element**	
Date	13/02/2019	**EDL**	Tree
Observers	PW, EO	**Geology**	
Bioregion	11	**Altitude**	10
Mapped RE	Non-remnant	**Aspect**	
Confirmed RE	Non-remnant 11.3.1	**Slope (°)**	
Landzone	3	**Soil Colour**	Black
Start GPS Location	23.32497, 150.49347	**Soil Texture**	
End GPS Location	23.32473, 150.49386	**Soil Type**	Clayey loam

VEGETATION STRUCTURAL DESCRIPTION (Modified Specht)

Acacia harpophylla open forest on clay soils.

GENERAL SITE COMMENTS/VEGETATION CONDITION/DISTURBANCES

Site is in good condition with little weeds present within the patch, only present on the edges. Thick whipstick brigalow regrowth which meets the EPBC Act listed TEC Brigalow (*Acacia harpophylla* dominant and co-dominant).

VEGETATION STRUCTURAL SUMMARY

Strata	Height range (m)	Median height (m)	Crown Cover (%)				
E							
T1	**5 to 9**	**7**	**74**				
T2							
T3							
S1	**2 to 5**	**3**					
S2	**0 to 2**	**1**					

TREE AND SHRUB SPECIES

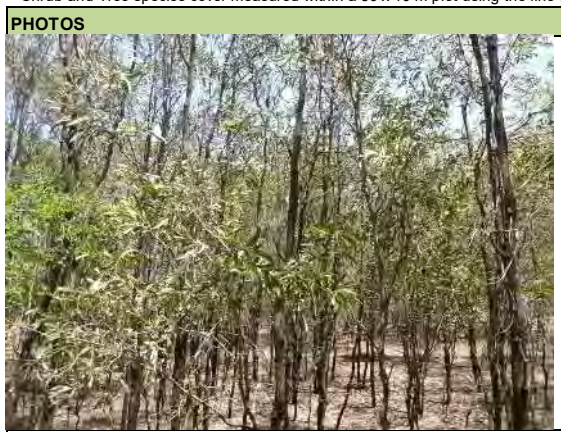
Species	Stratum	Crown Cover (%) calculations* Crown cover of each individual (m)								Total Cover	Stem count
Acacia harpophylla	T1	3.9	9.9	10	13.2					74	278
Lysiphyllum carronii	T1									0	1
Casuarina cristata	T1									0	1
Alectryon diversifolius	S1									0	2
Lysiphyllum carronii	S1									0	8
Acacia harpophylla	S1									0	6
Lysiphyllum carronii	S2									0	1
Cryptostegia grandiflora	S2									0	1
Harrisia martinii	S2									0	3
Acacia harpophylla	S2									0	2
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0

GROUND SPECIES (PFC measured in 5, 1 x 1 m plots)

Coll. No.	Species	G1	G2	G3	G4	G5	Average
	Cyperus sp.	1					1
	Acacia harpophylla				7		7
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
	Extra species						#DIV/0!
	Parsonsia straminea						#DIV/0!
	Capparis lasiantha						#DIV/0!
	Bryophyllum delagoense						#DIV/0!
	Harrisia martenii						#DIV/0!
	Lysiphyllum carronii						#DIV/0!
	Terminalia oblongata						#DIV/0!
	Cyptostegia grandiflora						#DIV/0!
	Parkinsonia aculeata						#DIV/0!
	Lantana camara						#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
							#DIV/0!
Bare Ground		25	20		3	5	13.25
Litter		74	80	100	90	95	13.25
Rock							87.8
Timber							#DIV/0!
Cryptogram							#DIV/0!

* Shrub and Tree species cover measured within a 50 x 10 m plot using the line-intercept method

PHOTOS



Detailed Flora Datasheet

SITE INFORMATION

Project Name	RRR	**Erosional Pattern**	
Site No.	T9	**Landform Pattern**	
Site Type	Secondary	**Landform Element**	
Date	13/02/2018	**EDL**	Tree
Observers	PW, EO	**Geology**	
Bioregion	11	**Altitude**	21
Mapped RE	HVR 11.11.15	**Aspect**	
Confirmed RE	11.11.15	**Slope (°)**	
Landzone	11	**Soil Colour**	
Start GPS Location	23.32078, 150.49607	**Soil Texture**	Clay
End GPS Location	23.32036, 150.49627	**Soil Type**	

VEGETATION STRUCTURAL DESCRIPTION (Modified Specht)

Eucalyptus crebra open woodland to 16m on metamorphics.

GENERAL SITE COMMENTS/VEGETATION CONDITION/DISTURBANCES

Site is in good condition with a variety of native herbaceous species regenerating after a fire (likely late last year).

VEGETATION STRUCTURAL SUMMARY

Strata	Height range (m)	Median height (m)	Crown Cover (%)				
E							
T1	**10 to 16**	**14**	**22.2**				
T2	**6 to 9**	**8**	**3.4**				
T3							
S1	**2 to 5**	**3**					
S2	**0 to 2**	**1**	**0.6**				

TREE AND SHRUB SPECIES

Species	Stratum	Crown Cover (%) calculations* Crown cover of each individual (m)								Total Cover	Stem count
Eucalyptus crebra	T1	1.1	3.9	6.1						22.2	11
Psydrax oleiofolia	S2	0.3								0.6	9
Grewia latifolia	S2									0	3
Eremophila debilis	S2									0	4
Acacia decora	S2									0	1
Alphitonia excelsa	S2									0	1
Harrisia martinii	S2									0	3
Eucalyptus crebra	S2									0	1
Myoporum acuminatum	S2									0	1
Acacia decora	S1									0	1
Vachellia bidwillii	S2									0	2
Opuntia stricta	S2									0	1
Eucalyptus crebra	T2	1.7								3.4	2
Corymbia dallachiana	S2									0	2
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0
										0	0

