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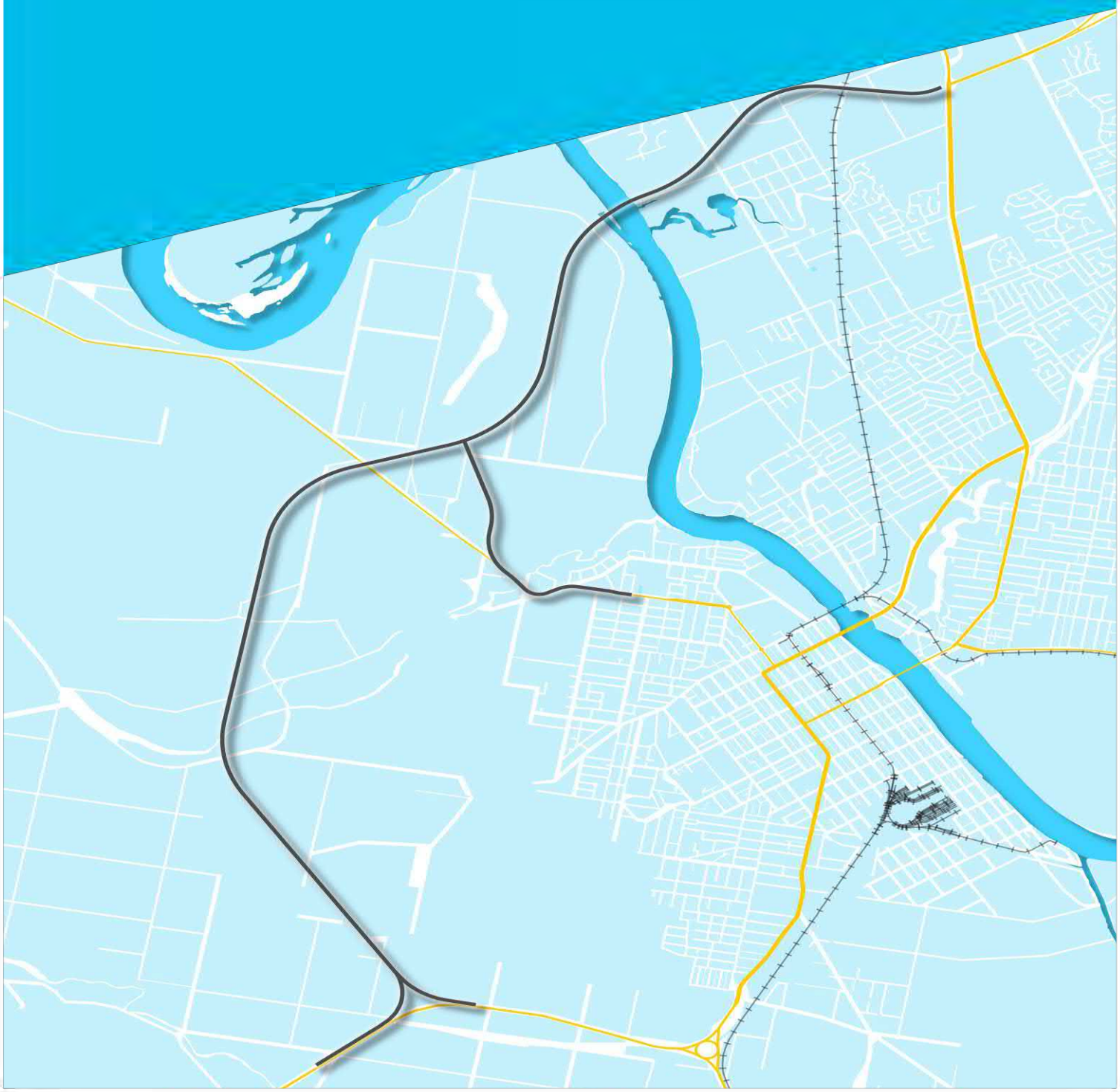
Rockhampton Ring Road
Department of Transport and Main Roads
20-Feb-2020
Doc No. 00038 - 60593305 - RRR BC - Terrestrial Fauna and Migratory Birds Technical Report

Terrestrial Fauna and Migratory Birds Technical Report

Rockhampton Ring Road - Business Case



Terrestrial Fauna and Migratory Birds Technical Report

Rockhampton Ring Road - Business Case

Client: Department of Transport and Main Roads

ABN: 39 407 690 291

Prepared by

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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 Project (FRFRPS) (December 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 RRR Project (the 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 aim of the terrestrial fauna and migratory bird assessment was to document the species and habitat types within the Project Area, with particular reference to the occurrence of conservation significant species. The assessment was a two stage process involving a desktop assessment followed by a general fauna survey, and subsequent targeted fauna surveys for the ornamental snake (*Denisonia maculata*) and migratory shorebirds in February 2019. Surveying completed in February 2019 was restricted to the main RRR alignment as the Project was in the Preliminary Evaluation (PE) phase. An additional day of surveying was completed in October 2019 focused on the connection areas of the Project when details about the connection areas became available.

Key findings of this assessment include the following:

- A total of 136 fauna species were recorded during the survey, comprising 105 bird species, 19 mammals, nine reptiles and four amphibians.
- Five conservation significant and/or migratory species were recorded in or near the Project Area:
  - Latham's snipe (*Gallinago hardwickii*); Migratory under the EPBC Act
  - Caspian tern (*Hydroprogne caspia*); Migratory under the EPBC Act
  - Eastern osprey (*Pandion cristatus*); Migratory under the EPBC Act
  - Glossy ibis (*Plegadis falcinellus*); Migratory under the EPBC Act
  - Marsh sandpiper (*Tringa stagnatilis*); Migratory under the EPBC Act.
- The fauna surveys identified a range of habitat values suitable to support both conservation significant and Least Concern species. Seven habitat types (comprising eight REs and non-remnant vegetation) were recorded within the Project Area.
- Wetlands, although modified, were identified to support roosting and foraging habitat for a number of migratory shorebird species. Input from the Project's hydrological assessment determined that no significant hydrological changes, including to water quality, are expected to occur at wetlands within and adjacent to the Project Area. will be required before potential impacts to these habitats can be finalised.
- Wetlands and some riparian zones investigated during the field survey provided some microhabitat features suitable for the ornamental snake. However, habitat was considered to be marginal due to the abundance of cane toads, low abundance of woody debris, heavy weed infestation and lack of gilgai formation or brigalow communities.
- Eleven conservation significant and ten migratory species are considered to have a moderate or high likelihood of occurring in the Project Area based on the habitat assessed during the field surveys.
- A number of potential impacts to flora and fauna 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.

- The Significant Impact Assessment determined that the Project has the potential to significantly impact the Latham's snipe (*Gallinago hardwickii*). Given this result, a referral under the EPBC Act is required to the Department of Environment and Energy (DoEE) and offsets may be applicable to compensate for any significant impacts.

Although targeted surveys were conducted as per the EPBC Act *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (Department of the Environment and Energy, 2017), climatic conditions at the time were not conducive to high detectability due to prolonged dry conditions. Additional targeted surveys under ideal climatic conditions may allow for greater accuracy in likelihoods' of species absence/presence, as well as wetland habitat quality and extent.

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 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% 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 RRR project commences on the Capricorn Highway approximately 2km west of the intersection of the Bruce and Capricorn Highways at the Yeppen Roundabout and its alignment traverses north through the Western Yeppen Floodplain, sweeping around the Rockhampton Airport at Pink Lily and connecting to West Rockhampton near Ridgelands Road before crossing the Fitzroy River north of Limestone Creek. After crossing the Fitzroy River, the RRR intersects Alexandra Street in Parkhurst and connects with the Bruce Highway at the Bruce Highway and Rockhampton - Yeppoon Road intersection. See Figure A.

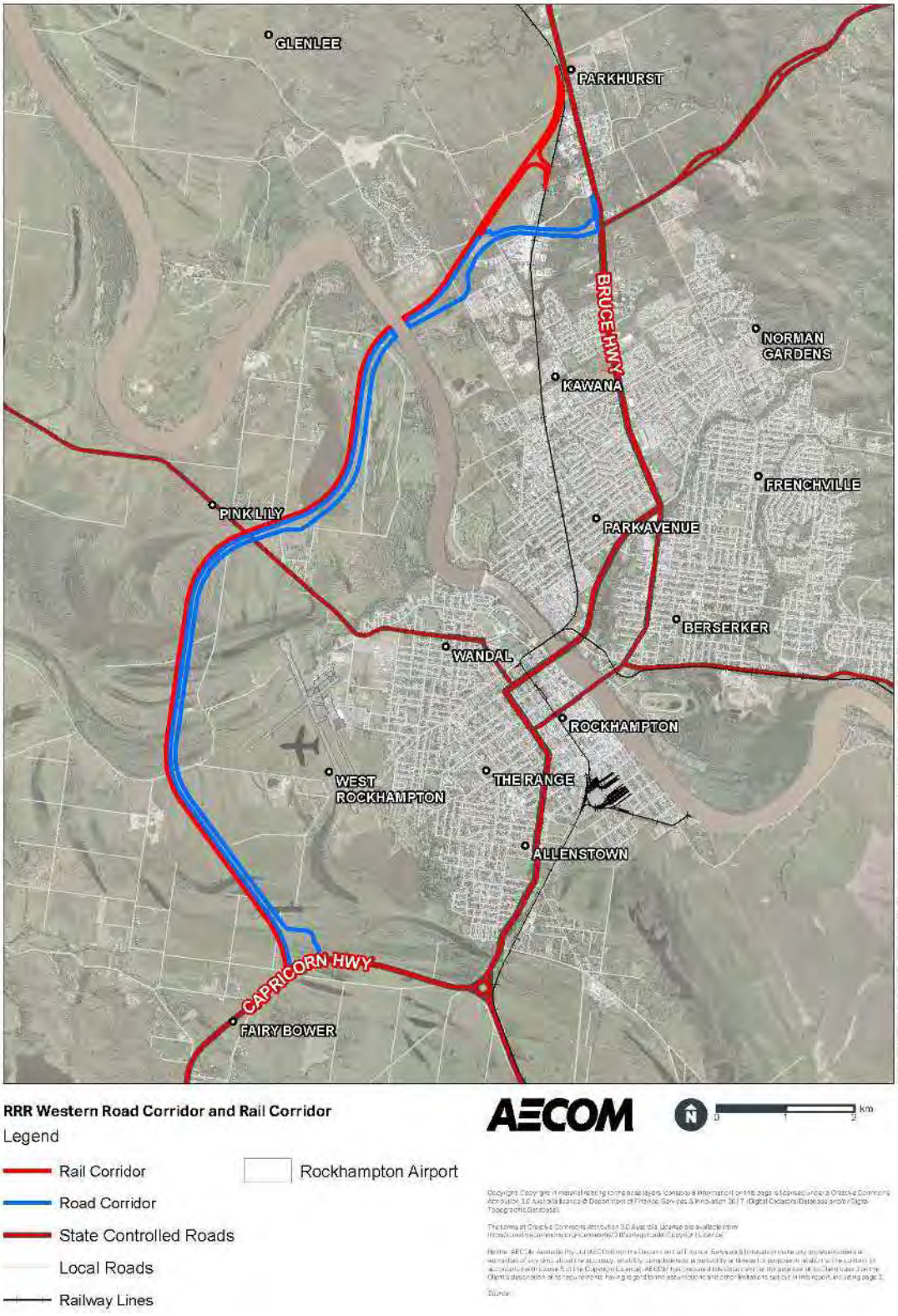

Figure A: RRR Western Road and Rail Corridor

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 flood plain in conjunction with the road alignment;
- Multi-modal corridor 140m (60m rail, 80m road);
- Construction of a new intersection at the Capricorn Highway, approximately 2km 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);
- Relocation of affected Public Utility Plant (PUP); and

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 $1billion for delivery, based on a split of $800m from the Commonwealth and $200m from the State Government.

1.2 Project Area

The Project commences on the Capricorn Highway approximately 2 kilometres (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.

The preferred RRR alignment including connection points is herein referred to as the Project Area (Figure 1). The Project Area is inclusive of a 20 m construction area buffer and is therefore considered 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 alone was the primary investigation area. Following the BC phase in mid-2019, road connections to the alignment were refined, and an additional day of surveying was completed in these areas in October 2019. Clearing area calculations discussed in this report are thus for the Project Area, inclusive of the connection areas.

1.3 Survey Area

Aerial imagery indicates that the Project Area is located in close proximity to a number of potentially sensitive environments such as wetlands and riparian vegetation communities. In order to characterise the baseline fauna values of these environments, and the indirect impacts that may occur at these locations as a result of the Project, field surveying was completed in an area greater than the Project Area. This area encompasses the aforementioned potential sensitive environments and the Project Area and is henceforth referred to as the Survey Area (Figure 1).

The Survey Area represents the total area aimed to be surveyed as part of this assessment. However, it should be noted that survey effort was subject to land access approval under DTMR's notice of entry (NOE) process.

1.4 Project Aims and Objectives

The aim of the terrestrial fauna and migratory bird assessment was to document the species and habitat types within the Project Area, with particular reference to the occurrence of conservation significant species. To achieve this, the assessment:

- Reviewed existing terrestrial ecology data for the Project Area.
- Described the diversity of terrestrial fauna and habitat found in the Project Area during field investigations.
- Identified the occurrence or expected occurrence of conservation significant fauna species.
- Identified the occurrence of pest species and their distribution across the Project Area.
- Assessed potential Project related impacts on identified fauna values in the Project Area, including an assessment of the significance of the impacts.
- Provided measures to avoid or mitigate adverse impacts on significant terrestrial fauna at the design, construction and operational phases of the Project.

1.5 Assumptions

This fauna and migratory bird assessment has been undertaken based on the following assumptions:

- 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 DBC 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.

As a worst-case scenario it is assumed all vegetation within the Project Area will be cleared for construction.

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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

- Proposed Project Bridges
- Project Area
- Survey Area
- 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 & SURVEY AREA

PROJECT ID	60593305
CREATED BY	McKeeJ2
LAST MODIFIED	15-Nov-2019
VERSION	<version number>

Figure 1

A3 size

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2.0 Regulatory Framework

2.1 Commonwealth Legislation

2.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) describes the Commonwealth's role in environmental assessment, biodiversity conservation and the management of Matters of National Environmental Significance (MNES). Under the provisions of the EPBC Act, an action that is likely to have a significant impact on a MNES requires the approval of the Minister for Environment and Energy. The Act identifies nine MNES:

1. World heritage properties
2. National heritage places
3. Wetlands of international importance (Ramsar wetlands)
4. Nationally listed threatened species and communities
5. Listed migratory species
6. Protection of the environment from nuclear actions
7. Commonwealth marine environment
8. The Great Barrier Reef Marine Park
9. A water resource, in relation to coal seam gas development and large coal mining development.

The MNES that were considered in this report are:

- listed threatened species and ecological communities
- listed migratory species.

2.2 Queensland Legislation

2.2.1 Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) prohibits the taking or destruction, without authorisation, of protected flora and fauna species in the wild. All native plants and animals in Queensland are protected under Section 71 of the Act. This Act also provides for an integrated and comprehensive approach to conserving nature. It provides a legislative basis for research, community education, dedicating, declaring and managing protected areas, and protecting native wildlife and its habitat.

The Nature Conservation (Wildlife) Regulation 2006 (NC Regulation) lists the plants and animals considered presumed extinct in the wild, endangered, vulnerable, near threatened, least concern, international and prohibited. The NC Regulation discusses their significance and states the declared management intent and the principles to be observed in any taking and use for each group.

2.2.2 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 a number of issue-specific Environmental Protection Policies (EPPs) that the Project will need to comply with. These include the, *Environmental Protection (Air) Policy 2008*, *Environmental Protection (Noise) Policy 2008* and *Environmental Protection (Water) Policy 2009*.

In co-ordination with the *Planning Act 2016*, the EP Act provides for licensing and approval of Environmentally Relevant Activities (ERA's). ERA's 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 all of the prescribed ERAs can be found in Schedule 2 of the Environmental Protection Regulation 2008.

2.2.3 Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VM Act) regulates the clearing of native vegetation, including remnant (defined as Regional Ecosystems (REs)), high-value regrowth (HVR) (as of May 2018), reef regrowth watercourse vegetation (as of May 2018) and non-remnant on certain tenures, except for exemptions under the NC Act, the *Land Act 1994*, and the *Forestry Act 1959*. 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.

Amendments to the VM Act in May 2018 reinstated the regulation of HVR and reef regrowth watercourse vegetation. HVR areas are those which have not been cleared for over 15 years if the area is an endangered, of concern or least concern regional ecosystem. Reef regrowth watercourse vegetation is native regrowth vegetation on watercourse areas within the Great Barrier Reef Catchments. The clearing of this vegetation has been regulated to increase wetland and watercourse bank stability, and maintain water quality, habitat and landscape stability.

The status of REs and HVRs is based on their pre-clearing and remnant extent, as gazetted under the VM Act and listed in the Regional Ecosystem Description Database (REDD) maintained by the Queensland Department of Natural Resources and Mines and Energy (DNRME). A RE considered to have a "Vegetation Management Status" is described as an:

Endangered regional ecosystem:

- less than 10% of its pre-clearing extent remaining; or
- 10% to 30% of its pre-clearing extent remaining and the remnant vegetation remaining is less than 10,000 ha.

Of Concern regional ecosystem:

- 10% to 30% of its pre-clearing extent remaining; or
- more than 30% of its pre-clearing extent remaining and the remnant vegetation remaining is less than 10,000 ha.

Least Concern regional ecosystem:

- more than 30% of its pre-clearing extent remaining and the remnant vegetation remaining is more than 10,000 ha.

2.2.4 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 occur.

2.2.5 Environmental Offsets Act 2014

The *Environmental Offsets Act 2014* (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 wetlands, and wetland protected areas)
- 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 on a prescribed environmental matter that is a MSES.

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, 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.

2.3 Classification of Ecological Values

2.3.1 Conservation Significant Fauna Species

Conservation significant fauna are assigned status according to Queensland or Commonwealth legislation as described in the:

- EPBC Act
- NC Act and the subordinate Nature Conservation (Wildlife) Regulation 2006.

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: the short-beaked echidna (*Tachyglossus aculeatus*) and the platypus (*Ornithorhynchus anatinus*)).

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

- Extinct
- Extinct in the Wild
- Critically Endangered
- Endangered
- Vulnerable.

2.3.2 Migratory Shorebird Species

Australia is located within the East-Asian Australasian Flyway for migratory shorebirds. These species breed as far north as Siberia and Alaska during the northern hemisphere summer and migrate to non-breeding grounds in Australia and New Zealand to avoid the northern winter and take advantage of energy rich food sources in the southern hemisphere. Migrating shorebirds arrive in northern Australia between late August and early November. Many birds remain in the northern hemisphere, but others disperse southwards for the austral summer.

The EPBC Act includes a list of migratory shorebird species, comprising:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under an international agreement such as the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

3.0 Assessment Methodology

3.1 Desktop Assessment

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

The following information sources were reviewed as part of this assessment:

- EPBC Act Protected Matters Search Tool (PMST)
- Department of Environment and Science (DES) Wildlife Online database
- DES Essential Habitat mapping
- DES Wetlands of High Ecological Significance (HES) and Wetland Protection Area (WPA) mapping
- DES certified Biodiversity Planning Assessment (BPA) mapping to identify significant wildlife corridors and areas of state, regional and local biodiversity significance
- VM Act wetlands and watercourses
- Department of Natural Resources, Mines and Energy (DNRME) Regulated Vegetation Management Map
- The Queensland Herbarium Vegetation Management Regional Ecosystems (RE) map
- Atlas of Living Australia (ALA) database
- eBird Australia database
- Birdlife International Important Bird Areas
- Species distribution maps from various current field guides.

Information collected as part of the desktop assessment was reviewed and used in the preparation of the field survey, to determine appropriate survey technique and to identify fauna species potentially found within the Project Area.

3.2 Fauna Field Survey

Three fauna field surveys have been completed as part of this assessment, which consisted of the following:

- initial terrestrial ecological survey
- targeted turtle survey and fish habitat assessment
- additional terrestrial ecological survey.