GROUND SPECIES (PFC measured in 5, 1 x 1 m plots)

Coll. No.	Species	G1	G2	G3	G4	G5	Average
	Cyperus fulvus	3	10		25	1	9.75
	Brunoniella australis	1					1
	Scleria brownii	1		10	5	5	5.25
EO24	*Mecardonia procumbens*		0.5				0.5
	Chrysopogon fallax	2	3	1			2
	Heteropogon contortus	3	7	5	5	25	9
	Hybanthus sp.	0.5					0.5
	Galactia tenufolia	2	3	5			3.333333333
	Phyllanthus virgatus	0.5	0.5	0.5			0.5
	Styosanthes scabra		0.5	0.5	2	5	2
	Sida acuta		0.5				0.5
	Bothriochloa pertusa			1			1
	Crotalaria montana					0.5	0.5
	Fimbristylis dichotoma			2	1	1	1.333333333
	Megathyrsus maximus			2			2
	Psydrax oleofolius			2			2
	Neptunia sp.				1	1	1
	Rostellularia sp.				1	1	1
	Passiflora foetida					3	3
	Sphaeococe brachystema					1	1
							#DIV/0!
	Extra species						#DIV/0!
	Themeda triandra						#DIV/0!
	Murdannia graminea						#DIV/0!
	Eremophila debilis						#DIV/0!
	Phyllanthus virgatus						#DIV/0!
	Acacia decora						#DIV/0!
	Indigofera trita						#DIV/0!
	Parsonsia straminea						#DIV/0!
Bare Ground		25	25	41	20	35	29.2
Litter		60	45	25	35	19.5	29.2
Rock		2	5	5	5	2	36.9
Timber							3.8
Cryptogram							#DIV/0!

* Shrub and Tree species cover measured within a 50 x 10 m plot using the line-intercept method

PHOTOS

Appendix B

Flora species list

Appendix B Flora species list

Table 19 Flora species list

Family	Species	Introduced
Acanthaceae	*Brunoniella australis*	
Acanthaceae	*Pseuderanthemum variabile*	
Acanthaceae	*Rostellularia adscendens*	
Acanthaceae	*Ruellia simplex*	*
Agavaceae	*Agave americana*	*
Aizoaceae	*Trianthema portulacastrum*	*
Amaranthaceae	*Achyranthes aspera*	
Amaranthaceae	*Alternanthera denticulata*	
Amaranthaceae	*Alternanthera ficoidea*	*
Amaranthaceae	*Alternanthera nana*	
Amaranthaceae	*Alternanthera pungens*	*
Amaranthaceae	*Gomphrena celosioides*	*
Anacardiaceae	*Mangifera indica*	*
Anacardiaceae	*Pleiogynium timorense*	
Anacardiaceae	*Schinus terebinthifolius*	*
Apocynaceae	*Cascabela thevetia*	*
Apocynaceae	*Catharanthus roseus*	*
Apocynaceae	*Cryptostegia grandiflora*	*
Apocynaceae	*Gymnanthera oblonga*	
Apocynaceae	*Parsonsia straminea*	
Apocynaceae	*Rauvolfia tetraphylla*	*
Araceae	*Lemna aequinoctialis*	
Araliaceae	*Schefflera actinophylla*	
Arecaceae	*Phoenix dactylifera*	*
Asparagaceae	*Asparagus racemosus*	
Asteraceae	*Ageratum houstonianum*	*
Asteraceae	*Bidens pilosa*	*
Asteraceae	*Calotis cuneata*	
Asteraceae	*Cirsium vulgare*	*
Asteraceae	*Conyza bonariensis*	*
Asteraceae	*Cyanthillium cinereum*	
Asteraceae	*Emilia sonchifolia*	*
Asteraceae	*Epaltes* sp.	
Asteraceae	*Erigeron bonariensis*	*

Family	Species	Introduced
Asteraceae	*Parthenium hysterophorus*	*
Asteraceae	*Peripleura hispidula*	
Asteraceae	*Praxelis clematidea*	*
Asteraceae	*Pterocaulon* sp.	
Asteraceae	*Tridax procumbens*	*
Azollaceae	*Azolla pinnata*	
Boraginaceae	*Heliotropium amplexicaule*	*
Boraginaceae	*Heliotropium indicum*	*
Boranginaceae	*Cordia dichotoma*	
Brassicaceae	*Lepidium africanum*	*
Cactaceae	*Harrisia martinii*	*
Cactaceae	*Opuntia streptacantha*	*
Cactaceae	*Opuntia stricta*	*
Cactaceae	*Opuntia tomentosa*	*
Caesalpiniaceae	*Bauhinia variegata*	*
Caesalpiniaceae	*Chamaecrista absus*	
Caesalpiniaceae	*Delonix regia*	*
Caesalpiniaceae	*Lysiphyllum carronii*	
Caesalpiniaceae	*Lysiphyllum hookeri*	
Caesalpiniaceae	*Parkinsonia aculeata*	*
Caesalpiniaceae	*Peltophorum pterocarpum*	*
Caesalpiniaceae	*Senna barclayana*	
Campanulaceae	*Wahlenbergia gracilis*	
Capparaceae	*Capparis lasiantha*	
Casuarinaceae	*Casuarina cristata*	
Casuarinaceae	*Casuarina cunninghamiana*	
Characeae	*Chara* sp.	
Chenopodiaceae	*Atriplex muelleri*	
Chenopodiaceae	*Suaeda australis*	
Combretaceae	*Terminalia oblongata*	
Commelinaceae	*Commelina diffusa*	
Commelinaceae	*Murdannia graminea*	
Convolvulaceae	*Convolvulus erubescens*	
Convolvulaceae	*Evolvulus alsinoides*	
Convolvulaceae	*Polymeria calycina*	
Crassulaceae	*Bryophyllum delagoense*	*
Cucurbitaceae	*Cucumis* sp.	

Family	Species	Introduced
Cyperaceae	*Cyperus fulvus*	
Cyperaceae	*Cyperus gracilis*	
Cyperaceae	*Cyperus involucratus*	*
Cyperaceae	*Cyperus rotundus*	*
Cyperaceae	*Cyperus scariosus*	
Cyperaceae	*Cyperus* sp.	
Cyperaceae	*Fimbristylis dichotoma*	
Cyperaceae	*Fimbristylis* sp.	
Cyperaceae	*Scleria brownii*	
Euphorbiaceae	*Euphorbia cyathophora*	*
Euphorbiaceae	*Euphorbia drummondii*	
Euphorbiaceae	*Euphorbia heterophylla*	*
Euphorbiaceae	*Euphorbia hirta*	*
Euphorbiaceae	*Macaranga tanarius*	
Euphorbiaceae	*Mallotus philippensis*	
Euphorbiaceae	*Ricinus communis*	*
Fabaceae	*Aeschynomene indica*	
Fabaceae	*Clitoria ternatea*	*
Fabaceae	*Crotalaria lanceolata*	*
Fabaceae	*Crotalaria medicaginea*	
Fabaceae	*Crotalaria montana*	
Fabaceae	*Crotalaria pallida*	*
Fabaceae	*Erythrina vespertilio*	
Fabaceae	*Galactia tenuiflora*	
Fabaceae	*Glycine tabacina*	
Fabaceae	*Glycine tomentella*	
Fabaceae	*Indigofera hirsuta*	
Fabaceae	*Indigofera linifolia*	
Fabaceae	*Indigofera linnaei*	
Fabaceae	*Indigofera pratensis*	
Fabaceae	*Indigofera trita*	
Fabaceae	*Macroptilium atropurpureum*	*
Fabaceae	*Macroptilium lathyroides*	*
Fabaceae	*Rhynchosia minima*	
Fabaceae	*Sesbania cannabina*	
Fabaceae	*Stylosanthes scabra*	*
Fabaceae	*Tephrosia filipes*	

Family	Species	Introduced
Fabaceae	*Vigna lanceolata*	
Haloragaceae	*Myriophyllum verrucosum*	
Hemerocallidaceae	*Dianella longifolia*	
Lamiaceae	*Clerodendrum floribundum*	
Lamiaceae	*Leonotis nepetifolia*	*
Lamiaceae	*Ocimum americanum*	*
Laxmanniaceae	*Eustrephus latifolius*	
Lecythidaceae	*Planchonia careya*	
Loranthaceae	*Dendrophthoe glabrescens*	
Malvaceae	*Abutilon guineense*	*
Malvaceae	*Hibiscus rosasinensis*	*
Malvaceae	*Hibiscus tridactylites*	
Malvaceae	*Malvastrum americanum*	*
Malvaceae	*Malvastrum coromandelianum*	*
Malvaceae	*Sida acuta*	*
Malvaceae	*Sida cordifolia*	*
Malvaceae	*Sida hackettiana*	
Malvaceae	*Sida spinosa*	*
Malvaceae	*Urena lobata*	*
Marsileaceae	*Marsilea mutica*	
Meliaceae	*Melia azedarach*	
Meliaceae	*Owenia acidula*	
Mimosaceae	*Acacia decora*	
Mimosaceae	*Acacia harpophylla*	
Mimosaceae	*Acacia salicina*	
Mimosaceae	*Albizia lebbeck*	
Mimosaceae	*Desmanthus pernambucanus*	*
Mimosaceae	*Leucaena leucocephala*	*
Mimosaceae	*Mimosa pudica*	*
Mimosaceae	*Neptunia gracilis*	
Mimosaceae	*Neptunia* sp.	
Mimosaceae	*Vachellia bidwillii*	
Mimosaceae	*Vachellia farnesiana*	*
Mimosaceae	*Vachellia nilotica*	*
Molluginaceae	*Glinus lotoides*	
Moraceae	*Ficus opposita*	
Moraceae	*Ficus religiosa*	*