Initial surveying was completed by two AECOM ecologists over two 5-day periods in February 2019. The first February survey (4 February to 8 February) comprised the general fauna assessments and ornamental snake targeted surveying. This was followed by an additional 5-day survey (11 February to 15 February) primarily focused on migratory birds.

The Project Area was subsequently revised following the DBC phase, and additional areas not surveyed in February were surveyed over a single day in October 2019 by two AECOM ecologists. The methods utilised during each terrestrial survey are detailed in Table 1 below and described in detail in the following sections. All fauna survey locations are depicted on Figure 2. Survey methodology for the targeted turtle survey is detailed in the Threatened Turtle and Fish Habitat Assessment Report (AECOM, 2019b).

Table 1 Fauna methods utilised per terrestrial ecological survey

Method utilised	February 2019	October 2019
Fauna habitat assessments	✓	✓
Active searches and incidental observations	✓	✓
Microchiropteran bat call detection	✓	
Camera traps	✓	
Targeted migratory shorebird survey Visual and auditory identification surveys of birds	✓	
Targeted ornamental snake survey	✓	
Spotlighting	✓	✓

3.2.1 Fauna Habitat Assessments

Habitat assessments were undertaken to characterise the fauna habitat values within the Project Area. These assessments provide an indication of likely fauna utilisation, and suitability for fauna species, including conservation significant fauna. Habitat attributes recorded during the assessment include:

- Vegetation structure and dominant species, including a description of canopy, shrub and ground layer structure and composition
- Presence and abundance of tree hollows and stags
- Presence and abundance of woody debris such as habitat logs and ground timber
- Presence and abundance of koala food trees
- Presence and abundance of soil cracks and gilgai
- Rocky habitat such as surface rocks, boulders, crevices, overhangs and caves
- Proximity to water (both permanent and ephemeral)
- Presence of habitat features necessary for shorebirds e.g. muddy margins, fringing vegetation, riparian vegetation
- Disturbance from invasive weeds/pests
- Other disturbances such as grazing pressure, clearing, thinning or fire
- Any other significant habitat features or values present e.g. large nesting trees.

Included in the habitat assessments were searches for signs of animal activity, including tracks, scats, scratches, bones, fur, feathers, nests, foraging holes and diggings.

At all fauna habitat assessment locations, active searches, incidental observations and visual and auditory survey of birds (including for migratory birds where suitable conditions existed) were conducted. A total of 35 habitat assessments were completed across the Project Area (Figure 2).

3.2.2 Active Searches and Incidental Observations

Active searches were undertaken for reptiles, amphibians, small mammals and cryptic or ground-dwelling bird species. Conservation significant fauna identified as potentially occurring during the desktop were also actively searched for, such as migratory shorebirds, koala, grey-headed flying fox, ornamental snake and squatter pigeon.

This included scanning the trees and ground, searching beneath microhabitat such as rocks, fallen timber and peeling bark, digging through leaf litter and soil at tree bases and flushing birds from areas with a dense or grassy ground cover. Active searches were undertaken within suitable microhabitat at each habitat assessment site (i.e. across the broad range of habitat types throughout the Project Area).

All fauna observed incidentally within or in close proximity to the Project Area were also recorded, including those seen while travelling along roads and tracks. A total of 11.5 person hours of active searches were completed across 35 sites (completed at all fauna habitat assessment locations) within the Project Area (Figure 2).

3.2.3 Microchiropteran Bat Call Detection

Microchiropteran bat echolocation calls were recorded using Anabat SD2 and Song Meter SM2 ultrasonic bat call detectors, configured to record microchiropteran species potentially occurring in the area including the threatened large-eared pied bat (*Chalinolobus dwyeri*), Corben's long-eared bat (*Nyctophilus corbeni*) and ghost bat (*Macroderma gigas*). Call recording was conducted across the Project Area between dusk and dawn across the broad range of habitat types. Where possible, detection units were positioned in natural flyways, favourable for microchiropteran bat detection (refer to Figure 2 for location of detection units).

Three units were deployed in six separate locations for a combined 23 recording nights.

3.2.4 Camera Traps

Camera traps were deployed in strategic positions to record visitation by nocturnal and diurnal animals. A variety of species were targeted, including feral ground-dwelling fauna such as foxes (*Vulpes vulpes*) and dogs (*Canis lupus*). Strategic locations included fauna corridors and watering points such as wetlands and creek lines. A honey-oat mix or chicken necks were used as an attractant, placed on the ground in front of camera traps

Four cameras were set at a total of six locations for a combined 24 camera trap nights (refer to Figure 2).

3.2.5 Visual and Auditory Identification Surveys of Birds

Roaming/meandering bird surveys were undertaken using both visual and auditory identification. Surveys were conducted for the duration of each survey period at each habitat assessment site and during transit between sites. Hilltop vantage points were used to observe aerial hunters, feeders and scavengers. Overall, a total of 39.5 person hours of bird surveys were completed within the Project Area (Figure 2).

3.2.6 Spotlighting

In order to locate other nocturnal fauna such as the threatened koala (*Phascolarctos cinereus*) and greater glider (*Petauroides volans*), spotlighting on foot using head torches and hand-held spotlights was also undertaken in areas of representative habitat such as riparian woodlands. A total of 36 person hours of spotlighting surveys were completed across 5 sites within the Project Area.

3.2.7 Targeted Migratory Shorebird Survey

As prescribed by the *EPBC Act Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (Department of the Environment and Energy, 2017), wetlands and watercourses mapped within and adjacent to the Project Area were targeted for migratory shorebird surveys to identify areas of potential important habitat (Table 2). Habitat assessments completed in the general fauna survey (4 February to 8 February 2019) allowed for required survey effort per wetland to be estimated beforehand; large wetlands or wetlands with greater ecological value had greater survey effort during the migratory shorebird surveys. Wetlands were identified to be non-tidal.

The targeted migratory bird survey was completed over five days from 11 February 2019 to 15 February 2019 by two AECOM ecologists at various times during the day, including dawn and dusk. The survey timing followed the EPBC Act Industry guidelines (Department of the Environment and Energy, 2017), occurring when the majority of migratory shorebirds are present in the area (Rockhampton's wet season). A spotting scope and binoculars were used to visually identify species from a distance, and observe abundance of individuals, behaviour and species' richness. Target species were those listed as Migratory under the EPBC Act and included (but were not limited to) the species listed in Table 3.

Table 2 Surveyed wetlands

Site Name	Coordinates	Date and Time	Survey Effort (person hours)
Pink Lily Lagoon, including smaller lagoons east of Von Allmen Rd[1]	-23.344985, 150.476504 -23.340021, 150.484086 -23.343134, 150.485835	07/02/2019 3pm to 4pm 07/02/2019, 6pm to 10pm 11/02/2019, 9am to 10am 11/02/2019, 4pm to 5pm 12/02/19, 1pm to 4pm 14/02/2019, 10am to 11:30am	23
Lotus Lagoons	-23.369691, 150.463480	04/02/2019,6pm to 10pm 05/02/2019, 8am to 10am 05/02/2019, 12:30pm to 1:30pm 06/02/2019 4pm to 5pm 07/02/2019 5pm to 6pm 14/02/2019 8am to 10am	22
Dunganweate Lagoon, including smaller waterbody directly south and likely connected during flooding	-23.400136, 150.461978 -23.401566, 150.464829	08/02/2019 9am to 12pm 13/02/2019 6:30am to 8am	9
Nelson Lagoon	-23.403563, 150.469213	13/02/2019, 9am to 12pm	6
Murray Lagoon	-23.398403, 150.485484	04/02/2019, 10am to 2pm	8
Yeppen Lagoon	-23.407611, 150.493667	13/02/2019, 8am to 10am	4
Black Duck Lagoon	-23.360347, 150.479072	08/10/2019, 1pm to 3pm	4
Capricorn Highway Wetland	-23.411715, 150.476140	Fauna values at this location could not be assessed. Effort is considered nil.	
		TOTAL	**76**

[1] Due to land access restrictions, survey effort in the southern extent of this lagoon was restricted to adjacent roads and properties. The no access properties are displayed on Figure 2.

Table 3 The 37 migratory shorebird species listed under the EPBC Act

Scientific Name	Common Name
Actitis hypoleucos	Common sandpiper
Arenaria interpres	Ruddy turnstone
Calidris acuminata	Sharp-tailed sandpiper
Calidris alba	Sanderling
Calidris canutus	Red knot*
Calidris ferruginea	Curlew sandpiper*
Calidris melanotos	Pectoral sandpiper
Calidris ruficollis	Red-necked stint
Calidris subminuta	Long-toed stint
Calidris tenuirostris	Great knot*
Charadrius bicinctus	Double-banded plover
Charadrius dubius	Little ringed plover

Scientific Name	Common Name
Charadrius leschenaultii	Greater sand plover*
Charadrius mongolus	Lesser sand plover*
Charadrius veredus	Oriental plover
Gallinago hardwickii	Latham's snipe
Gallinago megala	Swinhoe's snipe
Gallinago stenura	Pin-tailed snipe
Glareola maldivarum	Oriental pratincole
Heteroscelus brevipes	Grey-tailed tattler
Heteroscelus incanus	Wandering tattler
Limicola falcinellus	Broad-billed sandpiper
Limnodromus semipalmatus	Asian dowitcher
Limosa lapponica	Bar-tailed godwit*
Limosa limosa	Black-tailed godwit
Numenius madagascariensis	Eastern curlew*
Numenius minutus	Little curlew
Numenius phaeopus	Whimbrel
Phalaropus lobatus	Red-necked phalarope
Philomachus pugnax	Ruff
Pluvialis fulva	Golden plover
Pluvialis squatarola	Grey plover
Tringa glareola	Wood sandpiper
Tringa nebularia	Common greenshank
Tringa stagnatilis	Marsh sandpiper
Tringa totanus	Common redshank
Xenus cinereus	Terek sandpiper

3.2.8 Targeted Ornamental Snake Survey

A method for detecting ornamental snakes included in the *Survey Guidelines for Australia's threatened reptiles* (Department of Sustainability, Environment, Water, 2011) is spotlighting. The ornamental snake is regarded as nocturnal and a specialist predator of native frogs. Peak activity levels, and hence highest potential for ornamental snake detection, are typically restricted to periods following suitable summer rainfall events which create optimum conditions for its favoured prey to be most active and concentrated around its breeding sites. Thus, the main opportunity to detect the ornamental snake is seasonally constrained.

Ornamental snake spotlighting was conducted by two AECOM ecologists as part of the general fauna survey from 4 February to 8 February 2019, during Rockhampton's wet season. Spotlighting on foot using head torches and hand-held spotlights occurred in areas of habitat considered potentially suitable for the species from habitat assessments completed during the day. This included areas that contained an abundance of soil cracks, riparian zones, wetlands and in areas of mapped Essential Habitat. General spotlighting surveys (Section 3.2.6) also included active searches for ornamental snake in preferred microhabitat features such as under woody debris and in cracking clay soils. A total

of 36 person hours of spotlighting surveys for ornamental snake were completed across 5 sites within the Project Area (Figure 2).

3.2.9 Regulatory Survey Guidelines

Table 4 below details the relevant survey guidelines per species, as well as survey effort completed to date.

Table 4 Survey guidelines and survey effort completed to date

Relevant regulatory survey guideline	Regulatory survey guideline requirement	Seasonal survey requirement	Survey effort completed to date
EPBC Act referral guidelines for the vulnerable koala (DoE, 2014): Koala (*Phascolarctos cinereus*)	The EPBC Act referral guidelines for the koala (DoE, 2014) do not prescribe specific survey effort requirements. Survey effort determined on a case by case basis. • Spotlighting with call playback • Remote camera • SATs (Philips & Callaghan 2011) - Sampling of a minimum of 30 koala food trees within suitable habitat.	Optimal time period for direct observation surveys is between August and January	February and October 2019: • 36 person hrs of spotlighting across 5 sites over 6 nights. • Targeted habitat assessments were conducted for the species throughout the duration of the field survey.
Draft referral guidelines for nationally listed Brigalow Belt reptiles (DSWEPaC, 2011a): Ornamental snake (*Denisonia maculata*) Survey guidelines for Australia's threatened reptiles (DSWEPaC, 2011c): Ornamental snake (*Denisonia maculata*)	• One off diurnal active searches of microhabitat for 1.5 hours in each hectare of suitable habitat. A minimum of 3 days with 1 repeat (6 days) • Spotlighting: - Targeting water-inundated gilgais, wetlands, riparian habitats and the surrounding environment (e.g., roads) and large logs between dusk and early morning hours - 1.5 hours in each hectare of suitable habitat. - A minimum of 3 nights with 1 repeat. • Opportunistic surveys of roads.	Late September to March	February 2019: • 36 person hrs of spotlighting across 5 sites over 6 nights. • Targeted habitat assessments were conducted for the species throughout the duration of the field survey.

Relevant regulatory survey guideline	Regulatory survey guideline requirement	Seasonal survey requirement	Survey effort completed to date
Survey guidelines for Australia's threatened reptiles (DSWEPaC, 2011c): Fitzroy River turtle and white-throated snapping turtle	No prescribed effort, however recommended survey techniques for Fitzroy River turtle are: • Snorkelling is most effective, however not recommended where a risk of salt-water crocodile encounter is possible. • Meat-baited traps should be trialled Although white-throated snapping turtle is not explicitly included in the guideline, recommended techniques typically applied to the detection of freshwater turtles are: • Snorkelling, OR • Baited trapping	NA	As detailed in the *Threatened Turtle & Fish Habitat Assessment* (AECOM, 2019b) report completed for the Project, surveying was completed at 3 sites in August 2019. Survey effort: • 26 cathedral trap units and 4 crab pot units. • Targeted habitat assessments were conducted for the species throughout the duration of the field survey.
Survey guidelines for Australia's threatened birds (DEWHA, 2010b): Squatter pigeon (*Geophaps scripta scripta*)	• Road driving during day (driving transects). • Active searches: - 15 hours over 3 days in areas <50 ha. • Flushing surveys: - 10 hours over 3 days in areas <50 ha. • Waterhole searches - Survey effort not specified.	N/A	February and October 2019: • Targeted habitat assessments were conducted for the species throughout the duration of the field survey. • 39.5 person hours of bird survey.
Survey guidelines for Australia's threatened birds (DEWHA, 2010b): Australian painted snipe (*Rostratula australis*)	At suitable wetlands: • Targeted stationary observations: - 10 hours over 5 days • Land-based area searches or line transects - 10 hours over 3 days	NA	February 2019: • Targeted stationary observations: 38 person hours over 10 days • Land-based area searches: 16 person hours • Targeted habitat assessments were conducted for the species throughout the duration of the field survey.

Relevant regulatory survey guideline	Regulatory survey guideline requirement	Seasonal survey requirement	Survey effort completed to date
No Commonwealth species-specific guideline available for Glossy ibis (*Plegadis falcinellus*), Australasian bittern (*Botaurus poiciloptilus*), eastern curlew (*Numenius madagascariensis*) In absence of guideline, Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (Eyre, T.J., et. al. 2014) for diurnal birds applies.	• 6 x 5-10 minute area searches within 100 x 100m survey site	Spring and summer	February 2019: • Opportunistic surveys. • Targeted stationary observations: 76 person hours over 10 days • Targeted habitat assessments were conducted for the species throughout the duration of the field survey.
Draft referral guideline for 14 migratory birds listed under the EPBC Act: • White-throated needletail • Eastern osprey	White-throated needletail does not have any survey guideline requirement due to their transitory and predominantly aerial nature. Ospreys should be surveyed using one or more of the following techniques: • Observations from vantage points to detect birds in flight over suitable habitat • Area searches on foot to detect birds or signs of occupancy in suitable habitat • Transect surveys from vehicles to detect birds or nests in large survey areas; • Transect surveys from boats along suitable coastal or riparian habitat; • Aerial surveys to detect birds or nests in large survey areas.	NA	February 2019: • Opportunistic surveys and targeted wetland migratory bird survey. • Targeted habitat assessments were conducted for the species throughout the duration of the field survey.

Relevant regulatory survey guideline	Regulatory survey guideline requirement	Seasonal survey requirement	Survey effort completed to date
Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species: • Latham's snipe • Black-tailed godwit • Bar-tailed godwit (considered to include sub-species) • Eastern curlew • Marsh sandpiper • Common greenshank • Wood sandpiper • Common sandpiper • Pectoral sandpiper • Sharp-tailed sandpiper • Curlew sandpiper	• Bird survey by 2 people taking counts: - 1 x survey in December - 2 x survey in January - 1 x survey in February	Summer & when water is present	February 2019: • Targeted stationary observations: 76 person hours over 10 days • Targeted habitat assessments were conducted for the species throughout the duration of the field survey.

3.3 Survey limitations

3.3.1 Land access

Due to landholder access restrictions, field surveying was not undertaken on all properties that intersect the Project Area. Specifically, survey effort for Lot 2 on SP247118 and Lot 1 on RP604085 (the southern extent of Pink Lily Lagoon) was limited to the roadside and adjacent properties. Lot 21 on RP844280 - the location of the Capricorn Highway Lagoon - was unable to be accessed at all and as such ground-truthing of ecological values has not been completed across this location. Information collected from the roadside and adjacent properties is considered sufficient for this level of assessment. In addition, a precautionary approach was undertaken and where ecological values were identified in these areas in desktop information, they were assumed present.

3.3.2 Climatic conditions

The initial field surveys were undertaken over a two week period in February 2019 in warm, humid conditions. Although this timing coincides with peak activity periods for some target species (i.e. ornamental snake and migratory shorebirds), climatic conditions during and prior to the survey were unseasonably dry (see Section 4.2.1) and therefore potentially not representative of a typical wet season in Rockhampton.

Field surveying for the connection areas occurred on 8 October 2019. The timing of this survey coincides with general peaks in vertebrate activity with some species beginning breeding activity (Eyre et al., 2018). The species directly observed during this surveying are opportunistic sightings only and not considered exhaustive.

3.3.3 Survey guidelines for threatened species

Both surveys represent a 'snapshot' of the species using the Project Area at single points in time, and do not account for seasonal or long-term variations in fauna movements. As such, it was assumed that no detection did not equate to absence, especially where potential habitat was identified and/or species records occurred nearby.

3.4 Data analysis

3.4.1 Threatened and migratory species habitat mapping

Threatened and migratory species habitat mapping within the Project Area was undertaken with the guidance of multiple data inputs including habitat assessments collected during the field surveys, species records (previous and survey records), and the Project vegetation mapping. Habitat was classified in accordance with defined habitat criteria for each species considered known or potentially to occur within the Project Area. The developed criteria utilised species-specific information outlined in the relevant Species Profile and Threats Database (SPRAT) and is detailed in Table 5.