Family	Species	Introduced
Moraceae	*Ficus virens*	
Myrtaceae	*Corymbia dallachiana*	
Myrtaceae	*Corymbia intermedia*	
Myrtaceae	*Corymbia ptychocarpa*	
Myrtaceae	*Corymbia tessellaris*	
Myrtaceae	*Corymbia torelliana*	
Myrtaceae	*Eucalyptus coolabah*	
Myrtaceae	*Eucalyptus crebra*	
Myrtaceae	*Eucalyptus fibrosa*	
Myrtaceae	*Eucalyptus raveretiana*	V
Myrtaceae	*Eucalyptus tereticornis*	
Myrtaceae	*Eugenia reinwardtiana*	
Myrtaceae	*Lophostemon suaveolens*	
Myrtaceae	*Melaleuca bracteata*	
Myrtaceae	*Melaleuca dealbata*	
Myrtaceae	*Melaleuca fluviatilis*	
Myrtaceae	*Melaleuca leucadendra*	
Myrtaceae	*Melaleuca linariifolia*	
Nyctaginaceae	*Boerhavia dominii*	
Nymphaeaceae	*Nymphaea caerulea*	*
Nymphaeaceae	*Nymphaea* sp.	
Oleaceae	*Jasminum didymum*	
Onagraceae	*Ludwigia octovalvis*	
Onagraceae	*Ludwigia perennis*	
Oxalidaceae	*Oxalis corniculata*	*
Passifloraceae	*Passiflora foetida*	*
Phyllanthaceae	*Breynia oblongifolia*	
Phyllanthaceae	*Phyllanthus maderaspatensis*	
Phyllanthaceae	*Phyllanthus virgatus*	
Picrodendraceae	*Petalostigma pubescens*	
Plantaginaceae	*Mecardonia procumbens*	*
Plantaginaceae	*Plantago* sp.	
Poaceae	*Aristida calycina*	
Poaceae	*Aristida personata*	
Poaceae	*Arundinella nepalensis*	
Poaceae	*Bothriochloa bladhii*	
Poaceae	*Bothriochloa pertusa*	*

Family	Species	Introduced
Poaceae	*Cenchrus ciliaris*	*
Poaceae	*Cenchrus echinatus*	*
Poaceae	*Chloris divaricata*	
Poaceae	*Chloris gayana*	*
Poaceae	*Chloris inflata*	*
Poaceae	*Chrysopogon fallax*	
Poaceae	*Cynodon dactylon*	*
Poaceae	*Dactyloctenium aegyptium*	*
Poaceae	*Dactyloctenium radulans*	
Poaceae	*Dichanthium aristatum*	*
Poaceae	*Dichanthium fecundum*	
Poaceae	*Digitaria* sp.	
Poaceae	*Echinochloa colona*	*
Poaceae	*Eleusine indica*	*
Poaceae	*Eragrostis sororia*	
Poaceae	*Eragrostis tenuifolia*	*
Poaceae	*Eriochloa procera*	
Poaceae	*Heteropogon contortus*	
Poaceae	*Hymenachne amplexicaulis*	*
Poaceae	*Hyparrhenia rufa*	*
Poaceae	*Megathyrsus maximus* var. *maximus*	*
Poaceae	*Megathyrsus maximus* var. *pubiglumis*	*
Poaceae	*Melinis repens*	*
Poaceae	*Panicum decompositum*	
Poaceae	*Panicum effusum*	
Poaceae	*Panicum larcomanium*	
Poaceae	*Paspalum* sp.	
Poaceae	*Pennisetum ciliatum*	
Poaceae	*Phragmites australis*	
Poaceae	*Sorghum halepense*	*
Poaceae	*Sporobolus caroli*	
Poaceae	*Sporobolus creber*	
Poaceae	*Sporobolus natalensis*	*
Poaceae	*Themeda triandra*	
Poaceae	*Tragus australianus*	
Poaceae	*Urochloa mosambicensis*	*
Poaceae	*Urochloa mutica*	*

Family	Species	Introduced
Poaceae	*Urochloa subquadripara*	*
Polygonaceae	*Persicaria attenuata*	
Polygonaceae	*Persicaria orientalis*	
Polygonaceae	*Polygonum plebeium*	
Pontederiaceae	*Eichhornia crassipes*	*
Portulacaceae	*Portulaca oleracea*	*
Portulacaceae	*Portulaca pilosa*	*
Potamogetonaceae	*Stuckenia pectinata*	
Putranjivaceae	*Drypetes deplanchei*	
Rhamnaceae	*Alphitonia excelsa*	
Rhamnaceae	*Ziziphus mauritiana*	*
Rubiaceae	*Psydrax odorata*	
Rubiaceae	*Psydrax oleifolia*	
Rubiaceae	*Spermacoce brachystema*	
Rutaceae	*Flindersia australis*	
Rutaceae	*Geijera salicifolia*	
Rutaceae	*Murraya paniculata*	*
Salviniaceae	*Salvinia molesta*	*
Sapindaceae	*Alectryon diversifolius*	
Sapindaceae	*Cardiospermum grandiflorum*	*
Sapindaceae	*Cupaniopsis anacardioides*	
Sapindaceae	*Jagera pseudorhus*	
Scrophulariaceae	*Eremophila debilis*	
Scrophulariaceae	*Eremophila mitchellii*	
Scrophulariaceae	*Myoporum acuminatum*	
Solanaceae	*Solanum torvum*	*
Sparrmanniaceae	*Grewia latifolia*	
Sterculiaceae	*Brachychiton australis*	
Typhaceae	*Typha domingensis*	
Verbenaceae	*Glandularia aristigera*	*
Verbenaceae	*Lantana camara*	*
Verbenaceae	*Lantana montevidensis*	*
Verbenaceae	*Phyla nodiflora*	
Verbenaceae	*Stachytarpheta jamaicensis*	*
Verbenaceae	*Verbena bonariensis*	*
Violaceae	*Hybanthus monopetalus*	
Violaceae	*Hybanthus* sp.	

Family	Species	Introduced
Zamiaceae	*Macrozamia miquelii*	
Zygophyllaceae	*Tribulus terrestris*	

Appendix C

Fauna wetland indicator species list

Appendix C Fauna wetland indicator species list

Scientific name	Common name	Wetland				
		Pink Lily Lagoon	Black Duck Lagoon	Lotus Lagoon	Dunganweate Lagoon	Nelson Lagoon
Anas gracilis	Grey teal	X		X		X
Anas superciliosa	Pacific black duck		X	X		X
Anhinga novaehollandiae	Australasian darter	X		X	X	
Ardea ibis	Cattle egret	X		X		
Ardea intermedia	Intermediate egret	X		X		
Ardea alba modesta	Eastern great egret		X	X	X	
Aythya australis	Hardhead					X
Chenonetta jubata	Australian wood duck			X	X	X
Chlidonias hybrida	Whisked tern	X				
Cygnus atratus	Black swan			X	X	X
Dendrocygna arcuata	Wandering whistling-duck	X				
Dendrocygna eytoni	Plumed whistling-duck	X				
Egretta garzetta	Little egret			X	X	X
Egretta novaehollandiae	White-faced heron	X				
Elseyornis melanops	Black-fronted dotterel	X		X	X	
Ephippiorhynchus asiaticus	Black-necked stork			X		
Fulica atra	Eurasian coot					
Gallinago hardwickii	Latham's snipe	X				
Gallinula tenebrosa	Dusky moorhen	X		X		
Grus rubicunda	Brolga				X	
Himantopus himantopus	Black-winged stilt	X		X		
Hydroprogne caspia	Caspian tern	X				X
Irediparra gallinacea	Comb-crested jacana			X		
Litoria fallax	Eastern sedge frog	X	X	X		
Litoria rothii	Roth's tree frog	X				
Litoria rubella	Desert tree frog	X				
Malacorhynchus membranaceus	Pink-eared duck					
Microcarbo melanoleucos	Little pied cormorant	X			X	
Nettapus coromandelianus	Cotton pygmy-goose	X	X			X

Scientific name	Common name		Wetland			
		Pink Lily Lagoon	Black Duck Lagoon	Lotus Lagoon	Dunganweate Lagoon	Nelson Lagoon
Pandion cristatus	Eastern osprey					
Pelecanus conspicillatus	Australian pelican	X		X	X	X
Phalacrocorax carbo	Great cormorant			X		
Phalacrocorax sulcirostris	Little black cormorant	X	X	X	X	
Phalacrocorax varius	Pied cormorant	X		X	X	X
Philemon citreogularis	Little friarbird			X	X	
Platalea flavipes	Yellow-billed spoonbill	X		X		
Platalea regia	Royal spoonbill	X		X		
Plegadis falcinellus	Glossy ibis	X		X		X
Podiceps cristatus	Great crested grebe					
Porphyrio porphyrio	Purple swamphen	X				
Tachybaptus novaehollandiae	Australasian grebe	X		X		
Threskiornis molucca	Australian white ibis	X		X		X
Threskiornis spinicollis	Straw-necked ibis					
Tringa stagnatilis	Marsh sandpiper	X				
Vanellus miles	Masked lapwing	X		X	X	X
Total species observed		**29**	**5**	**26**	**13**	**13**

Appendix D

Likelihood of occurrence assessment

Appendix D Likelihood of occurrence assessment

Scientific name	Common name	Status (EPBC Act, NC Act)	Discussion	Likelihood
Flora				
Backhousia oligantha		- Endangered	*Backhousia oligantha* is known from a few populations between Rockhampton and Gayndah in Central Queensland. It occurs in Araucarian microphyll vine forest with associated species including *Archidendropsis thozetiana, Alectryon diversifolius, Psydrax odoratum* and *Gossia bidwillii* (Bean, 2003).	**Unlikely** No suitable habitat is present to support this species. Nearby records exist, however these occur in a different habitat type.
Callicarpa thozetii		- Endangered	*Callicarpa thozetii* occurs in tall woodland and semi-evergreen vine forests. Associated species include *Eucalyptus platyphylla*, *Lophostemon suaveolens* and *Corymbia intermedia* on clayey sand; *Eucalyptus acmenoides, Corymbia citriodora and C. intermedia* on shallow, stony, clay loam soil and semi-evergreen vine thicket on steep slopes and valleys on alluvial-colluvial soils (Munir, A., 1982).	**Unlikely** No suitable habitat is present to support this species. Nearby records exist, however these occur in a different habitat type.
Cycas megacarpa	Marlborough blue	Endangered, Endangered	*Cycas megacarpa* is endemic to south-east Queensland. It is found from as far south as Woolooga to Bouldercombe in the north. *Cycas megacarpa* is found in woodland, open woodland and open forests, often in conjunction with a grassy understory. This species is found in habitat dominated by *Eucalyptus crebra* and *Corymbia citriodora* as well as *Corymbia erythrophloia*, *Eucalyptus melanophloia* and *Lophostemon confertus* (Department of the Environment & Energy, 2019).	**Unlikely** No suitable habitat is present to support this species. Nearby records exist, however these occur in a different habitat type.