Table 5 Habitat mapping criteria for known and potentially occurring conservation significant species

Species	Habitat utilisation	Habitat criteria
Common sandpiper (*Actitis hypoleucos*)	Foraging only	Palustrine and lacustrine wetlands with shallow waters and muddy margins
Australasian bittern (*Botaurus poiciloptilus*)	Breeding and foraging	Palustrine and lacustrine wetlands with either shallow or deep waters fringed with dense tall vegetation
Sharp-tailed sandpiper (*Calidris acuminata*)	Foraging only	Palustrine and lacustrine wetlands with shallow waters, emergent aquatic vegetation and muddy margins
Curlew sandpiper (*Calidris ferruginea*)	Foraging only	Palustrine and lacustrine wetlands with shallow waters and muddy margins
Pectoral sandpiper (*Calidris melanotos*)	Foraging only	Palustrine and lacustrine wetlands with shallow waters, emergent aquatic vegetation and muddy margins
Red-necked stint (*Calidris ruficollis*)	Foraging only	Palustrine and lacustrine wetlands with shallow waters and muddy margins
Salt-water crocodile (*Crocodylus porosus*)	Breeding / nesting	Elevated, isolated freshwater swamps that do not experience the influence of tidal movements
	Foraging and dispersal	Riparian zones north of Rockhampton
Ornamental snake (*Denisonia maculata*)	Breeding, foraging and dispersal	Clay plains with gilgai formation and riparian / floodplain woodlands, palustrine and lacustrine wetlands with cracking clay soils or fallen woody debris
White-throated snapping turtle (*Elseya albagula*)	Breeding / nesting	Permanent waterbodies with alluvial sand/loam sloped banks with either closed or open canopy and ground layer
	Foraging and dispersal	Permanent waterbodies with clear, high flowing and oxygenated water with complex sub-surface structure (undercut banks, logs, etc)
Latham's snipe (*Gallinago hardwickii*)	Foraging only	Palustrine and lacustrine wetlands with either shallow or deep waters fringed with dense low vegetation
Squatter pigeon (*Geophaps scripta scripta*)	Breeding	Remnant and regrowth vegetation on land zone 5 or 7 within 1km of permanent watersource
	Foraging	Remnant and regrowth vegetation on land zone 5 or 7 within 3km of permanent watersource
	Dispersal	Remnant and regrowth vegetation on other land zones
White-throated needletail	Roosting	Woodland areas
	Foraging	Above woodlands, regrowth or cleared paddocks

Species	Habitat utilisation	Habitat criteria
(*Hirundapus caudacutus*)		
Caspian tern (*Hydroprogne caspia*)	Foraging only	Palustrine and lacustrine wetlands with either shallow or deep waters
Western Alaskan bar-tailed godwit (*Limosa lapponica baueri*)	Foraging only	Palustrine and lacustrine wetlands with shallow waters and muddy margins
Black-tailed godwit (*Limosa limosa*)	Foraging only	Palustrine and lacustrine wetlands with shallow waters and muddy margins
Little curlew (*Numenius minutus*)	Foraging only	Palustrine and lacustrine wetlands
Eastern osprey (*Pandion cristatus*)	Breeding / nesting	Natural and artificial sites including dead or partly dead trees, cliffs, pylons, jetties
	Foraging	Variety of coastal habitats including wetlands
Koala *(Phascolarctos cinereus)*	Refuge	Connected woodland habitat with koala food trees situated on riparian zones
	Breeding, foraging and dispersal	Woodland and regrowth habitat with koala food trees
Glossy ibis (*Plegadis falcinellus*)	Foraging only	Palustrine and lacustrine wetlands with either shallow or deep waters
Fitzroy River turtle (*Rheodytes leukops*)	Breeding	Riparian zones within Fitzroy River catchment with relatively steep river sand banks, low density of ground and understorey vegetation and partial shade cover
	Foraging and dispersal	Waterways within the Fitzroy River catchment with riffle zones, high water clarity, associated with ribbon weed microhabitat features including undercut banks, root mats, logs and rocks
Australian painted snipe (*Rostratula australis*)	Breeding / nesting	Small exposed islands within freshwater wetlands with a combination of exposed muddy areas, dense tall or low vegetation cover
	Foraging	Palustrine and lacustrine wetlands with shallow waters and muddy margins
Grey-headed flying-fox (*Pteropus poliocephalus*)	Roosting, foraging and dispersal	Woodland and regrowth areas
Little tern (*Sterna albifrons*)	Foraging only	Palustrine and lacustrine wetlands with either shallow or deep waters
Wood sandpiper (*Tringa glareola*)	Foraging only	Palustrine and lacustrine wetlands with either shallow or deep waters fringed with dense low vegetation
Common greenshank (*Tringa nebularia*)	Foraging only	Palustrine and lacustrine wetlands with shallow waters and muddy margins
Marsh sandpiper (*Tringa stagnatilis*)	Foraging only	Palustrine and lacustrine wetlands with shallow waters and muddy margins

3.4.2 Bat call analysis

Bat calls collected on ultrasonic recorders surveys were analysed by a qualified specialist, Greg Ford of Balance! Environmental. A total of 23 nights of recordings were analysed from various habitat types. The format and content of the analysis summary reports complies with nationally accepted standards for the interpretation and reporting of Anabat data (Reardon, 2003).

3.5 Likelihood of Occurrence Assessment

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

A likelihood of occurrence assessment for conservation significant 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**: No suitable habitat within the survey area and no records of the species in the surrounding area, or species distribution does not overlap site. This is usually applied to marine species or seabirds for terrestrial sites.
- **Low**: Habitat in the survey area might be suitable or marginal; however species was not recorded during the field survey, and no known records of the species exist within the surrounding 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, including roost sites.
- **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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N

DATUM GDA 1994, PROJECTION MGA ZONE 56

0 550 1,100 2,200

Metres

1:46,000 (when printed at A3)

LEGEND

- ProjectArea
- No Access - 1/RP604085, 2/SP247118 & 21/RP844280
- MSES High Ecological Significance Wetlands
- VM Act Watercourses and Drainage Lines
- Highway
- Spot Lighting / Ornamental Snake Survey Locations
- Song Meter Sites
- Habitat Assessment & Migratory Shorebird Survey Locations
- Camera Trap Sites
- 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

FAUNA SURVEY LOCATIONS

PROJECT ID	60593305
CREATED BY	McKeeJ2
LAST MODIFIED	02-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_F2_FaunaSurveyLocations_A3_JM.mxd

4.0 Terrestrial Fauna Results

4.1 Desktop Assessment

4.1.1 Regional context

The Project Area is located within the Brigalow Belt bioregion, characterised by the leguminous tree *Acacia harpophylla* (brigalow) which forms forest and woodland on clay soils. Other dominant vegetation communities in the bioregion include eucalypt forests and woodland, grassland, dry rainforest, cypress pine woodland and riparian communities (Sattler & Williams, 1999).

Within the Brigalow Belt bioregion, the Project Area is located in the Marlborough Plains subregion.

4.1.2 Essential Habitat

Essential Habitat mapping shows vegetation which is known to support Essential Habitat values for particular conservation significant species, or habitat which surrounds point records of conservation significant species.

Essential Habitat for the ornamental snake has been mapped within the Project Area. Within proximity to the Project Area, Essential Habitat is also mapped for the Australian painted snipe (*Rostratula australis*), squatter pigeon (southern) (*Geophaps scripta scripta*), curlew sandpiper (*Calidris ferruginea*) and the bar-tailed godwit (*Limosa lapponica*).

Essential Habitat mapping is presented in Figure 3.

4.1.3 Wetlands

A review of the wetlands in the Rockhampton region revealed that the western side of the city of Rockhampton is surrounded by the BirdLife International 'Important Bird Area' (IBA) and Directory of Important Wetlands (DIWA) wetland of the Fitzroy floodplain and delta which extends from Yaamba to the coast at Port Alma and is approximately 98,743 hectares (ha) in size. The Fitzroy floodplain extends north-west from Rockhampton and largely consists of cleared and grazed land that generally extends to the banks of dissecting stream. In some places it is bordered by remnant woodland along drainage channels or punctuated by heavily disturbed sedgeland and aquatic macrophytes associated with lagoons (BirdLife International, 2019).

Within the DIWA and to the south, significant permanent wetlands occur. The wetlands include Pink Lily Lagoon, Lotus Lagoons, Lower Gracemere and Murray (which can be described as floodwater lagoons/wetlands) as well as the semi-permanent pools within the defined natural change of Lion Creek.

Wetlands are significant landscape features, and can also provide important bird habitat (Queensland Wetlands Program, 2013) consisting of:

- Diverse mosaics of wetlands ranging from permanent deep water habitats through to ephemeral swamps that support migratory shorebirds.
- Regionally significant breeding populations of waterfowl, including cotton pygmy geese, black swans, black-necked storks, magpie geese and brolgas.
- A seasonally dry environment but with a number of permanent freshwater lagoons and at least one perennial stream fed by groundwater.

Wetlands within and adjacent to the Project Area are displayed on Figure 4.

4.1.3.1 Wetland Protection Area Mapping

The map of Queensland wetland environmental values is a state-wide regulatory map under the Environment Protection (Water and Wetland Biodiversity) Policy 2019. It identifies the location of Wetland Protection Areas (WPA) in Great Barrier Reef (GBR) catchments which applies to State Development Assessment Provisions (SDAP) State code 9: Great Barrier Reef WPAs.

The map of Queensland wetland environmental values also identifies wetlands of High Ecological Significance (HES) and General Ecological Significance (GES) across the state. HES wetlands on the

map are identified as 'matters of state environmental significance' (MSES) under the Planning and Environmental Offsets legislation.

The WPA mapping shows that the Project Area occurs within trigger areas for WPAs and HES wetlands (Figure 4). Mapped HES wetlands within the Survey Area include:

- Murray Lagoon
- Yeppen Lagoon
- Pink Lily Lagoons, inclusive of the small lagoons east of Von Allmen road
- Lotus Lagoons, located east and west of Nine Mile Creek road
- Dunganweate Lagoon, inclusive of small lagoon directly south
- Nelson Lagoon
- Black Duck Lagoon
- Unnamed Lagoon, henceforth referred to as 'Capricorn Highway Wetland' due its location.

4.1.4 Threatened Fauna Species

The desktop assessment identified 31 threatened fauna species with the potential to occur within the Project Area. These species and their conservation status under the EPBC Act and NC Act are detailed in Table 6 below.

Table 6 Desktop results for conservation significant fauna

Scientific Name	Common Name	EPBC Act Status	NC Act Status
Birds			
Botaurus poiciloptilus	Australasian bittern	Endangered	-
Calidris ferruginea	Curlew sandpiper	Critically Endangered / Migratory	Endangered
Epthianura crocea macgregori	Yellow chat	Critically Endangered	Endangered
Erythrotriorchis radiatus	Red goshawk	Vulnerable	Endangered
Geophaps scripta scripta	Squatter pigeon (southern)	Vulnerable	Vulnerable
Hirundapus caudacutus	White-throated needletail	Vulnerable / Migratory	-
Limosa lapponica baueri	Western Alaskan bar-tailed godwit	Vulnerable	Vulnerable
Limosa lapponica menzbieri	Northern Siberian bar-tailed godwit	Critically Endangered	Endangered
Macronectes giganteus	Southern giant-petrel	Endangered	Endangered
Neochmia ruficauda ruficauda	Star finch	Endangered	Endangered
Numenius madagascariensis	Eastern curlew	Critically Endangered / Migratory	Endangered
Poephila cincta cincta	Black-throated finch (southern)	Endangered	Endangered
Rostratula australis	Australian painted snipe	Endangered	Vulnerable
Thalassarche impavida	Campbell albatross	Vulnerable	-
Turnix melanogaster	Black-breasted button quail	Vulnerable	Vulnerable

Scientific Name	Common Name	EPBC Act Status	NC Act Status
Mammals			
Chalinolobus dwyeri	Large-eared pied bat	Vulnerable	Vulnerable
Dasyurus hallucatus	Northern quoll	Endangered	-
Macroderma gigas	Ghost bat	Vulnerable	Endangered
Nyctophilus corbeni	Corben's long-eared bat	Vulnerable	Vulnerable
Petauroides volans	Greater glider	Vulnerable	Vulnerable
Phascolarctos cinereus	Koala	Vulnerable	Vulnerable
Pteropus poliocephalus	Grey-headed flying fox	Vulnerable	-
Reptiles			
Crocodylus porosus	Salt-water crocodile	-	Vulnerable
Delma torquata	Collared delma	Vulnerable	Vulnerable
Denisonia maculata	Ornamental snake	Vulnerable	Vulnerable
Egernia rugosa	Yakka skink	Vulnerable	Vulnerable
Elseya albagula	White-throated snapping turtle	Critically Endangered	Endangered
Furina dunmalli	Dunmall's snake	Vulnerable	Vulnerable
Hemiaspis damelii	Grey snake	-	Endangered
Rheodytes leukops	Fitzroy River turtle	Vulnerable	Vulnerable
Fish			
Maccullochella peelii	Murray cod	Vulnerable	-

4.1.5 Migratory Fauna

The desktop assessment identified an additional 23 migratory species with the potential to occur within the Project Area and surrounds (excluding those species that are also listed as Critically Endangered, Endangered, Vulnerable or Near Threatened). These species and their respective conservation status under the EPBC Act and NC Act are detailed in Table 7 below.

Table 7 Desktop results of migratory bird species listed under the EPBC Act

Scientific Name	Common Name	EPBC Act Status	NC Act Status
Migratory Marine Birds			
Apus pacificus	Fork-tailed swift	Migratory	Special Least Concern
Calonectris leucomelas	Streaked shearwater	Migratory	Special Least Concern
Hydroprogne caspia	Caspian tern	Migratory	Special Least Concern
Macronectes giganteus	Southern giant petrel	Migratory	Special Least Concern
Plegadis falcinellus	Glossy ibis	Migratory	Special Least Concern
Sterna albifrons	Little tern	Migratory	Special Least Concern
Thalassarche impavida	Campbell albatross	Migratory	Special Least Concern
Migratory Terrestrial Species			
Cuculus optatus	Oriental cuckoo	Migratory	Special Least Concern
Monarcha melanopsis	Black-faced monarch	Migratory	Special Least Concern
Monarcha trivirgatus	Spectacled monarch	Migratory	Special Least Concern

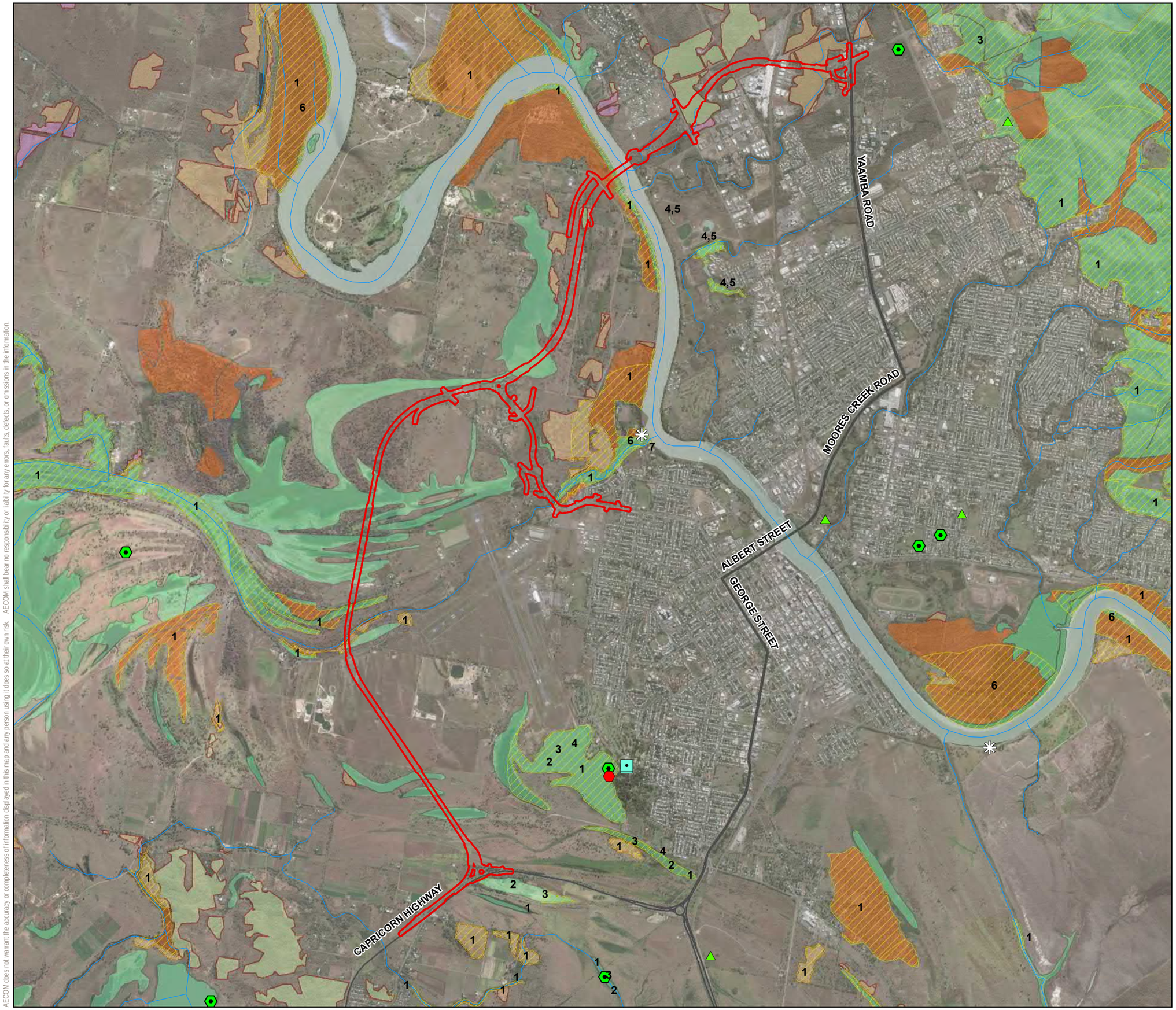
Scientific Name	Common Name	EPBC Act Status	NC Act Status
Myiagra cyanoleuca	Satin flycatcher	Migratory	Special Least Concern
Rhipidura rufifrons	Rufous fantail	Migratory	Special Least Concern
Migratory Wetland Species			
Actitis hypoleucos	Common sandpiper	Migratory	Special Least Concern
Calidris acuminata	Sharp-tailed sandpiper	Migratory	Special Least Concern
Calidris ruficollis	Red-necked stint	Migratory	Special Least Concern
Calidris melanotos	Pectoral sandpiper	Migratory	Special Least Concern
Gallinago hardwickii	Latham's snipe	Migratory	Special Least Concern
Limosa limosa	Black-tailed godwit	Migratory	Special Least Concern
Limosa lapponica	Bar-tailed godwit	Migratory	Special Least Concern
Pandion haliaetus	Eastern osprey	Migratory	Special Least Concern
Tringa glareola	Wood sandpiper	Migratory	Special Least Concern
Tringa nebularia	Common greenshank	Migratory	Special Least Concern
Tringa stagnatilis	Marsh sandpiper	Migratory	Special Least Concern

4.1.5.1 Migratory Bird Records

Publicly available records of migratory birds within and in proximity to the Project Area were reviewed. Previously identified species include:

- Australian painted snipe (*Rostratula australis*), 2013 - one record approximately 1.5 km from the Project Area
- Black-tailed godwit (*Limosa limosa*), 2018 – multiple records within 5 km of the Project Area
- Caspian tern (*Hydroprogne caspia*), 2018 – greater than 10 records within the Project Area
- Common greenshank (*Tringa nebularia*), 2016 – one record approximately 1.5 km from the Project Area
- Eastern osprey (*Pandion haliaetus*), 2017 – one record approximately 1.5 km from the Project Area
- Latham's snipe (*Gallinago hardwickii*), 2018 - greater than 10 records within 5 km of the Project Area
- Little curlew (*Numenius minutus*) (undated) – one record approximately 3 km from the Project Area
- Little tern (*Sterna albifrons*), 2017 - one record approximately 1.5 km from the Project Area
- Marsh sandpiper (*Tringa stagnatilis*), 2018 – greater than 5 records within 5 km of the Project area
- Red-necked stint (*Calidris ruficollis*), 2018 – one record approximately 1.5 km from the Project Area
- Sharp-tailed sandpiper (*Calidris acuminata*), 2018 – multiple records within 5 km of the Project Area
- Western Alaskan bar-tailed godwit (*Limosa lapponica bauera*) (2016).

The locations of the above records are included on Figure 4.