Scientific name	Common name	Status (EPBC Act, NC Act)	Discussion	Likelihood
Cycas ophiolitica	Cycad	Endangered, Endangered	Marlborough blue is endemic to Queensland, occurring from Marlborough to Rockhampton in central-eastern Queensland. This species grows on hills and slopes in sparse, grassy open forest at altitude ranges from 80–400 m above sea level. Although this species reaches its best development on red clay soils near Marlborough, it is more frequently found on shallow, stony, infertile soils, which are developed on sandstone and serpentinite, and is associated with species such as *Corymbia dallachiana, Corymbia erythrophloia, Corymbia xanthope* and *Eucalyptus fibrosa* (Department of the Environment, 2019).	**Unlikely** No suitable habitat is present to support this species. Nearby records exist, however these occur in a different habitat type.
Dichanthium setosum	Bluegrass	Vulnerable, -	In Queensland, this species has been reported from the Leichhardt, Morton, North Kennedy and Port Curtis regions. Bluegrass occurs in heavy cracking clay or alluvial soils, often gilgaied, in brigalow or eucalypt communities in tropical or subtropical climates with marked seasonal drying (Department of the Environment, 2019).	**Unlikely** No suitable habitat is present to support this species. No nearby records exist.
Eucalyptus raveretiana	Black ironbox	- Vulnerable	Black ironbox has a wide distribution in coastal and sub-coastal areas of Queensland, from south of Townsville to Nebo, around Rockhampton and areas 100 km west of the city. This species usually grows along watercourses, and sometimes on river flats or open woodland. Soil varies from sand through to heavy clay. Altitudinal range is 0–300 m and the climate of the area is sub-tropical with an annual rainfall of 650–1100 m (Department of the Environment, 2019).	**Present** The species is present within the Project Area and is known to occur in the adjacent Limestone Creek.

Scientific name	Common name	Status (EPBC Act, NC Act)	Discussion	Likelihood
Graptophyllum excelsum	Scarlet fuchsia	- Near threatened	Scarlet fuchsia occurs in coastal central and northern Queensland. The species is known to occur at Mount Archer National Park and surrounds. The species occurs in rainforest communities.	**Unlikely** No suitable habitat is present to support this species. Nearby records exist, however these occur in a different habitat type.
Livistona drudei	Halifax fan palm	- Vulnerable	The Halifax fan palm occurs in north eastern Queensland between Conway Beach and Tully. The species occurs in Melaleuca swamp forest, fringes of rainforest and eucalypt forest with a rainforest understorey.	**Unlikely** No suitable habitat is present to support this species and the Project Area is outside the species' known range.
Marsdenia brevifolia		Vulnerable, Vulnerable	*Marsdenia brevifolia* occurs in north and central Queensland where it is known from near Townsville, Springsure and north of Rockhampton. *Marsdenia brevifolia* occurs on serpentine outcrops of crumbly black soils in eucalypt woodlands, often in association with *Eucalyptus fibrosa* or *Corymbia xanthope* (Department of the Environment, 2019).	**Unlikely** No suitable habitat is present to support this species. No nearby records exist.
Phaius australis	Lesser swamp orchid	Endangered, Endangered	The lesser swamp-orchid is often associated with rainforest communities and tends to be restricted to the coastal areas of Queensland. In North and Central Queensland, *Phaius australis* tends to be restricted to areas that are permanently wet. This species is restricted to the margins of swamps surrounded by dry sclerophyll, swampy rainforest or fringing open forest (Department of the Environment, 2019).	**Unlikely** No suitable habitat is present to support this species. No nearby records exist.

Scientific name	Common name	Status (EPBC Act, NC Act)	Discussion	Likelihood
Samadera bidwillii	Quassia	Vulnerable, Vulnerable	Quassia is endemic to Queensland and is currently known to occur in several localities between Scawfell Island, near Mackay, and Goomboorian, north of Gympie. Included within this range are a number of populations along the Mary River; Tinana Creek, Tallegalla Weir, Teddington Weir pondage, and from Teddington Weir to Tiana Barrage. This species prefers lowland rainforest, open forest and woodlands and often adjacent to watercourses. It commonly occurs in association with *Corymbia citriodora*, *Eucalyptus propinqua*, *Eucalyptus acmenoides*, *Eucalyptus tereticornis*, *Eucalyptus intermedia*, *Eucalyptus siderophloia*, *Eucalyptus moluccana*, *Eucalyptus cloeziana* and *Eucalyptus fibrosa* (Department of the Environment, 2019).	**Unlikely** No suitable habitat is present to support this species. No nearby records exist.

Appendix E

Significant impact assessment

Appendix E Significant impact assessment

Introduction

Under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act), a referral to the Department of the Environment and Energy (DoEE) will be required if the Project has the potential to cause a 'significant impact' on Matters of National Environmental Significance (MNES). In relation to listed conservation significant species, an action will require approval if the action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- extinct
- extinct in the wild
- critically endangered
- endangered
- vulnerable.

A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

Significant impact criteria

The EPBC Act Policy Statement 1.1 states that the following measures should be considered to determine whether an action is likely to have a significant impact on a MNES.

1. Whether there are any MNES located in the area of the proposed action (noting that 'the area of the proposed action' is broader that the immediate location where the action is undertaken; consider also whether there are any MNES adjacent to or downstream from the immediate location that may potentially be impacted)?
2. Consider the proposed action at its broadest scope (that is, considering all stages and components of the action, and all related activities and infrastructure), whether there is potential for impacts, including indirect impacts, on MNES?
3. Whether there are any proposed measures to avoid or reduce impacts on MNES (and if so, is the effectiveness of these measures certain enough to reduce the level of impact below the 'significant impact' threshold)?
4. Whether any impacts of the proposed action on MNES are likely to be significant impacts (important, notable, or of consequence, having regard to their context or intensity)?

For the purpose of this assessment, the proposed action is defined as the Project, which is outlined in Section 1.2.

Endangered ecological communities criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- reduce the extent of an ecological community
- fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
- adversely affect habitat critical to the survival of an ecological community
- modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns
- cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
- cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
  - assisting invasive species, that are harmful to the listed ecological community, to become established, or
  - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or
- interfere with the recovery of an ecological community.