AECOM

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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
- VM Act Watercourses and Drainage Lines
- Highway
- Essential Habitat Mapping

Threatened Species Records

- Estuarine crocodile
- Squatter pigeon
- Curlew sandpiper
- Koala

Regional Ecosystems

- Category A or B area containing endangered
- Category A or B area containing of concern
- Category A or B area that is least concern
- Category C area containing endangered
- Category C area containing of concern
- Category C area that is of least concern
- Water

Essential Habitat

1 Ornamental Snake *(Denisonia maculata)*
2 Australian Painted Snipe *(Rostratula australis)*
3 Squatter Pigeon (Southern) *(Geophaps scripta scripta)*
4 Curlew Sandpiper *(Calidris ferruginea)*
5 Bar-Tailed Godwit *(Limosa lapponica baueri)*
6 Esturine Crocodile *(Crocodylus porosus)*
7 Fitzroy Turtle *(Rheodytes leukops)*

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

DESKTOP ASSESSMENT RESULTS

PROJECT ID	60593305
CREATED BY	OwbridgeE
LAST MODIFIED	15-Nov-2019
VERSION	2

Figure 3

A3 size

Latham's Snipe

Latham's Snipe, Marsh Sandpiper

Latham's Snipe, Marsh Sandpiper

Latham's Snipe, Caspian Tern, Marsh Sandpiper

Caspian Tern, Black-tailed Godwit, Sharp-tailed Sandpiper, Marsh Sandpiper, Glossy Ibis

Latham's Snipe, Caspian Tern

Caspian Tern

Black-tailed Godwit, Sharp-tailed Sandpiper, Red-necked Stint, Marsh Sandpiper, Caspian Tern, Latham's Snipe, Little Tern, Bar-tailed Godwit, Common Greenshank, Australian Painted-snipe, Eastern Osprey

Caspian Tern

Caspian Tern

Latham's Snipe, Marsh Sandpiper

Latham's Snipe

Latham's Snipe

Caspian Tern

Marsh Sandpiper

Marsh Sandpiper

Latham's Snipe

Caspian Tern, Latham's Snipe

Latham's Snipe

Pink Lily Lagoon

Black Duck Lagoon

Lion Lagoon

Lotus Lagoon

Lower Gracemere Lagoon

Lower Gracemere Lagoon

Deadmans Lagoon

Dunganweate Lagoon

Nelson Lagoon

Crescent (Goval) Lagoon

Murray Lagoon

Yeppen Lagoon

Capricorn Highway Lagoon

Padgole (Gracemere) Lagoon

YAAMBA ROAD

MOORES CREEK ROAD

ALBERT STREET

GEORGE STREET

CAPRICORN HIGHWAY

AECOM
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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
- Highway
- MSES High Ecological Significance Wetlands
- Wetland Protection Area - Trigger
- Directory of Important Wetland Areas (DIWA)

Migratory Bird Records

- Desktop

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 MAPPING AND MIGRATORY BIRD DESKTOP RECORDS

PROJECT ID	60593305
CREATED BY	McKeeJ2
LAST MODIFIED	14-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_RockhamptonRingRoad_F4_WetlandProtectionArea_A3_JM_V2.mxd

4.2 Field Survey

4.2.1 Survey Timing and Climatic Conditions

General fauna, ornamental snake and migratory bird surveys were undertaken successively over ten days in February 2019 (4 February to 15 February). Weather conditions over this period consisted of hot days with high humidity and warm nights. A review of the daily weather observations sourced from the Bureau of Meteorology (BOM) Rockhampton Aero Station (Station 39083) recorded the minimum and maximum temperature during the survey as 23.3 degrees Celsius (°C) (recorded 5 February 2019) and 38.0°C respectively (recorded 13 February 2019) (Table 8). Rainfall occurred during the first week of surveying; the greatest amount of 13.6 millimetres (mm) recorded on 4 February 2019 (Bureau of Meteorology, 2019a).

December to March is generally considered the wet season in Rockhampton. However, at the time of the field survey, conditions were very dry. Rainfall recorded for February 2019 and the months prior were significantly less than the long-term averages for the area, with the exception of December which received above average rainfall (Figure 5).

Surveying of the connection areas (areas not confirmed at the time of initial surveying) was completed on 8 October 2019. The minimum temperature recorded was 17.0°C and the maximum was 40.7°C. No rainfall was recorded; the most recent rainfall of 1.6 mm occurring on 2 October 2019.

Table 8 Minimum and maximum daily temperatures recorded at Rockhampton Aero BOM station during surveying

Date	February 2019										October 2019
	04	05	06	07	08	11	12	13	14	15	08
Min Temperature (°C)	23.4	23.3	23.8	24.0	23.8	24.7	24.5	24.5	24.3	24.3	17.0
Max Temperature (°C)	31.2	29.3	29.5	28.5	30.2	34.7	36.0	38.0	36.4	33.7	40.7

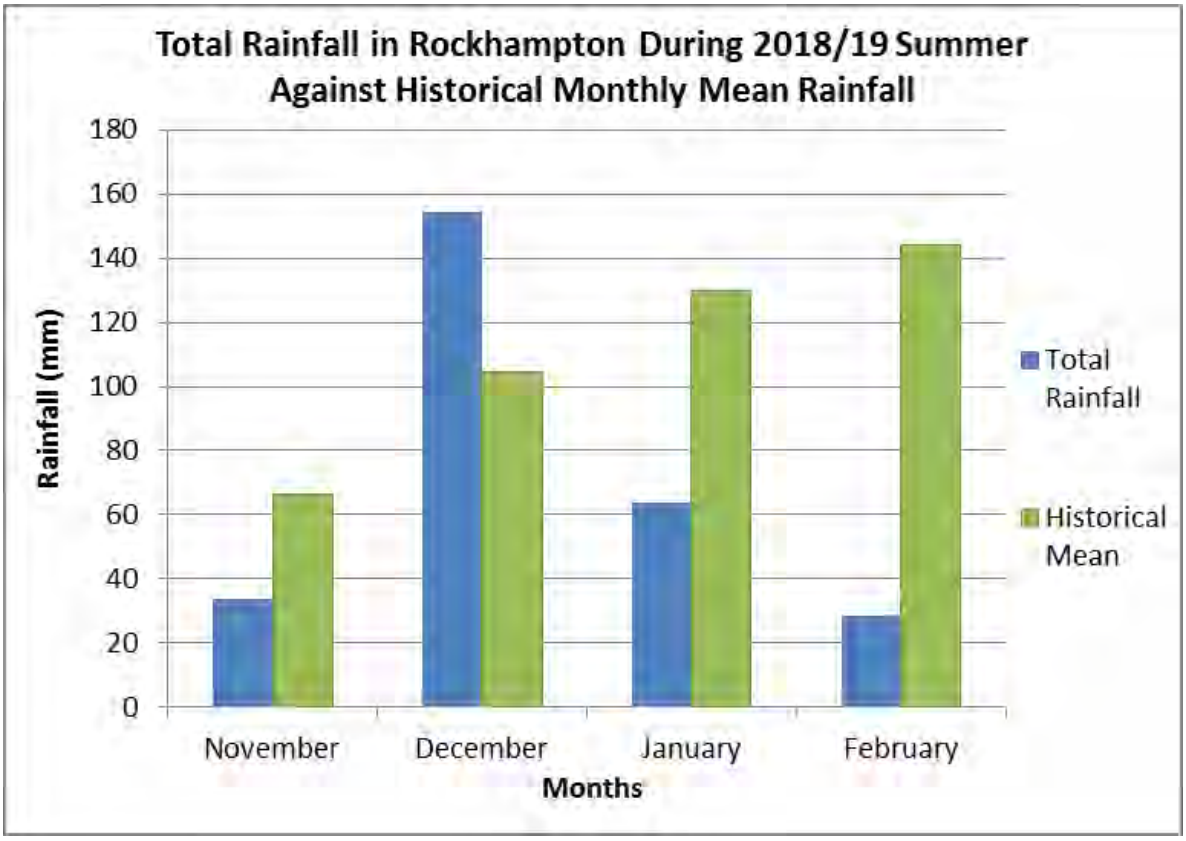


Figure 5 Climatic conditions before and during 2019 initial surveying

4.2.2 Fauna Species Richness

A total of 136 fauna species were recorded during the survey, comprising 105 bird species, 18 mammals, 9 reptiles and 4 amphibians. All observed were typical for the region and habitat types recorded on site. The species list is provided in Table 23 of Appendix A, and includes microchiropteran bat species confirmed using the song meters. The Balance! Environmental report detailing this analysis is also included in Appendix A.

4.2.2.1 Birds

A total of 105 bird species was detected during bird surveys or as incidental sightings. Of these species, 42 were waterbirds including five listed migratory bird species: Latham's snipe (*Gallinago hardwickii*), Caspian tern (*Hydroprogne caspia*), eastern osprey (*Pandion cristatus*), glossy ibis (*Plegadis falcinellus*) and marsh sandpiper (*Tringa stagnatilis*). These species are discussed further in the Targeted Survey Results (Section 4.2.3).

The remaining bird species were all woodland bird species commonly associated with eucalypts and known to occur in urban areas.

4.2.2.2 Mammals

Eighteen (18) mammal species have been recorded during field surveying, none of which are listed threatened species. Of the 18 mammals, five are exotic pest species, two are arboreal mammals, two are macropods, and the remaining nine are bats.

A single black flying fox was detected during spotlighting. An additional eight microbat species were confirmed using the microchiropteran ultrasonic call detectors. A total of 4395 distinct bat calls were recorded across 23 detector nights at six sites from 6 February to 14 February 2019. Bat calls were positively to one of eight distinct species, plus two species groups (*Chalinolobus morio/Vespadelus troughtoni* and *Nyctophilus* spp.) within which the species cannot be reliably differentiated. The *Nyctophilus* species group comprised *N. geoffroyi; N. gouldi;* and *N. bifax*. The threatened *N. corbeni*

was not listed as a potential species responsible for the *Nyctophilus* calls. Approximately 50% (2,108) of the identified calls captured by the detectors belonged to just one species: *Miniopterus australis*. Over 57% of all distinct bat calls occurred in the fringing riparian habitat, including almost 75% of the total *M. australis* calls.

No calls from the threatened large-eared pied bat (*Chalinolobus dwyeri*) or ghost bat (*Macroderma gigas*) were detected on the ultrasonic recorders during the survey period. The complete Microbat Call Identification Report is included in Appendix A**.**

4.2.2.3 Reptiles and amphibians

A relatively low diversity of reptiles (9 species) and amphibians (4 species) were recorded during surveying. Although targeted during spotlighting, ornamental snake was not recorded nor any other threatened reptile species. Reptiles recorded were all common and known to occur in woodland habitats or urban environments, including wall skink (*Cryptoblepharus virgatus*), common tree snake (*Dendrelaphis punctulatus*), eastern bearded dragon (*Pogona barbata*) and keelback snakes (*Tropidonophis mairii*). During one evening of spotlighting in February 2019, over 21 keelbacks were recorded foraging on juvenille cane toads.

The four amphibians recorded were the eastern sedge frog (*Litoria fallax*), Roth's tree frog (*Litoria rothii*), desert tree frog (*Litoria rubella*) and cane toads (*Rhinella marina*). In wetland areas especially, native frog abundance was low relative to the high abundance of cane toads.

4.2.3 Targeted Survey Results

Migratory Shorebird Species

The following five listed migratory bird species were recorded during the field survey:

- Latham's snipe (*Gallinago hardwickii*); Migratory under the EPBC Act. During the migratory bird survey, a total of 14 individuals were recorded in the main lagoon of Pink Lily Lagoon. In the week prior to this survey, a single Latham's snipe was recorded in the small lagoon directly east of Von Allmen Rd considered to be part of Pink Lily Lagoon.
- Caspian tern (*Hydroprogne caspia*); Migratory under the EPBC Act. This species was recorded at Pink Lily Lagoon (approximately 10 individuals), Nelson (single individual flying over head) and Murray Lagoon (single individual flying over head).
- Eastern osprey (*Pandion cristatus*); Migratory under the EPBC Act. One individual of this species was recorded at Yeppen Lagoon, located east of the Project Area.
- Glossy ibis (*Plegadis falcinellus*); Migratory under the EPBC Act. This species was recorded at Pink Lily (3 individuals), Lotus (single individual) and Nelson Lagoon (single individual) actively foraging in the shallow wetted areas where aquatic vegetation was abundant. Single individuals were observed at each lagoon.
- Marsh sandpiper (*Tringa stagnatilis*); Migratory under the EPBC Act. A single individual of this species was recorded at Pink Lily Lagoon.

The locations that the above species were recorded are depicted on Figure 6.

Ornamental Snake

The results from the desktop review concluded that Project Area may provide suitable habitat for ornamental snake and as such targeted surveys were conducted. Field survey timing was appropriate given the species' peak activity period; however climatic conditions were not ideal for the detection of ornamental snake with unseasonably dry conditions. During dry times, this species can remain "inactive in suitable shelter sites for months" (Department of the Environment, 2019).

The ornamental snake principally has a diet of native frogs. Surveys confirmed the presence of four amphibian species (including the cane toad) in the Project Area; frog activity throughout the Project Area was low in most areas. Cane toads (*Rhinella marina*) however were frequently recorded and are a known threat to the ornamental snake due to poisoning after ingestion and they also compete with native amphibians for food, shelter and breeding sites.

Wetlands and some riparian zones investigated during the field survey provided some microhabitat features suitable for the species with cracking clays and prey species present. However, habitat was considered to be marginal due to the abundance of cane toads, low abundance of woody debris, heavy weed infestation and lack of gilgai formation or brigalow communities.

4.2.4 Introduced Species

Eight introduced fauna species were recorded during surveys Table 9. Other introduced fauna species restricted under the *Biodiversity Act 2014* are likely to occur within the Project Area including black rat (*Rattus rattus*) and house mouse (*Mus musculus*).

Table 9 Introduced species recorded during surveying

Species name	Restricted Matter Category
Asian house gecko (*Hemidactylus frenatus*)	-
Brown hare (*Lepus capensis*)	-
Common myna (*Sturnus tristis*)	-
Cane toad (*Rhinella marina*)	-
Cat (*Felis catus*)	3,4,6
Feral pig (*Sus scrofa*)	3,4,6
European rabbit (*Oryctolagus cuniculus*)	3, 4, 5, 6
European fox (*Vulpes vulpes*)	3, 4, 5, 6

4.2.5 Fauna Habitats

Seven habitat types (comprising eight REs and non-remnant vegetation) were recorded within the Project Area. Fauna habitat types within the Project Area are delineated in Figure 6, and discussed in detail from Table 10 to Table 16.

Table 10 Habitat type 1 – Open woodland to low open woodland on alluvial floodplain

Habitat 1 **Open woodland to low open woodland on alluvial floodplain**
Analogous RE: 11.3.3 (HVR), remnant 11.3.4 and HVR 11.3.4
Vegetation Description
Habitat type 1 is an open woodland to low open woodland typically dominated by *Eucalyptus tereticornis* or *Eucalyptus coolabah* in the canopy. Other tree species frequently recorded in the T1 layer were *Corymbia tessellaris* and *Eucalyptus crebra*. Scattered patches of this habitat occur across the Project Area on alluvial floodplains and include areas of HVR (RE 11.3.3 and RE 11.3.4) and remnant (RE 11.3.4). The shrub layer was generally sparse and predominately comprised of the weeds *Leucaena leucocephala* and *Cryptostegia grandiflora* (rubbervine). The ground layer was dense, largely dominated by introduced grasses, especially *Megathyrsus maximus* (Guinea grass). Disturbance across the habitat areas is obvious, with historic clearing and thinning events as well as ongoing grazing evident.
Habitat Features
Key habitat values recorded in this community include fine litter in the ground cover, fallen logs and decorticating bark. These microhabitat features provide habitat opportunities for a variety of common reptile species, four of which were recorded in this habitat. Koala food trees (*Eucalyptus spp*. and *Corymbia spp.*) were abundant, indicating the potential utilisation of this habitat by koalas. When in flower, these trees provide foraging opportunities for nectivorous birds and flying-foxes. Mistletoes were also present on large trees in this habitat type. Mistletoe has dense foliage suitable for insects, provides nectar and fruit as well as nesting opportunities for woodland birds. Arboreal termitaria were occasionally recorded and provide nesting opportunities for birds such as the forest kingfisher (*Todiramphus macleayii*) which was recorded. Small hollows in large canopy trees were present, but generally rare. These

Habitat 1 Open woodland to low open woodland on alluvial floodplain
Analogous RE: 11.3.3 (HVR), remnant 11.3.4 and HVR 11.3.4
may provide nesting opportunities for woodland birds and small arboreal mammals such as squirrel glider (*Petaurus norfolcensis*) which was observed in this habitat type. Although evidence of cattle grazing was present in majority of this habitat, the dense grassy understory also makes it well suited to macropod foraging and dispersal; the eastern grey kangaroo (*Macropus giganteus*) and agile wallaby (*Macropus agilis*) were both recorded.
Conservation Significant Fauna
Possible: Koala (breeding, foraging and dispersal) Grey-headed flying-fox (*r*oosting, foraging and dispersal) Squatter pigeon (southern) (dispersal) White-throated needletail (roosting and foraging)
 

Table 11 Habitat type 2 – Lacustrine wetlands

Habitat 2 Lacustrine wetland
Analogous RE: 11.3.27a
Vegetation Description
As discussed in Section 4.2.1, survey conditions were unseasonably dry. Despite this, a number of mapped wetland areas were observed to have permanent waterbodies and are considered lacustrine wetlands (analogous with RE 11.3.27a). The Project Area intersects a number of lacustrine wetlands which vary in size; smaller lagoons (Dunganweate and Nelson's Lagoon) occurring in the south, and larger lagoons such as Lotus and Pink Lily towards the north. Most lagoons had some stags and aquatic vegetation in the littoral zone. Dense vegetation in the fringes was lacking at most locations, with the exception of Pink Lily where a dense fringe of 1-2m tall *Persicaria orientalis* and *Urochloa mutica* surrounded much of the wetland. However, this fringing vegetation did experience significant dieback during the dryer winter months. Vegetation in riparian zones varied but was generally considered non-remnant due to thinning; large Eucalypt trees were often present although isolated.
Habitat Features
Being a permanent water source, this community provides refuge for a variety of species, including amphibians, macropods, some reptiles and waterbirds. Muddy margins around the waterbodies were common, at some locations providing suitable shallow roosting and foraging habitat for migratory shorebirds such as the marsh sandpiper (*Tringa stagnatilis*) which was observed at Pink Lily lagoon. Where dense shrubs were present, these also provided refuge for the listed migratory species Latham's snipe which was recorded in high

Habitat 2
Lacustrine wetland

Analogous RE: 11.3.27a

numbers (14 individuals in one afternoon) at Pink Lily lagoon. Cracks in the muddy margins or riparian fringe were also recorded. These provide potential habitat opportunities for reptiles such as the keelback snake (*Tropidonophis mairii*). This species was recorded at Lotus Lagoons in high abundance (19 individuals in <0.5ha) utilising these features while hunting cane toads (*Rhinella marina*). Other reptiles such as freshwater turtles (Krefft's turtle (*Emydura krefftii*) were also observed in this habitat type.

Freshwater mussels were occasionally observed in the water's edge. Freshwater mussels are highly sensitive to disturbance and pollution and require habitat that includes dense vegetation and large woody debris or boulders to stabilise the streambed sediments. A fish population is also a key requirement for the freshwater mussels' development during the larval stage of their life cycle (Office of Environment and Heritage, 2011). The presence of the mussel shells indicates that this habitat recently held these features.

Canopy trees in the riparian zones were large, and in some obvious signs of bird nesting was observed. All lacustrine wetlands however were impacted to some degree, with cattle pugging and evidence of pest species such as pig (*Sus scrofa*) and fox (*Vulpes vulpes*) recorded.

Conservation Significant Fauna

Known:
- Latham's snipe (foraging)
- Caspian tern (foraging)
- Glossy ibis (foraging)
- Marsh sandpiper (foraging)
- Eastern osprey (foraging)

Possible:
- Australasian bittern (breeding and foraging)
- Sharp-tailed sandpiper (foraging)
- Curlew sandpiper (foraging)
- Red-necked stint (foraging)
- Ornamental snake (breeding, foraging and dispersal)
- Black-tailed godwit (foraging)
- Little curlew (foraging)
- Little tern (foraging)
- Common greenshank (foraging)
- Common sandpiper (foraging)
- Pectoral sandpiper (foraging)
- Wood sandpiper (foraging)
- Western Alaskan bar-tailed godwit (foraging)
- Australian painted snipe (foraging)
- Salt-water crocodile (foraging and dispersal)
- White-throated needletail (foraging)

Table 12 Habitat type 3 – Palustrine wetlands

Habitat 3 **Palustrine wetland**	
Analogous RE: 11.3.27c	
Vegetation Description	
At the time of the survey, all palustrine wetlands (analogous with RE 11.3.27c) were dry or had significantly receded. These wetlands are ephemeral, and when holding water are likely shallow due to the mostly flat terrain. Areas of this habitat varied in size. West of Lotus Lagoon, dry palustrine wetlands were expansive. In other areas, this habitat was present only on the perimeters of aforementioned lacustrine wetlands. The ground layer in this habitat had a very high cover of low, aquatic flowering plants. In many areas this vegetation was decaying due to the prevailing dry conditions. Vegetation in riparian zones varied but was generally considered non-remnant due to thinning; Eucalypt trees were often present although isolated.	
Habitat Features	
Key habitat values recorded in this community include cracking clays (although generally rare), as well as occasional hollow logs and woody debris especially in the adjacent fringing vegetation. In the fringing vegetation, large eucalypt canopy trees were also present with some bearing small hollows and providing nesting opportunities. These large trees shelter areas adjacent to waterbodies (where present) and provide refuge for arboreal mammals and hollow dependent birds and bats. Also notable was the high frequency of freshwater mussel shells in the ground layer. Freshwater mussels are considered an important indicator of a habitat's aquatic health, and are a food source for other animals (Office of Environment and Heritage, n.d.). Freshwater mussels are highly sensitive to disturbance and pollution, and require habitat that includes dense vegetation and large woody debris or boulders to stabilise the streambed sediments. A fish population is also a key requirement for the freshwater mussels' development during the larval stage of their life cycle (Office of Environment and Heritage, 2011). The presence of the mussel shells indicates that this habitat held these features at some point in recent history. Due to the historic thinning in riparian zones, weeds, ongoing cattle grazing and drought conditions this habitat was considered heavily impacted. However, it is likely that during flood conditions when wetlands are holding water, the habitat provides high value to a number of conservation significant species, in particular a range of listed migratory birds as well as providing substantial fauna dispersal and connectivity opportunities for aquatic fauna when inundated.	
Conservation Significant Fauna	
Possible: • Squatter pigeon (dispersal) • Koala (breeding, foraging and dispersal) • Ornamental snake (breeding, foraging and dispersal) • Caspian tern (foraging) • Glossy ibis (foraging) • Australasian bittern (breeding and foraging) • Marsh sandpiper (foraging) • Sharp-tailed sandpiper (foraging) • Red-necked stint (foraging) • Western Alaskan bar-tailed godwit (foraging) • Australian painted snipe (foraging)	• Black-tailed godwit (foraging) • Little curlew (foraging) • Little tern (foraging) • Common greenshank (foraging) • Common sandpiper (foraging) • Pectoral sandpiper (foraging) • Wood sandpiper (foraging) • Latham's snipe (foraging) • Curlew sandpiper (foraging) • White-throated needletail (roosting and foraging) • Eastern osprey (foraging)

Habitat 3 Palustrine wetland	
Analogous RE: 11.3.27c	
	

Table 13 Habitat type 4 – Fringing riparian woodland

Habitat 4 Fringing riparian woodland
Analogous RE: 11.3.25, 11.3.25a
Vegetation Description
Habitat 4 is a riparian woodland on alluvium analogous with RE 11.3.25, largely dominated by Eucalypt species in the T1 layer. Patches of this habitat across the Project Area are minimal, present only along the Fitzroy River and drainage lines in the north (Limestone Creek) and south (Lion Creek). In the areas along the Fitzroy River and Lion Creek, *Eucalyptus tereticornis* was the dominant canopy species (RE 11.3.25), with other tree species such as *Eucalyptus coolabah* and *Melaleuca leucadendra* also common. In the areas surrounding Limestone Creek, *Eucalyptus raveretiana* (sometimes emergent) and *Melaleuca fluviatilis* dominated (RE 11.3.25a). The lower tree and shrub layer was dense, comprised of *Acacia salicina* and other species. The ground layer was also dense, largely dominated by introduced grasses. In contrast, along Lion Creek both the shrub and ground layer was sparse due to ongoing cattle grazing and thinning.
Habitat Features
Habitat values recorded in this community included fine litter in the ground cover, occasional fallen logs and hollows in trees. Suitable habitat for several turtle species was present in pool habitat with the potential for riffle zones to form when flowing. These values, especially for reptiles and amphibians, were more prevalent in the northern areas of the Project Area (Limestone Creek) due to the greater amount of water present in the creek and absence of grazing cattle. Previous surveys conducted by AECOM in Limestone Creek for the Rockhampton North Upgrade confirmed the presence of multiple freshwater turtle species including the saw-shell turtle (*Wollumbinia latisternum*) and Krefft's river turtle (*Emydura macquarii krefftii*). Vegetation in the understory of the fringing zones of Limestone creek was structurally complex primarily due to an abundance of exotic flora species. These dense conditions provide suitable complexity and cover for a variety of woodland bird species. Where this habitat occurred in the south of the Project Area (Lion Creek and associated drainage lines), it was primarily dry with only small pools of disconnected water present. At this location, vegetation in the fringing areas was not structurally complex with only large eucalypt canopy trees present. Hollows were rare to occasional but where present provide nesting opportunities for small arboreal mammals and woodland birds. Although heavily grazed in most areas, the grassy understory present in habitat associated with Lion Creek is likely to provide foraging opportunities for macropods.

Habitat 4 **Fringing riparian woodland**
Analogous RE: 11.3.25, 11.3.25a
Fauna connectivity opportunities also exist in this habitat, with drainage lines providing fly-ways and foraging habitat suitable for a number of microchiropteran bats, birds and large-bodied mammals.
Conservation Significant Fauna
Possible: • Koala (breeding, foraging and dispersal) • Squatter pigeon (dispersal) • Fitzroy River turtle (foraging and dispersal on Fitzroy River and Limestone Creek only) • White-throated snapping turtle (foraging and dispersal on Fitzroy River and Limestone Creek only) • Salt-water crocodile (foraging and dispersal) • White-throated needletail (roosting and foraging) • Grey-headed flying-fox (roosting, foraging and dispersal)
 

Table 14 Habitat type 5 – *Eucalyptus crebra* and *Corymbia dallachiana* woodland

Habitat 5 ***Eucalytpus crebra* and *Corymbia dallachiana* woodland**
Analogous RE: 11.11.15
Vegetation Description
Habitat 5 is a woodland dominated by *Eucalyptus crebra* (narrow-leaved ironbark) and *Corymbia dallachiana* (Dallachy's gum) in the canopy layer (approximately 14 m height), located on deformed and metamorphosed sediments (analogous with RE 11.11.15). Within the Project Area this habitat occurs in two areas adjacent to an industrial precinct north of the Fitzroy River. The shrub layer was relatively sparse and included *Acacia decora* (Western silver wattle), *Alphitonia excelsa* (soap tree) and *Vachellia bidwillii*. The ground layer was generally dense, dominated by native grasses such as *Themeda triandra* (kangaroo grass) and exotic species.
Habitat Features
Historical clearing has occurred in this habitat type, with trees in the T1 layer relatively young in age. Hollow formation in trees is directly related to age; it is generally considered to take 100 years before hollows are formed (NSW National Parks and Wildlife Service, 1999). As the trees within the canopy are relatively small, they are unlikely to bear hollows in the immediate or near future. Although nesting opportunities for arboreal mammals and hollow-dependent bird species are considered limited, a number of habitat values suitable for common reptiles were recorded in this community, including fallen logs, occasional course litter, decorticating bark and stones in the ground layer. These microhabitat features are considered important for small reptiles especially as they allow for refuge from predators and weather, and in some instances create microclimates (McGregor & Burnett, 2014).

Habitat 5 ***Eucalytpus crebra* and *Corymbia dallachiana* woodland**	
Analogous RE: 11.11.15	
Mistletoe and flowering tree species provide foraging opportunities for woodland birds, including the rainbow lorikeet (*Trichoglossus moluccanus*) and blue-faced honeyeater (*Entomyzon cyanotis*) which were recorded. Within this habitat small gullies were also present which after rainfall events will hold water and provide habitat for amphibians. The abundance of grass (cover estimated to be greater than 70%) also provides suitable foraging habitat for macropods, evident from the presence of scats and tracks. As it is connected to a larger tract of vegetation in a northward direction, this habitat may also provide dispersal opportunities for a variety of fauna species.	
Conservation Significant Fauna	
Possible: • Koala (breeding, foraging and dispersal) • Squatter pigeon (dispersal) • White-throated needletail (roosting and foraging) • Grey-headed flying-fox (roosting, foraging and dispersal)	
	

Table 15 Habitat type 6 – Brigalow low forest

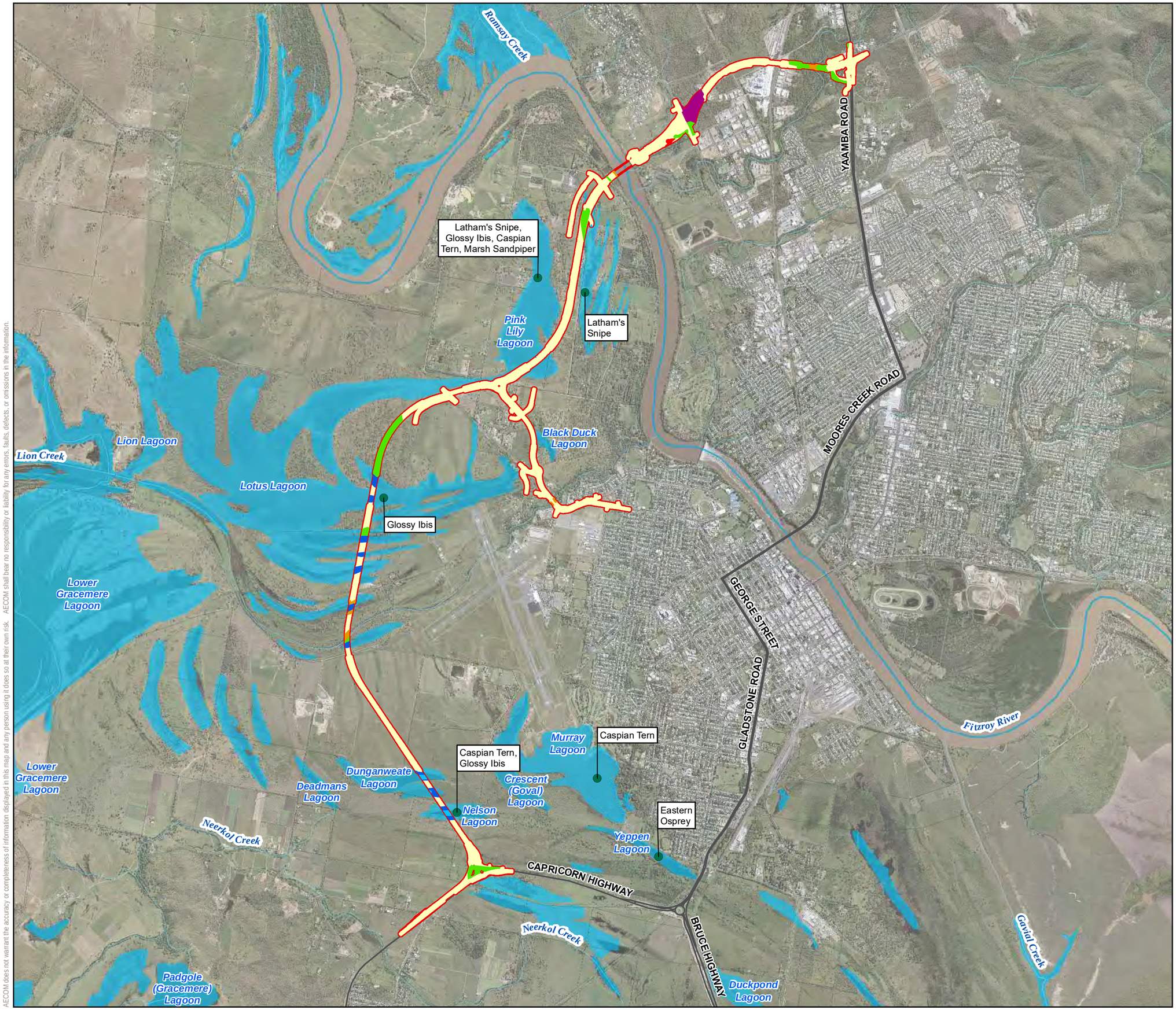
Habitat 6 **Brigalow low forest**
Analogous RE: HVR 11.3.1
Vegetation Description
This habitat was found in one small, isolated patch within the Project Area just north of the Fitzroy River on alluvial plains. It meets the condition thresholds of the Brigalow threatened ecological community (TEC). Regrowth *Acacia harpophylla* was dominant in the T1 layer and T2. Although these layers were quite low (up to 9 m in height) review of satellite imagery confirmed that this patch has not been cleared for greater than 15 years. Although small, the area was in relatively good condition, with exotic perennial plants found only in the edges, comprising less than one percent of total vegetation cover.
Habitat Features
This habitat type provided foraging opportunities for foliage-gleaning bird species and refuge for small reptiles, with high abundance of leaf-litter. A mature canopy layer was absent, and due to the age of trees present no hollows or deep crevices in the bark were present. Ground cover was relatively low, with areas of bare ground common and microhabitat features such as coarse woody debris and decorticating bark absent. Furthermore, *acacia sp*. are not considered koala food trees, and as such koala is unlikely to occur in this community.

Habitat 6 **Brigalow low forest**
Analogous RE: HVR 11.3.1
Due to the lack of structural complexity in this habitat, only a small number of common fauna species are expected to utilise it. Habitat values were not reflective of larger, remnant patches of brigalow communities which support a high diversity of brigalow belt reptiles, with no gilgai, cracking clays, ground timber or dense ground or lower shrub layer present. Due to the lack of suitable refuge and isolation of this habitat fragment, it was considered unlikely to support a population of ornamental snake.
Conservation Significant Fauna
• Squatter Pigeon (dispersal) • White-throated needletail (foraging)


Table 16 Habitat type 7 – Modified grasslands

Habitat 7 **Modified grasslands**
Analogous RE: -
Vegetation Description
Non-remnant vegetation as a result of historical clearing and cattle grazing dominates the Project Area (83% of the Project Area). Vegetation within this habitat type varied and included isolated paddock trees and some riparian vegetation between lagoons and along drainage lines. The introduced pasture species *Cenchrus ciliaris* (buffel grass) dominates much of this community, although patches of native grass still exist in places.
Habitat Features
Habitat values in this community were limited but included occasional tree hollows in riparian zones and high abundance of grass in the ground layer where grazing was restricted. Grasslands may provide habitat for small mammals, reptiles and granivorous birds. Larger mammal species such as the grey kangaroo also forage in this habitat.

Habitat 7 **Modified grasslands**	
Analogous RE: -	
Conservation Significant Fauna	
Where intact woodland vegetation occurs within 100 m, squatter pigeon (southern) is considered potential for dispersal only. White-throated needletail (foraging)	
	



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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
- MSES High Ecological Significance Wetlands
- Highway
- Roads and Tracks

VM Act Watercourses and Drainage Lines

- Major
- Minor

Fauna Habitat Types

- 1. Open woodland to low open woodland on alluvial floodplains dominated by *Eucalyptus tereticornis*
- 2. Lacustrine wetland
- 3. Palustrine wetland
- 4. Fringing riparian woodland on alluvium
- 5. Woodland dominated by *Eucalyptus crebra* and *Corymbia dallachiana* on metamorphics
- 6. Brigalow low woodland
- 7. Modified grasslands

Shorebird Records

- AECOM 2019

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

FIELD SURVEY RESULTS

PROJECT ID	60593305
CREATED BY	OwbridgeE
LAST MODIFIED	15-Nov-2019
VERSION	2

Figure 6

A3 size

Filename: \\aurok1fp001\Projects\605x\60593305\900_CAD_GIS\920_GIS\920_GIS\920_02_MXDs\Ecology Report\201910 Updates\60593305_RockhamptonRingRoad_F6_FieldSurveyResults_A3_JM.mxd

4.2.6 Wetland Values

The wetlands within the Project Area provide habitat values for a range of fauna species. Wetlands comprised both permanent and ephemeral systems, all exhibiting signs of disturbance. The hydrological and fauna habitat values of wetlands observed during the field surveys are noted in Table 17 below. It should be noted that the climatic conditions at the time of initial surveying (unseasonably dry) is a key limitation in the description of habitat values below (see Section 3.3).

A list of waterbird species recorded at each surveyed wetland is presented in Appendix A, Table 24.

Table 17 Hydrology and fauna values of wetlands within the Project Area

Wetland	Hydrological Summary	Fauna Habitat Values
Pink Lily Lagoon	A large wetland complex, containing a permanent waterbody and fringing sedgeland, located south of the Fitzroy River and intersected by the Project Area. Associated permanent waterbodies include those located directly east of Von Allmen road. Overbank flow that occurs at the Pink Lily Meander during flooding recharges this wetland.	Of wetlands surveyed, Pink Lily held the greatest habitat value due to its relatively minimal disturbance from grazing and large size, which at the time of the survey contained a large inundated area. Shallow edging and muddy margins were common, providing foraging and roosting opportunities for a variety of waterbirds. Large areas of the wetland fringes had dense vegetation; this feature is essential for the listed migratory species and Latham's snipe, which was recorded in high numbers (14 individuals recorded in one afternoon). Deep cracking in the soil was common in the wetland fringe, providing suitable habitat opportunities for reptile species such as the ornamental snake. Around the wetland perimeter there were multiple stags. These create perching and roosting opportunities for birds and bats, and when fallen become a substrate feature that provides refuge for aquatic species. Freshwater mussels, turtles and a number of waterbird species were observed at this location. Several listed migratory species were recorded in this wetland including one marsh sandpiper, Latham's snipe (as aforementioned), a group of approximately 15 Caspian tern roosting in shallow waters and several glossy ibis.
Black Duck Lagoon	A small wetland with a semi-permanent waterbody, directly recharged by the Fitzroy River and its tributaries that run to the east and south. The Project Area overlaps the mapped WPA associated with this wetland.	Although dry, the wetland was confirmed directly east of the Project Area by the presence of wetland vegetation. A narrow linear lagoon was also present in the south east of the mapped extent. This waterbody had significantly receded, lacked fringing low vegetation and had highly disturbed muddy margins due to cattle use. Based on the landform present, the waterbody is likely shallow. Aquatic vegetation is common in the inundated areas of the lagoon, especially at the eastern end. Large riparian trees are also present and provide perching opportunities for predatory birds, as well as potential nesting for arboreal mammals and woodland birds. Five common waterbird species were recorded at this location, however during the wet season when fully inundated, this wetland is likely to support low abundances of other migratory wadders due to a reduction in shallow wading areas and exposed muddy margins.

Wetland	Hydrological Summary	Fauna Habitat Values
Lotus Lagoons	A large floodplain wetland complex that is highly ephemeral, although some permanent water bodies are present. It is located east and west of Nine Mile Road, north of the Rockhampton Airport. The Project Area directly intersects this wetland. Neerkol and Lion Creek as part of Rockhampton's lower catchment zone recharge this system.	Although the majority of this wetland was dry or had significantly receded, a number of habitat values suitable to birds, reptiles and amphibians were recorded. Soil cracking although generally uncommon was present in the fringes of some of the waterbodies. A high abundance of keelback snakes (*Tropidonophis mairii*) were recorded during spotlighting utilising these cracks to forage. A variety of waterbirds were also recorded at the permanent waterbodies, including pelicans, egrets, ducks, cormorants and the migratory glossy ibis. Where dry, the presence of freshwater mussel shells in the ground layer indicates the wetland was functioning in recent history. Adjacent riparian zones were heavily impacted, especially in the northern-most section with exotic grass prevalent. Grazing activity was ongoing in the west of this wetland. When periodically inundated, this wetland may provide extensive, shallow, wetted habitat that may be utilised by a variety of migratory bird species.
Dunganweate Lagoon	A moderate sized wetland with an elongated crescent shaped permanent waterbody, recharged by Neerkol catchment system. The Project Area directly intersects this wetland.	This wetland was located within a disturbed and heavily grazed landscape, with riparian vegetation largely absent. The waterbody had moderately sloping banks, with a rocky and/or sandy ground layer in some areas. Some muddy margins were present and significant pugging was observed. Small patches of aquatic vegetation around the wetland fringes were recorded, but dense vegetation overall was absent. Fish activity was observed from the surface. Foraging opportunities exist for a range of waterbirds, such as egrets, cormorants and ducks. Overall, the habitat is sub-optimal for wading species due to very sparse cover of macrophytes or riparian vegetation. Water levels are also too deep to be suitable for foraging and roosting for most species.
Nelson Lagoon	A small wetland with a permanent waterbody, located directly south of Dunganweate Lagoon. Nelson Lagoon is recharged by Neerkol catchment system. This lagoon is likely connected to Dunganweate Lagoon during minor flooding events.	This wetland is also within a disturbed and heavily grazed landscape. The waterbody is on higher ground, and is potentially shallower than the adjacent Dunganweate, however too deep for foraging and roosting for most migratory bird species, with the exception of species which hunt for fish during flight such as the Caspian tern, which was observed here. Habitat is considered marginal for wading birds.
Capricorn Highway Lagoon	A small elongated permanent waterbody located south of the Capricorn Highway, connected to Neerkol Creek. The Project Area overlaps a small proportion of the northern mapped extent of this lagoon.	This wetland was surveyed in October 2019, however due to access restrictions fauna habitat values could not be accurately determined. A permanent waterbody was observed, and this could provide suitable foraging habitat for waterbirds and some migratory species.