Brigalow (*Acacia harpophylla* dominant and co-dominant) Significant impact assessment

The Brigalow (*Acacia harpophylla* dominant and co-dominant) threatened ecological community (TEC) is listed as endangered under the EPBC Act.

Table 20 Significant impact assessment for Brigalow (*Acacia harpophylla* dominant and co-dominant)

Criteria	Outcome of assessment and justification
Is there a real chance or possibility that the action will: • Reduce the extent of an ecological community?	A total of 0.42 ha of Brigalow TEC will be cleared as a result of the Project. The area of Brigalow TEC is a very small, single patch of high value regrowth (HVR) which is represented in the wider area. It is not considered an ecologically important patch in the area, however clearing as a result of the Project will reduce the extent of an occurrence of the ecological community. It is unlikely that the Project will significantly reduce the extent of the ecological community in a regional context.
• Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines?	The Brigalow TEC identified within the Project Area is a small, fragmented patch of HVR occurring within a significantly modified landscape. There are no brigalow communities mapped within 5 km of the Brigalow TEC. A total of 0.42 ha of the 0.71 ha Brigalow TEC will be cleared as a result of the Project. Whilst this clearing will occur, this remaining patch has already been compromised by previous clearing and fragmentation impacts.

Criteria	Outcome of assessment and justification
• Adversely affect habitat critical to the survival of an ecological community?	Habitat critical to the survival of Brigalow TEC across Australia are considered to be patches which meet the condition thresholds and diagnostic characteristics of Brigalow TEC, including the buffer zones around these communities (i.e. the area immediately adjacent to the patch) as outlined in Department of the Environment (2013). Field surveys determined that 0.42 ha of Brigalow TEC was present within the Project Area and clearing of this area as a result of the Project is not likely to adversely affect habitat critical to the survival of the Brigalow ecological community in a regional context.
• Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns?	Surface water drainage patterns are likely to be altered as a result of the action, however it is unlikely to affect the survival of the Brigalow TEC outside of the impact area. The vegetation species and regional soil and geology types suggest that the level of groundwater dependence is likely to be low within this patch of Brigalow TEC and vegetation is likely to be able to satisfy plant water requirements using retained soil moisture. Modification or destruction of abiotic factors to the extent that the Brigalow TECs survival is compromised outside of the area of impact is unlikely.
• Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting?	The Project will potentially cause a substantial change in the species composition of the small patch of Brigalow TEC identified within and adjacent to the Project Area. A total of 0.42 ha of the 0.71 ha Brigalow TEC will be cleared as a result of the Project, leaving a small 0.29 ha patch. This brigalow patch will be more susceptible to edge effects due to an increased edge to patch ratio. This causes the altering of vegetation composition and structure between the edge and interior of the patch, and may also impact the microclimate of the patch. This may have implications for fauna using the patch and the patch will be less likely to sustain viable populations of native flora and fauna. Although there will potentially be a substantial change to the Brigalow TEC within the Project Area at a site level, it is unlikely that the action will impact on the Brigalow TEC at a regional scale.
• Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: - Assisting invasive species, that are harmful to the listed ecological community, to become established? - Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community?	A total of 0.42 ha of the 0.71 ha Brigalow TEC will be cleared as a result of the Project, leaving a small 0.29 ha patch. The Project will also occur immediately adjacent to the remaining patch which may provide a conduit for weed species to be introduced and cause the delivery of pollutants in the surface water to the remaining brigalow patch. Large perimeter to patch area ratios (especially in small patches) also leaves vegetation more susceptible to seed dispersal pressure from introduced flora species. Therefore, the Project will potentially cause a substantial reduction in the quality or integrity of the Brigalow TEC. However, there are opportunities to manage pollutants leaving the Project Area and implement a Weed and Pest Management Plan to ensure that invasive species are appropriately managed during construction. This will assist in ensuring the Project does not impact on the quality or integrity of the remaining brigalow patch.

Criteria	Outcome of assessment and justification
• Interfere with the recovery of an ecological community?	The Commonwealth environment minister has declared that a national recovery plan for the Brigalow TEC is not required, however current threats to this species include clearing, inappropriate fire regimes, invasive species, inappropriate grazing regimes and climate change. While the clearing of this community will occur, the extent of habitat loss as a proportion of the habitat present within the region is very small (approximately 0.000088%) (Threatened Species Scientific Committee, 2013). Given these outcomes, the Project is unlikely to interfere with the recovery of the Brigalow TEC.

Vulnerable species criteria

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of an important population of a species
- reduce the area of occupancy of an important population
- fragment an existing important population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of an important population
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
- introduce disease that may cause the species to decline; or
- interfere substantially with the recovery of the species.

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are (Department of the Environment, 2013):

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

'Habitat critical to the survival of a species' refers to areas that are necessary (Department of the Environment Water Heritage and the Arts, 2013):

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species (including the maintenance of species essential to the survival of the species, such as pollinators)
- to maintain genetic diversity and long term evolutionary development; or
- for the reintroduction of populations or recovery of the species.

Eucalyptus raveretiana (Black Ironbox) Significant Impact Assessment

Eucalyptus raveretiana (black ironbox) is listed as vulnerable under the EPBC Act.