Wetland	Hydrological Summary	Fauna Habitat Values
Murray Lagoon	A large, permanent waterbody located west of the Botanic Gardens and south of the Rockhampton Airport. Murray Lagoon is recharged from local run off and during flood events in the Yeppen Floodplain, including regional flood events in the Lion Creek and Neerkol Creek catchments. This lagoon is not located in the Project Area and is not expected to be impacted by the Project.	This large waterbody provides a host of nesting and foraging opportunities for waterbirds with a high diversity of species recorded in this location. Areas of dense vegetation were present along the fringes and on the spit on the western side suitable for Latham's snipe and Australian painted snipe both of which have been previously recorded. Mudflats within the lagoon provide foraging opportunities for a number of listed wading species such as black-tailed godwit, sharp-tailed sandpiper, red-necked stint and common greenshank which have all been previously recorded. The lagoon likely supports numerous reptiles including Krefft's river turtle (*Emydura macquarii krefftii*) has been previously recorded.
Yeppen Lagoon	An elongated, perennial basin connected to the Fitzroy River, Neerkol Creek and other associated estuarine waters during major flood events. This lagoon is located south east of Murray Lagoon, and is not in the Project Area.	Yeppen Lagoon supports a range of foraging and nesting values for waterbirds such as waterfowl, grebes and moorhens. Dense shrubs in some areas in the wetland fringe provide suitable roosting habitat for Latham's snipe (which has been previously recorded here) and muddy margins provide foraging opportunities for a range of wading birds. The wetland is however too deep for roosting for most wading bird species. The perennial water may support a host of native amphibians and reptiles. The listed migratory species Caspian tern was also observed here.

4.2.7 Connectivity

The Project Area is situated close to the city of Rockhampton, and mainly intersects pastoral non-remnant land. Remnant habitat throughout the Project Area occurs in mostly isolated patches, generally surrounding wetlands and other water bodies. Habitat is not physically connected to any significant regional fauna corridors.

Although modified, palustrine and lacustrine wetlands, especially during non-drought conditions, are likely to provide large scale movement opportunities for amphibians, reptiles and migratory birds.

4.3 Likelihood of Occurrence

The likelihood assessment performed during the desktop assessment was refined following confirmation of habitat values during the field surveys. The resulting occurrence assessments identified 26 fauna species as present or having a moderate or high likelihood of occurring. This includes five migratory species that are known to occur within the Project Area as well as 11 threatened and 10 migratory species considered to potentially occur (Table 18). The extent of potential habitat for these species within the Project Area is outlined in Table 19. Further discussion on each species utilisation of habitat within the Project Area as well as habitat condition is provided in the individual significant impact assessments (SIA's) provided in Appendix C.

The full likelihood of occurrence assessment is presented in Table 25 and Table 26 (Appendix B).

Table 18 Likelihood of occurrence summary table

Value	Likelihood of Occurrence		
	Moderate	High	Present
Threatened Fauna	Australasian bittern Curlew sandpiper (also listed migratory) Koala Ornamental snake White-throated needletail	Australian painted snipe Fitzroy River turtle Grey-headed flying-fox Squatter pigeon (southern) Western Alaskan bar-tailed godwit (also listed migratory) White-throated snapping turtle	NA
Migratory Fauna	Common sandpiper Wood sandpiper	Sharp-tailed sandpiper Red-necked stint Black-tailed godwit Little curlew Little tern Common greenshank Pectoral sandpiper Estuarine crocodile (*Crocodylus porosus*)	Latham's snipe Caspian tern Eastern osprey Glossy ibis Marsh sandpiper

Table 19 Extent of potential habitat in the Project Area for threatened and migratory species

Species	Habitat utilisation	Area (ha)
Threatened species		
Australasian bittern	Breeding and foraging	0.07
Ornamental snake	Breeding, foraging and dispersal	27.05
White-throated snapping turtle	Breeding / nesting	0
	Foraging and dispersal	1.76
Squatter pigeon (southern)	Breeding	0
	Foraging	0
	Dispersal	33.75
Koala	Refuge	0
	Breeding, foraging and dispersal	26.56
Fitzroy River turtle	Breeding	0
	Foraging and dispersal	1.76
Australian painted snipe	Breeding / nesting	0
	Foraging	0.07
Grey-headed flying-fox	Roosting, foraging and dispersal	25.56
Threatened and Migratory species		
White-throated needletail	Roosting	32.48
	Foraging	199.07
Curlew sandpiper	Foraging only	6.77
Western Alaskan bar-tailed godwit	Foraging only	6.77

Species	Habitat utilisation	Area (ha)
Migratory species		
Common sandpiper	Foraging only	6.77
Sharp-tailed sandpiper	Foraging only	6.77
Pectoral sandpiper	Foraging only	6.77
Red-necked stint	Foraging only	6.77
Salt-water crocodile	Breeding / nesting	0.77
	Foraging and dispersal	2.3
Latham's snipe	Foraging only	6.77
Caspian tern	Foraging only	6.77
Black-tailed godwit	Foraging only	6.77
Little curlew	Foraging only	6.77
Eastern osprey	Breeding / nesting	8.15
	Foraging	9
Glossy ibis	Foraging only	6.77
Little tern	Foraging only	6.77
Wood sandpiper	Foraging only	6.77
Common greenshank	Foraging only	6.77
Marsh sandpiper	Foraging only	6.77

5.0 Potential Impacts

Potential impacts to fauna values may occur in the following phases of the Project:

1. Construction Phase
2. Operation and Maintenance Phase.

Further information on the potential impacts associated with the Project is outlined below. Proposed mitigation to minimise the potential impacts on fauna values is outlined in Section 6.0.

5.1 Construction Phase

Potential impacts on fauna and fauna habitat values during the construction of the Project include:

- Loss of fauna habitat and fragmentation
- Loss and degradation of wetland habitat and values
- Fauna mortality
- Degradation of habitat by introduced species
- Avoidance of fauna due to increased lighting and noise.

Each potential impact is described in greater detail below.

5.1.1 Loss of Fauna Habitat and Fragmentation

As a worst-case scenario, it has been assumed that the entire Project Area will be cleared of all vegetation to allow for construction. The areas of potential impact (i.e. habitat loss) discussed in the below sections are an indication of the amount (hectares) of available habitat within the Project Area (noting three lots were surveyed from roads and adjacent properties only), with the final impacted area likely to be lower, especially at bridge locations. Worse-case clearing impacts on threatened and migratory species habitat within the Project Area is outlined in Appendix C.

Table 20 Extent of potential impacts to fauna habitat types – worst case

Habitat ID	Short Description	Area (ha)
1	Open woodland to low open woodland on alluvial floodplains	18.05
2	Lacustrine wetland	0.85
3	Palustrine wetland	5.92
4	Fringing riparian woodland	2.23
5	Woodland dominated by *Eucalyptus crebra* and/or *Corymbia dallachiana* on metamorphics	6.28
6	Brigalow low woodland	0.42
7	Modified grasslands	165.31
	Total	**199.07**

The clearance of native vegetation can adversely affect native fauna species. Potential impacts resulting from clearing native vegetation may include the following:

- Loss of habitat causing a reduction of biological diversity or loss of local populations and genotypes
- Fragmentation of populations, which can reduce gene flow between small isolated populations, reduce the potential for species to adapt to environmental change and loss or severe modification of the interactions between species

- Disturbance which can permit the establishment and spread of exotic species that may displace native species
- Loss of microhabitat features such as leaf litter, tree hollows, ground timber which removes habitat for a wide variety of vertebrates and invertebrates
- Loss of food resources such as foliage, flowers, nectar, fruit and seeds.

The Project Area intersects 165.31 ha of non-remnant vegetation and cleared paddocks, accounting for approximately 83% of the estimated potential impact. While non-remnant vegetation is considered to contain fewer ecologically significant values, these areas may still provide habitat for fauna, including large isolated trees, leaf litter, ground timber, grasses and wetlands.

5.1.2 Loss and Degradation of Wetland Habitat and Values

Wetlands and floodplains are sensitive communities which often support high biodiversity and species richness. The Project Area dissects a number of HES wetlands, some of which are considered to be important areas for listed migratory shorebird species.

Five migratory bird species were recorded at the wetlands in the Project Area (Section 4.1.5). No distributional limits for any of the migratory bird species occur within the Project Area. Excluding the Latham's snipe, a relatively low number of individuals of these species were recorded in total at the time of the targeted survey. This suggests that across a large portion of the Project Area, wetlands and associated habitat values have been impacted by the ongoing disturbances associated with the current land use including grazing and adjacent urbanisation. This has limited the habitat resources and the capacity of the wetlands to support significant populations of conservation significant species.

However, high values do exist as demonstrated by the identified ecologically significant numbers of Latham's Snipe at Pink Lily Lagoon. This wetland has significant value for both common and conservation significant species. In addition, Lotus Lagoons is an expansive wetland system that is also considered be of high habitat value during periods of inundation.

As discussed in Section 3.2.7, although targeted survey timing was appropriate, climatic conditions were unseasonably dry and therefore may not be representative. In addition, no publicly available systematic shorebird surveys have occurred historically in the Rockhampton region to supplement the lack of field survey data. Additional targeted surveys under ideal climatic conditions may allow for greater accuracy in likelihoods' of species absence/presence, and understanding of wetland habitat quality and extents.

During the detailed design phase, micro-siting of the Project Area has occurred in order to reduce direct impacts to wetlands where practical. With the current DBC Project Area, four of the wetlands within the Survey Area are expected to be impacted (Table 21). It should be noted that predicted areas to be impacted are under worst-case scenario (no bridges).

Table 21 Direct impacts to wetlands – worst-case scenario

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
Murray Lagoon	HES Wetland	0.00
Yeppend Lagoon	HES Wetland	0.00
Total Clearing Area		**6.77**

Potential direct impacts to wetlands during construction include removal of wetland and riparian vegetation, cut and fill works for the construction of hardstands. These activities may lead to increased degradation of habitat values through salinization, sedimentation and decreased soil stability. Other construction impacts to wetland habitats include:

- Reduced water quality from point and non-point sources:
  - Large stockpiles of soil during construction may cause a direct influx of sediment in the surface water runoff from the work sites, particularly from areas of cleared vegetation
  - Increased nutrient input which may have flow on effects to vegetation and algal growth in the wetland
  - Contamination of hydrocarbons and other chemicals due to spills
- Stratification of temperature, dissolved oxygen and nutrients in the water column
- Changes to soil chemistry due to:
  - Importation of foreign soils
  - Exposure of subsoils
  - Exposure of acid sulfate soils
- Facilitation of the establishment of terrestrial and aquatic weed species, which may further degrade habitat value in fringing.

Potential impacts to each wetland during the construction phase are detailed in Table 22 below.

Table 22 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 Rd). 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.
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.

Wetland	Loss of Wetland Habitat during Construction
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 1). 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.
Murray Lagoon	This lagoon is adjacent but not within the Project Area. No direct impacts are expected.
Yeppen Lagoon	This lagoon is adjacent but not within the Project Area. No direct impacts are expected.

5.1.3 Fauna Mortality or Injury

Clearing of vegetation can result in injury or mortality of fauna, particularly ground dwelling fauna (e.g. reptiles), that may be crushed by machinery or struck by vehicles. Arboreal mammals may be trapped in trees as they are felled.

5.1.4 Introduced Species

It is unlikely that further introductions of feral vertebrate species would occur as a result of the Project. It is also unlikely that the proposed development would exacerbate current pest populations given they are well established in the region.

Weeds are already prevalent and distributed across the Project Area. However, there is a risk that disturbance to native vegetation, changes to microhabitat and mobilisation of earthmoving equipment and materials may introduce or exacerbate weeds within the Project Area. The RRR Flora Technical Report contains a detailed description of potential weed impacts and proposed mitigation measures (AECOM, 2019a).

A significant proportion of the land-use in the Project Area is pastoral grazing land. In the wetlands and adjacent riparian zones, continued incursion of livestock may further degrade these communities (specifically decreased soil stability, increased erosion potential and contamination). The presence of livestock will also hinder restoration efforts due to trampling and soil compaction.

Numerous feral species were also detected within the Project Area and the impacts associated with this were clearly evident in areas of remaining habitat areas. Construction activities can facilitate access by feral predators (such as wild dogs, cats and pigs) to areas of retained remnant vegetation and habitat. In addition, removal of habitat during construction may increase the predation risk of native fauna by feral predators due to increased exposure and changes in movement patterns. This is of particular significance for migratory shorebird species, which are at their most vulnerable point when they reach foraging grounds in Australia and are highly susceptible to predation by feral animals.

5.1.5 Activity and Noise

During the construction phase, there will be an increase in noise and activity in the Project Area as machinery undertakes clearing for access, foundations, bridge and tower erection activities. Impacts of activity and noise will be temporary and will not affect the entire Project Area simultaneously. However, when activity and noise is occurring in areas adjoining retained habitat, potential impacts may include the following:

- Reduced foraging ability by auditory predators due to increased background noise
- Increased risk of predation by visual predators due to increased background noise
- Increased potential for collisions with vehicles
- Human visitation causing disturbance to foraging or breeding behaviours i.e. fauna species which rely on aural cues to locate mates.

There are no government policies or other widely-accepted guidelines in respect to the noise levels which may be acceptable to wildlife. The levels or character of noise that may “startle” or otherwise affect the feeding or breeding pattern of birds or other wild animals are also not firmly established in the technical literature.

Sudden loud, impulsive or impact noises are capable of causing birds and other fauna to become startled, which if occurring over the longer term, may affect feeding and breeding behaviour in some species. It is expected that excavation, construction and earthmoving associated with the project will potentially cause disturbance to all groups of fauna, especially migratory shorebirds. Migratory shorebirds are at their most vulnerable point when they reach foraging grounds in Australia and can be more sensitive to changes in the environment such as noise levels. This will most likely result in avoidance of the area for the duration of these activities.

Artificial light can affect both nocturnal and diurnal animals by disrupting patterns, with quality of light (e.g. wavelength, colour), intensity and duration potentially evoking different responses. Impacts from increased light levels include: disorientation from or attraction toward artificial sources of light; mortality from collisions with structures; and, effects on light-sensitive cycles of species (e.g. breeding and migration for fauna and flowering in plants). An increase in artificial light can also increase the abundance and efficiency of predators. This could result in fauna avoiding some areas due to an increased perceived risk of predation and/or becoming more vulnerable to predation.

5.2 Operations Phase

Potential impacts on fauna and fauna habitat values during the operation of the Project include:

- Mortality or injury of fauna
- Avoidance of fauna due to increased lighting and noise
- Habitat degradation via surface water runoff contamination
- Loss of habitat values via altered surface hydrological regimes.

Each potential impact is described in greater detail below.

5.2.1 Hydrological Change and Potential Ecological Impact to Wetlands

Findings from the hydrological impact assessment completed by C&R Consulting indicate that no significant hydrological impacts including water quality, should occur to the wetlands within the Survey Area.

Nonetheless, surface hydrological regimes in the Project Area may be altered to some degree. As road surfaces are impervious, water run-off in areas adjacent to the Project Area is likely to increase and may be directed into wetlands. Both terrestrial and aquatic ecosystems have the potential to be impacted through changes to water flow paths, water quantities and quality.

Although it is considered unlikely to occur, increased water availability especially in ephemeral wetland systems could potentially have long-term negative impacts. Prolonged inundation can deplete oxygen levels in the root zone of wetland plants, leading to their death and the subsequent change in vegetation structure and habitat availability (Government of Western Australia, 2001). Increased surface water availability may also lead to a rise in the water table, in turn increasing the amount of dissolved salt in the water and reducing the extent of muddy margins needed by a variety of wading birds.

Where runoff is directed, higher peak flow rates in streams may occur. The increased frequency and magnitude of fast flowing water may reduce habitat values in this area (increased erosion and reduction in refuge), and ultimately become less suitable for a number of species (Austroads Inc., 2000).

Any potential changes to hydrological regime in HES wetlands as a consequence of construction (and constructability issues) and operation of the road will need to be confirmed to determine extent of impacts to wetlands and wetland dependent fauna species.

5.2.2 Habitat Degradation via Contamination

Contaminants created or deposited by vehicles using the Project may become suspended in run-off and drainage waters. Contaminants typical for a road include sediment, heavy metals, hydrocarbons, pesticides, and biological material such as faecal matter and seed (from the transportation of livestock). Deposition of contaminated runoff can particularly affect freshwater wetland communities which are dependent on specific water quality and chemistry characteristics.

Sediment and suspended solids are a significant road runoff pollutant in terms of ecological impacts (Austroads Inc., 2000). Water with a high level of sediment physically restricts plant respiration and the feeding of animals (Austroads Inc., 2000). Additionally, chemical pollutants (such as heavy metals and nutrients) can be absorbed by or travel with sediments.

When dissolved in the water, heavy metals and nutrients can lead to increased risk of eutrophication and algal blooms. Floating oil residues are also a common road pollutant and can prevent oxygenation of the water column needed for the respiration of aquatic fauna. Reduced biodiversity in wetland systems can result in trophic cascades.

5.2.3 Lighting and Noise

Once operational, the Project will have permanent lighting and generate ongoing noise from traffic. Potential impacts on fauna from lighting and noise will be similar to those discussed above in Section 5.1.5, with the main difference being the potential lower intensity (lack of construction activity) but longer duration and area of impact. High traffic volumes may be present along the Project at any one time.

Typically, fauna will move away from noise and light sources as these may be perceived as a threat. Acclimatisation by some species may occur over the medium to long term and many of the species identified in the Project Area are known to occur in areas subject to noise, light and general activity. However, it is possible that some habitats will no longer be used by certain species due to their already small size, disturbance during construction and close proximity to the Project (i.e. wetlands within and adjacent to the Project Area).

5.2.4 Mortality or Injury

Conflict between Project traffic and fauna is expected to occur, particularly in the areas that are not elevated (i.e. not the bridges). Once operational, the road corridor is likely to be used at all times (24 hours a day, seven days a week), and mortality or injury of fauna will be greater than during the construction phase.

Traffic is expected to be greatest during daylight hours, particularly during the morning and early evening when most people commute. Given this, reptiles are the fauna group most likely to be affected, as they utilise roads to gather warmth and seek prey. Macropods (kangaroos and wallabies) may also be impacted, primarily between sunset and sunrise.

Some birds, such as the squatter pigeon, the cumbersome pheasant coucal (*Centropus phasianinus*) and raptors feeding on carrion on the road side may also be involved in vehicle collisions.

6.0 Proposed Mitigation

The FRFRPS (December 2011) undertook a full options analysis for the Project. The outcome of the options analysis determined that the western road corridor was the preferred alignment, performing better under all three tests (effectiveness, feasibility and acceptability), with the main Project driver being long-term solutions for flooding impacts on freight, road and rail transport in and around the city of Rockhampton.

Due to limitations on placement within the Rockhampton region, avoiding the wetland areas was not a feasible option. Therefore, key environmental issues and constraints within the Project area, were taken into consideration as part of the Project alignment design, to minimise potential impacts to the environmental values where feasible.

6.1 Minimise

The main impacts expected during the operation and maintenance phase is to mapped wetlands adjacent to the Project Area. The C&R Consulting Wetlands Assessment findings have highlighted that high frequency (lower volume) flows (i.e. 1 in 1 up to a 1 in 10 events) across the floodplain are most important to ensuring the continued function of these wetlands.

The current design has incorporated numerous bridges and culverts at strategic locations in the Project area, allowing the low flow nature of the floodplain to continue to be maintained. As these hydrological patterns across the floodplain will be mostly unchanged, no significant changes to nutrient levels and water quality are expected to occur.

6.2 Mitigate

The following mitigation measures for each stage of the Project are proposed:

Detailed design phase

- Proposed bridges should be designed such that opening areas are wide enough to provide opportunity for dry fauna crossing, which is identified as a design requirement for terrestrial species in the Fauna Sensitive Road Design Manual
- Fauna-sensitive road design principles will be considered to reduce the impact of vehicle collision, particularly for threatened species
- Retain habitat trees where possible
- Lighting for the Project will be designed in accordance relevant standards and where practical, avoid unnecessary light spill into the adjoining areas.

Construction phase

- Disturbance to microhabitat features to be avoided wherever possible. These include – large woody debris, hollow logs, hollow bearing trees, dense ground cover. Where this is not possible, retaining and relocating microhabitat features such as felled trees and logs to other areas will be considered
- Progressive vegetation clearing will be staged to coincide with the Project construction program and providing fauna with the opportunity to relocate
- Suitably qualified fauna spotter catchers must be engaged to undertake pre-clearance habitat searches and be present during vegetation clearing activities to minimise fauna harm
- Any injured, sick and dead vertebrate fauna will be recorded before (by fauna spotter-catchers), during and after clearing and operation
- No-go zones will be clearly identified to avoid unauthorised disturbance of areas of sensitive vegetation and habitat adjacent to the Project area that will be retained; such as riparian zones associated with waterways and wetlands and other threatened species and migratory species habitat

- On TMR owned or managed properties, new fencing should be erected at lot boundaries to exclude cattle from riparian and wetland communities
- Develop appropriate spill prevention and response plans to cover Project activities and the types and quantities of fuel, oil and chemicals held at each site
- Temporary site offices, stockpiling/laydown areas, plant and equipment storage areas will be located away from waterbodies and within already cleared or disturbed areas
- Lighting for construction will be designed in accordance relevant standards and where practical, avoid unnecessary light spill into the adjoining areas

  Strategies and management measures (such as construction setbacks) will be developed and implemented in areas of migratory species habitat to minimise impacts on foraging and roosting migratory species
- Clearing and driving machinery within watercourses and their banks and wetlands will be minimised wherever possible
- Crossings at watercourses or wetlands and use existing crossings where present
- Construction works at night near sensitive environments (such as threatened and migratory terrestrial and aquatic species habitat), will be avoided wherever possible
- Implement a Water Quality Monitoring Program, to compare pre and post construction water quality and determine extent of Project related impacts
- If a koala is found prior to or during clearing activities, it must not be forcibly relocated. Any tree that has a koala present, as well as any tree with its crown overlapping that tree, must not be removed and remain in place until the koala vacates the tree of its own accord
- Rehabilitation works will be undertaken in accordance with TMR specification for Landscape and Revegetation Works and include a revegetation strategy.

Operational phase

- Erosion control requirements should be utilised for permanent structures, where required
- Weed and pest management measures will be implemented which at a minimum should include:
  - management methods to control spread of weed species (including but not limited to *Parthenium hysterophorus, Parkinsonia aculeata, Lantana camara, Cryptostegia grandiflora*), in keeping with regional management practice or Queensland Department of Agriculture and Fisheries pest control prescriptions;
  - ongoing monitoring of the Project Area to identify any new incidence of weed infestation;
  - methods for weed eradication from the site in accordance with local management practice and/or the Queensland Government Pest Fact sheets;
  - monitoring of weeds and pests throughout the Project Area.

6.3 Manage

The following management plans will be prepared outlining best practice industry measures to address potential environmental impacts that may arise during the construction and operational phase of the Project:

- A Species Management Plan will be developed for relevant threatened and migratory species, including the Latham's Snipe
- A Weed and Pest Management Plan will be developed and implemented to mitigate and manage the potential spread of pest fauna and flora species
- If disruption or removal of any animal breeding places is anticipated, it will be the Contractor's responsibility to undertake activities in accordance with the TMR 'Low Risk' Species Management Program (SMP), and any other relevant species specific SMPs, for tampering with animal

breeding places that is being used by a protected animal to incubate or rear offspring. This may be a 'High Risk' SMP for EVNT and/or colonial breeders, or a 'Low Risk' for least concern fauna

- An Erosion and Sediment Control Plan inclusive of construction and operation of the road will be prepared to manage potential sedimentation impacts
- A Construction Environmental Management Plan (CEMP) will be prepared to provide to address all relevant environmental protection matters below.
  - water quality
  - erosion and sedimentation
  - cultural heritage
  - noise and vibration
  - air quality
  - acid sulfate soils
  - contaminated sites
  - native fauna and vegetation
  - biosecurity
  - waste
  - chemicals and fuels
  - sourcing of construction materials.

7.0 Significant Impact Assessment

The potential impacts outlined in Section 5.0 may also impact threatened and migratory species, primarily through habitat loss and degradation.

An assessment to determine whether the Project is likely to have a significant impact on any threatened or migratory species 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) and the EPBC Act Policy Statement 3.21 '*Significant Impact Guidelines for 36 Migratory Shorebird Species'* (Department of the Environment and Energy, 2017). The full assessment is provided in Table 28 to Table 60 of Appendix C.

These assessments determined that the Project has the potential to significantly impact the listed migratory species, Latham's snipe. Given this result, a referral to the Commonwealth Environment Minister under the EPBC Act is recommended.

8.0 Conclusion

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

- A total of 136 fauna species were recorded during the survey, comprising 105 bird species, 18 mammals, nine reptiles and four amphibians.
- Five migratory species were recorded within the Survey Area:
  - Latham's snipe (*Gallinago hardwickii*); Migratory under the EPBC Act
  - Caspian tern (*Hydroprogne caspia*); Migratory under the EPBC Act
  - Eastern osprey (*Pandion cristatus*); Migratory under the EPBC Act
  - Glossy ibis (*Plegadis falcinellus*); Migratory under the EPBC Act
  - Marsh sandpiper (*Tringa stagnatilis*); Migratory under the EPBC Act.
- The fauna surveys identified a range of habitat values suitable to support both conservation significant and Least Concern species. Seven habitat types (comprising eight REs and non-remnant vegetation) were recorded within the Project Area.
- Wetlands, although modified, were identified to support the roosting and foraging of a number of migratory bird species. Final input from the Project's hydrological assessment will be required before potential impacts to these habitats can be finalised
- Wetlands and some riparian zones investigated during the field survey provided some microhabitat features suitable for the ornamental snake. However, habitat was considered to be marginal due to the abundance of cane toads, low abundance of woody debris, heavy weed infestation and lack of gilgai formation or brigalow communities. Limitations apply to this survey and are discussed below.
- Eleven conservation significant and ten migratory species are considered to have a moderate or high likelihood of occurring in the Project Area based on the habitat assessed during the field surveys.
- A number of potential impacts to flora and fauna 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.
- The significant impact assessment determined that the Project has the potential to significantly impact the listed migratory species, Latham's snipe. Given this result, a referral under the EPBC Act is recommended and offsets may be required.

Some limitations apply to this assessment and should be noted.

Although targeted surveys were conducted as per the EPBC Act *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (Department of the Environment and Energy, 2017), climatic conditions at the time were not conducive to high detectability and not ideal. Additional targeted surveys under ideal climatic conditions may allow for a more representative assessment of wetland habitat quality and extent, as well as potential species utilisation of such habitats.

9.0 References

AECOM. (2019a). *Rockhampton Ring Road - Flora and Wetlands Technical Report*.

AECOM. (2019b). *Rockhampton Ring Road - Threatened Turtle & Fish Habitat Assessment*.

Austroads Inc. (2000). *Road Runoff and Drainage: Environmental Impacts and Management Options*. Retrieved from www.austroads.com.au

BirdLife International. (2019). Important Bird Areas factsheet: Fitzroy Floodplain and Delta. Retrieved from http://www.birdlife.org

Bureau of Meteorology. (2019a). Climate Data Online. Retrieved from http://www.bom.gov.au/climate/data/index.shtml

Bureau of Meteorology. (2019b). Climate Statistics for Australian Locations. Retrieved from http://www.bom.gov.au/climate/data/?ref=ftr

Cann, J. (1998). *Australian Freshwater Turtles*. Beaumont Publishing Pty Ltd.

Cogger, H. G., Cameron, E. E., Sadlier, R. A., & Eggler, P. (1993). *The Action Plan for Australian Reptiles*. Retrieved from http://www.environment.gov.au/biodiversity/threatened/action/reptiles/index.html

Department of Environment and Energy. (2019). Crocodylus porosus — Salt-water Crocodile, Estuarine Crocodile. Retrieved June 25, 2019, from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1774

Department of Environment and Resource Management. (2011). *Queensland Wetland Buffer Planning Guideline*. Retrieved from https://wetlandinfo.des.qld.gov.au/resources/static/pdf/resources/reports/buffer-guide/wetland-buffer-guideline-14-04-13.pdf

Department of Sustainability, Environment, Water, P. and C. (2011). *Survey guidelines for Australia's threatened reptiles: guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Retrieved from Australian Government website: www.ag.gov.au/cca.

Department of Sustainability Environment Water Population and Communities. (2011). *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles*. Retrieved from www.environment.gov.au/epbc/.

Department of the Environment, Water, H. and the A. (2008). *Approved Conservation Advice for Rheodytes leukops (Fitzroy Tortoise)*. Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/1761-conservation-advice.pdf

Department of the Environment. (2014). *EPBC Act Referral Guidelines for the Vulnerable Koala*. Commonwealth of Australia.

Department of the Environment. (2015a). *Referral guideline for 14 birds listed as migratory species under the EPBC Act*. Retrieved from http://www.environment.gov.au/system/files/resources/c05f5b87-0a99-4998-897e-7072c236cf83/files/migratory-birds-draft-referral-guideline.pdf

Department of the Environment. (2015b). *Wildlife Conservation Plan for Migratory Shorebirds*. Retrieved from Commonwealth of Australia website: www.environment.gov.au/resource/wildlife-conservat

Department of the Environment. (2019). *Species Profile and Threats Database*. Retrieved from http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Department of the Environment and Energy. (2017). *EPBC Act Policy Statement 3.21: Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird*

species. Retrieved from Commonwealth of Australia website: http://www.environment.gov.au/system/files/resources/67d7eab4-95a5-4c13-a35e-e74cca47c376/files/bio4190517-shorebirds-guidelines.pdf

Department of the Environment Water Heritage and the Arts. (2013). *Matters of National Environmental Significance: Significant Impact Guildelines 1.1*. Canberra.

DoEE. (n.d.). Crocodylus porosus - salt-water crocodile, estuarine crocodile. Retrieved November 10, 2019, from SPRAT website: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=1774

DotEE. (2019). Pandion cristatus - Eastern Osprey.

Eby, P. (1991). Seasonal Movements of Grey-headed Flying-foxes Pteropus poliocephalus (Chiroptera: Pteropodidae), from Two Maternity Camps in Northern New South Wales. *Wildlife Research*, *18*, 547–559.

Eby, P., & Lunney, D. (2002). Managing the Grey-headed Flying-fox as a threatened species in NSW. *Proceedings of the Royal Zoological Society of New South Wales*. Mosman, Sydney: Royal Zoological Society of New South Wales.

Eyre, T. J., Ferguson, D. J., Hourigan, C. l., Smith, G. C., Mathieson, M. T., Kelly, A. L., … Rowland, J. (2018). *Terrestrial Vertebrate Fauna Survey Guidelines*. Brisbane.

Government of Western Australia. (2001). *Living Wetlands: An Introduction to Wetlands*. Retrieved from http://www.water.wa.gov.au/__data/assets/pdf_file/0016/5380/11420.pdf

Higgins, P. J., & Davies, S. J. J. F. (1996a). *Handbook of Australian, New Zealand & Antarctic Birds*. *3*, 104–113.

Higgins, P. J., & Davies, S. J. J. F. (1996b). *Handbook of Australian, New Zealand and Antarctic Birds. Volume 3: Snipes to Pigeons*. Melbourne, Victoria: Oxford University Press.

Leach, G.J., Delaney, R., Fukuda, Y. (2009). *Management Program for the Saltwater Crocodile in the Northern Territory of Australia, 2012-2014*. Retrieved from https://www.environment.gov.au/system/files/consultations/229bce33-342a-4304-bd0f-9f2ccf1e76ce/files/nt-crocodile-management-plan.pdf

Legler, J. M., & Cann, J. (1980). A new genus and species of chelid turtle from Queensland, Australia. *Contributions in Science*, *324*, 1–18. Retrieved from https://www.biodiversitylibrary.org/part/241260

Limpus, C. (2008). *Freshwater Turtles in the Mary River, Queensland - Review of biological data for turtles in the Mary River, with emphasis on Elusor macrurus and Elseya albagula*. Retrieved from https://environment.des.qld.gov.au/wildlife/pdf/mary-river-turtles.pdf

Limpus, C. (2011). *The biology and management strategies for freshwater turtles in the Fitzroy Catchment, with particular emphasis on Elseya albagula and Rheodytes leukops*. Brisbane.

McGregor, M., & Burnett, S. (2014). Proximity to coarse woody debris increases reptile presence in an Australian subtropical rainforest remnant. *Australian Zoologist*, *37*(2), 267–274. https://doi.org/10.7882/AZ.2014.004

NSW National Parks and Wildlife Service. (1999). *Natural Tree Hollows*.

Office of Environment and Heritage. (n.d.). Freshwater mussels. Retrieved March 22, 2019, from https://www.environment.nsw.gov.au/topics/animals-and-plants/native-animals/native-animal-facts/freshwater-mussels

Office of Environment and Heritage. (2011). *Freshwater mussels in coastal streams in New South Wales*. Retrieved from www.environment.nsw.gov.au/animals/NativeAnimalFactSheetsByTitle.htm,

Queensland Wetlands Program. (2013). *Fitzroy coastal floodplain wetlands*. Australian and Queensland governments.

Read, M. A., Miller, J. D., Bell, I. P., & Felton, A. (2004). the distribution and abundance of the estuarine crocodile, Crocodylus porosus, in Queensland. *Wildlife Research*, *31*, 527–534.

Sattler, P., & Williams, R. (1999). *The Conservation Status of Queensland's Bioregional Ecosystems* (R. Sattler, P., Williams, Ed.). Brisbane: Environmental Protection Agency, Queensland Government.

Tarburton, M. K. (1993). Radio Tracking a White-throated Needletail to roost. *Emu*, *93*, 121–124.

Thomson, S., Georges, A., & Limpus, C. J. (2006). A New Species of Freshwater Turtle in the Genus Elseya (Testudines: Chelidae) from Central Coastal Queensland, Australia. *Chelonian Research Foundation*, *5*(2), 323–325. https://doi.org/10.2744/1071-8443(2006)5

Threatened Species Scientific Committee. (2001). Commonwealth Listing Advice on Pteropus poliocephalus (Grey-headed Flying-fox). Retrieved from http://www.environment.gov.au/biodiversity/threatened/conservation-advices/pteropus-poliocephalus

Threatened Species Scientific Committee. (2011). *Commonwealth Listing Advice on Botaurus poiciloptilus (Australasian bittern)*. Canberra, A.C.T.

Threatened Species Scientific Committee. (2014). *Conservation Advice - Elseya albagula (White-throated snapping turtle)*. Retrieved from http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Threatened Species Scientific Committee. (2019a). *Conservation Advice: Hirundapus caudacutus (white-throated needletail)*. Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/682-conservation-advice-04072019.pdf

Threatened Species Scientific Committee. (2019b). *Conservation Advice - Botaurus poiciloptilus (Australasian Bittern)*. Retrieved from http://dx.doi.org/10.2305/IUCN.UK.2014-2.RLTS.T22697353A62652637.en

Tidemann, C. (1998). Grey-headed Flying-fox, Pteropus poliocephalus, Temminck, 1824. In R. Strahan (Ed.), *The Mammals of Australia*. Frenchs Forest: New Holland Publishers Pty Ltd.

Todd, E. V, Blair, D., Farley, S., Farrington, L., Fitzsimmons, N. N., Georges, A., … Jerry, D. R. (2013). Contemporary genetic structure reflects historical drainage isolation in an Australian snapping turtle, Elseya albagula. *Zoological Journal of the Linnean Society*, *169*, 200–214. https://doi.org/10.1111/zoj.12049

Tucker, A. D., Limpus, C. J., Priest, T. E., Cay, J., Glen, C., & Guarino, E. (2001). Home ranges of Fitzroy River turtles (Rheodytes leukops) overlap riffle zones: potential concerns related to river regulation. *Biological Conservation*, *102*, 171–181.