Table 21 Significant impact assessment for *Eucalyptus raveretiana* (Black ironbox)

Criteria	Outcome of assessment and justification
Is there a real chance or possibility that the action will: • Lead to a long-term decrease in the size of an important population of a species?	An important population is a population that is necessary for a species' long term survival and recovery. This may include populations identified as such in recovery plans and or that are: • Key source populations either for breeding or dispersal • Populations that are necessary for maintaining genetic diversity and or • Populations that are near the limit of the species range. Black ironbox has a wide distribution in Queensland coastal and sub-coastal areas, from Townsville to Nebo, around Rockhampton and areas 100 km to the west of Rockhampton in tributaries of the Fitzroy River (DoEE, 2016). Population data is limited, although it is locally common on some permanent streams, but absent from many others (Bean, 2001) in DoEE (2016b). It is likely that the Black Ironbox population in Limestone Creek (a tributary of the Fitzroy River) is both a locally and regionally important population due to the likely presence of the species along the length of Limestone Creek and the location of the population near the known limit of the species' range. Recruitment of Black Ironbox requires good light levels for germination as the very small seeds hold little food reserves. This species is highly capable of regenerating following disturbance (BAMM, 2011). Limestone Creek has very low levels of recruitment of native species, and high levels of weed invasion (Appendix C in (AECOM, 2017a). This may impact on the importance of the Black Ironbox population in a regional context. It has been determined that the population of Black Ironbox in Limestone Creek is likely to be both a locally and regionally important population. Based on habitat mapping, 0.61 ha will be cleared as part of the Project in addition to approximately eight planted Black ironbox trees, however this not expected to lead to a long-term decrease in the size of an important population, due to the small area of clearing.
• Reduce the area of occupancy of an important population?	The Project will reduce the area of occupancy of an important population in Limestone Creek by 0.61 ha, in addition to approximately eight planted Black ironbox trees. The extent of this reduction is not considered to be significant.
• Fragment an existing important population into two or more populations?	The Project is likely to fragment the existing Black Ironbox population in Limestone Creek, particularly during the construction phase (due to the potential construction of access tracks and other supporting infrastructure). It is unlikely to cause the population to become severely disconnected due to the final constructed footprint of the Project Area being relatively narrow, and the ability of Black Ironbox to regenerate following disturbance. In addition, Black Ironbox disperses its seed via instream flow, with the seed capsule floating on the surface and depositing in a suitable location for germination downstream. Through the inclusion of bridges in the Project design, the

Criteria	Outcome of assessment and justification
	hydrological flow regime of Limestone Creek will be maintained as well as the seed dispersal abilities for Black ironbox.
• Adversely affect habitat critical to the survival of a species?	Habitat critical to the survival of a species are areas that are necessary: • For activities such as reproduction and dispersal • For the long-term maintenance of the species (including maintenance of species essential to the survival of the species or ecological community, such as pollinators) • To maintain genetic diversity and long term evolutionary development, or • For the reintroduction of populations or recovery of the species Black ironbox has a wide distribution in Queensland coastal and sub-coastal areas, with the extent of occurrence approximately 124,000 km (Queensland Herbarium 2009). Due to it's wide distribution, areas to be cleared in the Project Area were not identified as habitat critical to the survival of the species.
• Disrupt the breeding cycle of an important population?	Black Ironbox disperses its seed via instream flow, with the seed capsule floating on the surface and depositing in a suitable location for germination downstream. Through the inclusion of bridges in the Project design, the hydrological flow regime of Limestone Creek will be maintained as well as the seed dispersal abilities for Black ironbox.
• Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	A total of 0.61 ha of Black Ironbox habitat and approximately eight planted Black ironbox trees will be cleared as a result of the Project and all habitat adjacent to the Project Area is currently substantially compromised and degraded due to a significant infestation of *Leucaena leucocephala* (leucaena) in the mid storey. The Project will dissect the Black Ironbox population in Limestone Creek and may provide a conduit for weed species to be introduced and cause the delivery of pollutants in the surface water to Limestone Creek, despite the degraded nature of the existing environment in Limestone Creek. There are opportunities to manage pollutants leaving the Project Area and implement a Weed and Pest Management Plan to ensure that invasive species are appropriately managed during construction. The Project is considered unlikely to decrease habitat availability to the extent that the species is likely to decline due to the small area of clearing, degraded nature of the habitat in Limestone Creek and ability of the species to regenerate following disturbance.
• Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species' habitat?	The main identified threat to Black Ironbox is habitat disturbance and smothering by rubber vine (*Cryptostegia grandiflora*). It is unlikely that rubber vine and other invasive species would further establish in the species' habitat, due to the current significantly degraded and weed-infested state (including the current presence of rubber vine) of the Black Ironbox habitat in Limestone Creek. There is an opportunity for a Weed and Pest Management Plan to be developed for the Project to mitigate and manage the potential spread of pest flora and fauna species.

Criteria	Outcome of assessment and justification
• Introduce disease that may cause the species to decline?	Myrtle rust (*Puccinia psidii*) is identified as a disease which, if introduced, may threaten the survival of the Black Ironbox population in Limestone Creek. Implementing biosecurity hygiene procedures will assist in managing the risk of the introduction of myrtle rust to the Black Ironbox population.
• Interfere substantially with the recovery of the species?	At a regional scale, it is unlikely that the Project will interfere substantially with the recovery of the species due to the wide distribution of Black Ironbox. In the context of the local environment, it is unlikely that the Project will interfere substantially with the recovery of the species due to the heavily weed-infested and degraded nature of the Black Ironbox habitat in Limestone Creek. There are opportunities to assist with the recovery of the Black Ironbox population along Limestone Creek through habitat restoration including targeted weed management.