Venz, M. F., Mathieson, M., & Schulz, M. (2002). *Fauna of the Lower Dawson Floodplain - An Assessment of Fauna Downstream of the Proposed Nathan Dam*. https://doi.org/10.13140/RG.2.1.1848.1041

Appendix A

Fauna Species List

Appendix A Fauna Species List

Table 23 Fauna species list for February 2019 survey

Scientific Name	Common Name	Habitat						
		1	2	3	4	5	6	7
Birds								
Anas gracilis	Grey teal		X					
Anas superciliosa	Pacific black duck		X					X
Anhinga novaehollandiae	Australasian darter		X	X				
Anseranas semipalmata	Magpie goose		X	X				X
Anthus novaeseelandiae	Australasian pipit							X
Aprosmictus erythropterus	Red-winged parrot			X				X
Aquila audax	Wedge-tailed eagle		X					
Ardea ibis	Cattle egret			X				X
Ardea intermedia	Intermediate egret		X	X				
Ardea modesta	Eastern great egret		X					
Artamus leucorynchus	White-breasted woodswallow			X				
Aythya australis	Hardhead		X	X				
Cacatua galerita	Sulphur-crested cockatoo							X
Cacatua sanguinea	Little corella							X
Calyptorhynchus banksii	Red-tailed black-cockatoo							X
Centropus phasianinus	Pheasant coucal	X					X	X
Chenonetta jubata	Australian wood duck		X					
Chlidonias hybrida	Whiskered tern		X					

Scientific Name	Common Name	Habitat						
		1	2	3	4	5	6	7
Cisticola exilis	Golden-headed cisticola			X				X
Coracina novaehollandiae	Black-faced cuckoo-shrike	X						X
Corcorax melanorhamphos	White-winged chough	X		X	X			
Corvus orru	Torresian crow	X						X
Coturnix ypsilophora	Brown quail	X						
Cracticus nigrogularis	Pied butcherbird		X					X
Cracticus torquatus	Grey butcherbird							
Cracticus tibicen	Australian magpie	X						X
Cygnus atratus	Black swan		X					
Dacelo leachii	Blue-winged kookaburra			X				
Dacelo novaeguineae	Laughing kookaburra					X		
Daphoenositta chrysoptera	Varied sittella					X		
Dendrocygna arcuata	Wandering whistling-duck		X					
Dendrocygna eytoni	Plumed whistling-duck		X					X
Dicaeum hirundinaceum	Mistletoebird	X						X
Dicrurus bracteatus	Spangled drongo	X				X		
Dromaius novaehollandiae	Emu							X
Egretta garzetta	Little egret		X					
Egretta novaehollandiae	White-faced heron		X					
Elseyornis melanops	Black-fronted dotterel		X					
Entomyzon cyanotis	Blue-faced honeyeater					X		
Ephippiorhynchus asiaticus	Black-necked stork			X				

Scientific Name	Common Name	Habitat						
		1	2	3	4	5	6	7
Eudynamys orientalis	Eastern koel							X
Eurystomus orientalis	Dollarbird	X						
Falco berigora	Brown falcon			X				X
Falco cenchroides	Nankeen kestrel							X
Fulica atra	Eurasian coot		X					
Gallinago hardwickii	Latham's snipe		X					
Gallinula tenebrosa	Dusky moorhen		X	X				
Geopelia striata	Peaceful dove	X				X		X
Gerygone albogularis	White-throated gerygone	X						
Grallina cyanoleuca	Magpie-lark	X		X				X
Grus rubicunda	Brolga		X					
Haliaeetus leucogaster	White-bellied sea-eagle		X					
Haliastur sphenurus	Whistling kite		X					X
Himantopus himantopus	Black-winged stilt		X					
Hirundo neoxena	Welcome swallow		X					
Hydroprogne caspia	Caspian tern		X					
Irediparra gallinacea	Comb-crested jacana		X	X				
Lichmera indistincta	Brown honeyeater		X					
Lonchura castaneothorax	Chestnut-breasted mannikin							X
Malacorhynchus membranaceus	Pink-eared duck		X					
Malurus melanocephalus	Red-backed fairy-wren	X	X			X		X
Manorina melanocephala	Noisy miner	X				X		X

Scientific Name	Common Name	Habitat						
		1	2	3	4	5	6	7
Melithreptus albogularis	White-throated honeyeater		X					
Merops ornatus	Rainbow bee-eater	X						
Microcarbo melanoleucos	Little pied cormorant		X					
Milvus migrans	Black kite	X	X					
Mirafra javanica	Horsfield's bushlark							X
Nectarinia jugularis	Olive-backed sunbird		X					
Nettapus coromandelianus	Cotton pygmy-goose		X					
Ocyphaps lophotes	Crested pigeon	X		X				X
Oriolus sagittatus	Olive-backed oriole					X		
Pachycephala rufiventris	Rufous whistler							X
Pandion cristatus	Eastern osprey		X					
Pelecanus conspicillatus	Australian pelican		X					
Phalacrocorax carbo	Great cormorant		X					
Phalacrocorax sulcirostris	Little black cormorant		X	X				
Phalacrocorax varius	Pied cormorant		X					
Phasianus colchicus	Common pheasant					X		
Philemon citreogularis	Little friarbird	X						X
Platalea flavipes	Yellow-billed spoonbill		X					
Platalea regia	Royal spoonbill		X	X				
Platycercus adscitus	Pale-headed rosella	X						X
Plegadis falcinellus	Glossy ibis		X	X				
Podargus strigoides	Tawny frogmouth							X

Scientific Name	Common Name	Habitat						
		1	2	3	4	5	6	7
Podiceps cristatus	Great crested grebe		X					
Pomatostomus temporalis	Grey-crowned babbler							X
Porphyrio porphyrio	Purple swamphen		X					
Rhipidura leucophrys	Willie wagtail		X		X			X
Scythrops novaehollandiae	Channel-billed cuckoo		X					X
Sphecotheres vieilloti	Australasian figbird							X
Streptopelia chinensis	Spotted dove							X
Struthidea cinerea	Apostlebird							X
Sturnus tristis	Common myna*							X
Tachybaptus novaehollandiae	Australasian grebe		X	X				
Taeniopygia bichenovii	Double-barred finch							X
Threskiornis molucca	Australian white ibis		X	X				
Threskiornis spinicollis	Straw-necked ibis			X				
Todiramphus macleayii	Forest kingfisher	X			X			
Todiramphus sanctus	Sacred kingfisher	X	X		X			
Trichoglossus chlorolepidotus	Scaly-breasted lorikeet	X		X				
Trichoglossus haematodus	Rainbow lorikeet	X	X			X		X
Tringa stagnatilis	Marsh sandpiper		X					
Turnix maculosus	Red-backed buttonquail			X				
Tyto javanica	Eastern barn owl							X
Vanellus miles	Masked lapwing		X	X				X

Scientific Name	Common Name	Habitat						
		1	2	3	4	5	6	7
Mammals								
Chaerephon jobensis	Northern mastiff bat							
Chalinolobus gouldii	Gould's wattled bat							
Chalinolobus nigrogriseus	Hoary wattled bat							
Felis catus	Cat*							X
Lepus capensis	Brown hare*							X
Macropus agilis	Agile wallaby	X	X					
Macropus giganteus	Eastern grey kangaroo	X		X				
Miniopterus australis	Little bent-wing bat							
Miniopterus orianae	Australasian bent-wing bat							
Oryctolagus cuniculus	European rabbit*							X
Ozimops lumsdenae	Northern free-tailed bat							
Ozimops ridei	Ride's free-tailed bat							
Petaurus norfolcensis	Squirrel glider							
Pteropus alecto	Black flying-fox							X
Scotorepens sanborni	Nothern broad-nosed bat							
Sus scrofa	Feral pig*	X						X
Trichosurus vulpecula	Common brushtail possum							X
Vulpes vulpes	Red fox*		X					
Amphibians								
Litoria fallax	Eastern sedge frog			X				
Litoria rothii	Roth's tree frog		X	X				

Scientific Name	Common Name	Habitat						
		1	2	3	4	5	6	7
Litoria rubella	Desert tree frog	X	X					
Rhinella marina	Cane toad*		X	X		X		X
Reptiles								
Cryptoblepharus virgatus	Wall skink					X		X
Dendrelaphis punctulatus	Common tree snake							X
Emydura macquarii krefftii	Krefft's river turtle		X	X		X		
Ghehyra dubia	Dubious dtella					X		
Hemidactylus frenatus	Asian house gecko*					X		
Pogona barbata	Eastern bearded dragon	X						
Pseudonaja textilis	Eastern brown snake							X
Tropidonophis mairii	Keelback		X	X				

* Invasive species

Table 24 Waterbird species observed during field surveys

Scientific Name	Common Name	Conservation Status (NC Act, EPBC Act)	Wetland					
			Pink Lily Lagoon	Lotus Lagoons	Dunganweate Lagoon	Nelson Lagoon	Murray Lagoon	Yeppen Lagoon
Anas gracilis	Grey Teal	Least Concern, -	X	X		X		
Anas superciliosa	Pacific Black Duck	Least Concern, -		X		X		X
Anhinga novaehollandiae	Australasian darter	Least Concern, -	X	X	X		X	
Ardea ibis	Cattle egret	Least Concern, -	X	X				
Ardea intermedia	Intermediate egret	Least Concern, -	X	X				
Ardea modesta	Eastern great egret	Least Concern, -		X	X		X	X
Aythya australis	Hardhead	Least Concern, -				X	X	X
Chenonetta jubata	Australian wood duck	Least Concern, -		X	X	X	X	X
Chlidonias hybrida	Whisked tern	Least Concern, -	X				X	
Cygnus atratus	Black swan	Least Concern, -		X	X	X	X	
Dendrocygna arcuata	Wandering whistling-duck	Least Concern, -	X					
Dendrocygna eytoni	Plumed whistling-duck	Least Concern, -	X					
Egretta garzetta	Little egret	Least Concern, -		X	X	X		X
Egretta novaehollandiae	White-faced heron	Least Concern, -	X					X
Elseyornis melanops	Black-fronted dotterel	Least Concern, -	X	X	X			
Ephippiorhynchus asiaticus	Black-necked stork	Least Concern, -		X				
Fulica atra	Eurasian coot	Least Concern, -						

Scientific Name	Common Name	Conservation Status (NC Act, EPBC Act)	Wetland					
			Pink Lily Lagoon	Lotus Lagoons	Dunganweate Lagoon	Nelson Lagoon	Murray Lagoon	Yeppen Lagoon
Gallinago hardwickii	Latham's snipe	Special Least Concern, Migratory	X					
Gallinula tenebrosa	Dusky moorhen	Least Concern, -	X	X			X	
Grus rubicunda	Brolga	Least Concern, -			X			
Himantopus himantopus	Black-winged stilt	Least Concern, -	X	X				
Hydroprogne caspia	Caspian tern	Special Least Concern, Migratory	X			X	X	
Irediparra gallinacea	Comb-crested jacana	Least Concern, -		X				
Litoria fallax	Eastern sedge frog	Least Concern, -	X	X				
Litoria rothii	Roth's tree frog	Least Concern, -	X					
Litoria rubella	Desert tree frog	Least Concern, -	X					
Malacorhynchus membranaceus	Pink-eared duck	Least Concern, -						
Microcarbo melanoleucos	Little pied cormorant	Least Concern, -	X		X			X
Nettapus coromandelianus	Cotton Pygmy-goose	Least Concern, -	X			X		
Pandion cristatus	Eastern osprey	Special Least Concern, Migratory						X
Pelecanus conspicillatus	Australian pelican	Least Concern, -	X	X	X	X	X	
Phalacrocorax carbo	Great cormorant	Least Concern, -		X				
Phalacrocorax sulcirostris	Little black cormorant	Least Concern, -	X	X	X		X	X

Scientific Name	Common Name	Conservation Status (NC Act, EPBC Act)	Wetland					
			Pink Lily Lagoon	Lotus Lagoons	Dunganweate Lagoon	Nelson Lagoon	Murray Lagoon	Yeppen Lagoon
Phalacrocorax varius	Pied cormorant	Least Concern, -	X	X	X	X	X	X
Philemon citreogularis	Little friarbird	Least Concern, -		X	X			
Platalea flavipes	Yellow-billed spoonbill	Least Concern, -	X	X				
Platalea regia	Royal spoonbill	Least Concern, -	X	X				X
Plegadis falcinellus	Glossy ibis	Special Least Concern, Migratory	X	X		X		
Podiceps cristatus	Great crested grebe	Least Concern, -						X
Porphyrio porphyrio	Purple swamphen	Least Concern, -	X				X	
Tachybaptus novaehollandiae	Australasian grebe	Least Concern, -	X	X				
Threskiornis molucca	Australian white ibis	Least Concern, -	X	X		X		X
Threskiornis spinicollis	Straw-necked ibis	Least Concern, -						
Tringa stagnatilis	Marsh sandpiper	Special Least Concern, Migratory	X				X	
Vanellus miles	Masked lapwing	Least Concern, -	X	X	X	X		X

Microbat Call Identification Report

Prepared for ("Client"):	AECOM
Survey location/project name:	Rockhampton area
Survey dates:	6-14 February 2019
Client project reference:	60593305 Task OA04
Job no.:	AEC-1901
Report date:	26 March 2019

Methods

Data received

Balance! Environmental received 6395 full-spectrum acoustic files (WAV format), recorded on three Song Meter SM2BAT detectors (Wildlife Acoustics, Maynard MA, USA) between 6th and 14th February 2019.

Bat-call analysis and species identification

Call analyses were performed using the Cluster Analysis function of Wildlife Acoustics' *Kaleidoscope Pro* (Version 5.1.8), which scanned the WAV files and automatically clustered detected bat-calls into groups with similar pulse-characteristics (based on zero-crossing analysis). All clusters were then manually scanned in spectrogram view and allocated either to single species or groups of difficult-to-differentiate species ("unresolved calls").

Manual verification of call identities was based on comparison of call spectrograms and derived metrics with those of reference calls from central and southern Queensland and/or with published call descriptions (e.g. Reinhold et al. 2001). Consideration was also given to the probability of species' occurrence based on published distribution information (e.g. Churchill 2008; van Dyck *et al.* 2013) and on-line database records (e.g. http://www.ala.org.au).

Species identification was based largely on sequences of more than four search-phase pulses; however, where good-quality foraging sequences were available (*i.e.* a call sequence with contiguous search-phase, attack-phase and feeding-buzz components), those calls were used to provide additional evidence of some species' presence. The feeding buzzes of Molossids (free-tailed bats) and Miniopterids (bent-winged bats) are quite distinctive, compared with those of Vespertilionids (vesper bats) with which they often share search-phase characteristics (Corben 2010).

Reporting standard

The format and content of this report follows Australasian Bat Society standards for the interpretation and reporting of bat call data (Reardon 2003), available on-line at http://www.ausbats.org.au/.

Species nomenclature follows Jackson & Groves (2015).

Results & Discussion

The cluster analysis recognised 4395 distinct bat calls and grouped them into 40 clusters. Verification of call identities in those clusters resulted in the aggregation of several clusters that contained call-variants of the same species; however, some clusters were further subdivided due to the presence of multiple species' calls that were obvious to the experienced observer.

Eight call types were reliably identified to the following species:

- *Chalinolobus gouldii;*
- *C. nigrogriseus;*
- *S. sanborni;*
- *Miniopterus australis;*
- *M. orianae;*
- *Chaerephon jobensis;*
- *Ozimops lumsdenae;* and
- *Saccolaimus flaviventris.*

Another two distinct call-types represented at least two and potentially five additional species. These were allocated to the following species groups:

- *Nyctophilus bifax / N. geoffroyi / N. gouldi;* and
- *Chalinolobus morio / Vespadelus troughtoni*.

Table 1 provides a summary of species recorded at each survey location. A full breakdown of the number of calls allocated to each species or unresolved group per location is provided in **Appendix 1**. **Appendix 2** includes sample spectrograms of all identified call types recorded during this survey.

In addition to the two undifferentiated species groups listed above, numerous unresolved calls were allocated to seven other multi-species groups. All but one of these groups represented species that were otherwise positively identified from more definitive calls. One unresolved group contained calls that potentially represented an additional species (*Scotorepens balstoni*), but they could equally have belonged to *C. gouldii*.

Where calls were attributed to unresolved species groups, the presence of all group members is shown as "possible" in **Table 1** unless one or more group members were also reliably identified from other calls.

Table 1 Microbat species recorded during the Rockhampton survey, 6-14 February 2019.

♦ = 'definite' - at least one call was attributed unequivocally to the species
□ = 'possible' - calls like those of the species were recorded, but were not reliably identified

Detector & location:	SM1 Location 1	SM1 Location 2	SM3 Location 1	SM3 Location 2	SM4 Location 1
Chalinolobus gouldii	♦	♦	♦	♦	♦
Chalinolobus morio	□		□		□
Chalinolobus nigrogriseus	♦	♦	♦	♦	♦
Nyctophilus sp.	♦	♦	♦		♦
Scotorepens balstoni	□	□	□	□	
Scotorepens sanborni	□	♦	♦	□	□
Vespadelus troughtoni	□		□		□
Miniopterus australis	♦	♦	♦	♦	♦
Miniopterus orianae	♦	♦	♦	♦	♦
Chaerephon jobensis	♦	♦	♦	♦	
Ozimops lumsdenae	♦	♦	♦	□	□
Ozimops ridei	♦	♦	♦	♦	♦

References

Churchill, S. (2008). *Australian Bats.* Jacana Books, Allen & Unwin; Sydney.

Corben, C. (2010). Feeding Buzzes. *Australasian Bat Society Newsletter* **35**, 40-44.

Jackson, S. and Groves, C. (2015). *Taxonomy of Australian Mammals*. CSIRO Publishing, Melbourne.

Reardon, T. (2003). Standards in bat detector based surveys. *Australasian Bat Society Newsletter* **20**, 41-43.

Reardon, T., Adams, M., McKenzie, N. and Jenkins, P. (2008). A new species of Australian freetail bat *Mormopterus eleryi* sp. nov. (Chiroptera: Molossidae) and a taxonomic reappraisal of *M. norfolkensis* (Gray). *Zootaxa* **1875**: 1-31.

Reardon, T. B., McKenzie, N. L., Cooper, S. J. B., Appleton, B., Carthew, S. and Adams, M. (2014). A molecular and morphological investigation of species boundaries and phylogenetic relationships in Australian free-tailed bats *Mormopterus* (Chiroptera: Molossidae). *Aust. J. Zool*. **62**, 109–136.

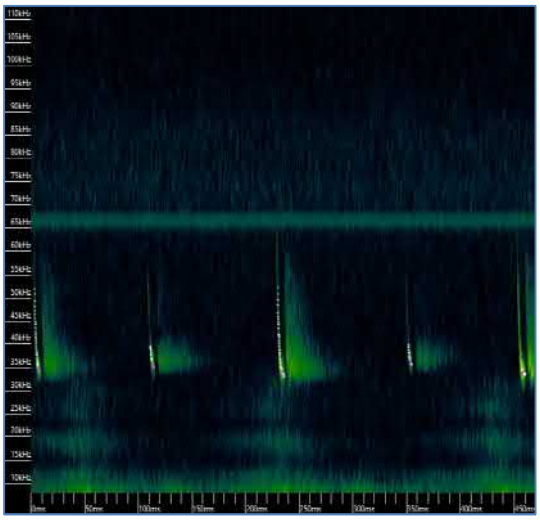
Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the bat calls of south-east Queensland and north-east New South Wales*. Department of Natural Resources and Mines, Brisbane.

van Dyck, S., Gynther, I. and Baker, A. (ed.) (2013). *Field Companion to the Mammals of Australia*. New Holland; Sydney.

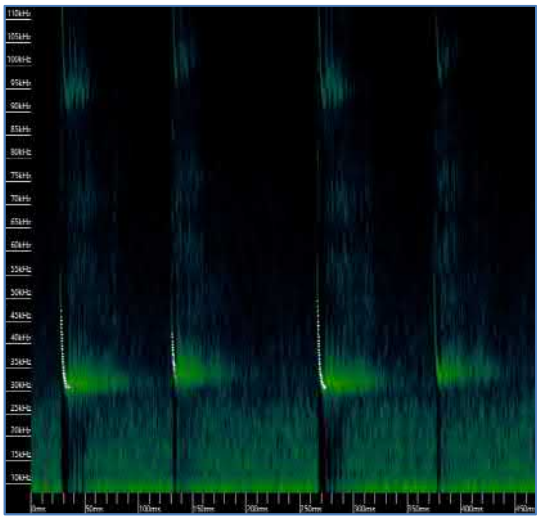
Appendix 1 Number of bat-calls attributed to each species or unresolved group for the Rockhampton survey, 6-14 February 2019.

Detector & location:	SM1 Loc. 1	SM1 Loc. 2	SM3 Loc. 1	SM3 Loc. 2	SM4 Loc. 1	Species Total
Positively identified calls						
Chalinolobus gouldii	93	26	27	5	9	160
Chalinolobus nigrogriseus	78	24	64	7	1	174
Scotorepens sanborni		1	8			9
Miniopterus australis	1526	235	274	28	45	2108
Miniopterus orianae	62	62	183	18	9	334
Chaerephon jobensis	41	4	42	2		89
Ozimops lumsdenae	70	2	5			77
Ozimops ridei	156	69	109	8	9	351
Unresolved calls						
C. gouldii / O. lumsdenae	27	4	15		3	49
C. gouldii / O. ridei	76	18	16	3	5	118
C. gouldii / O. ridei / S. balstoni	31	7	2	2		42
C. jobensis / O. lumsdenae	173	4	1	1		179
C. nigrogriseus / S. sanborni	125	105	225	9	10	474
Nyctophilus sp.	27	4	10		1	42
S. sanborni / M. orianae	53	60	46	6	6	171
Vespadelus troughtoni / Chalinolobus morio	1		16		1	18
Site Total	2539	625	1043	89	99	4395

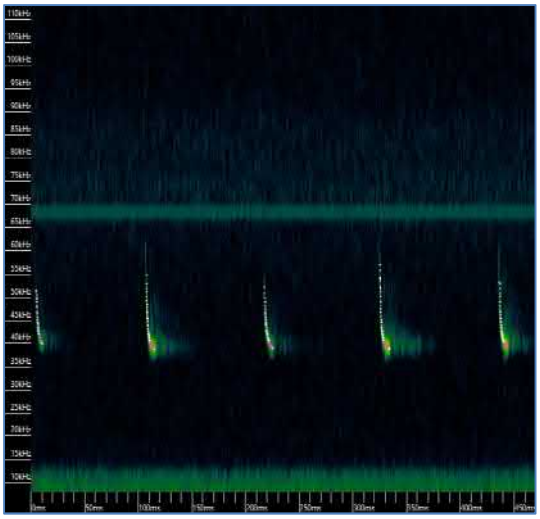
Appendix 2 Representative call sequences from the Rockhampton survey, 6-14 February 2019.
x-axis = 10 ms per tick-mark; true-time (non-compressed); spectrogram with ZC trace



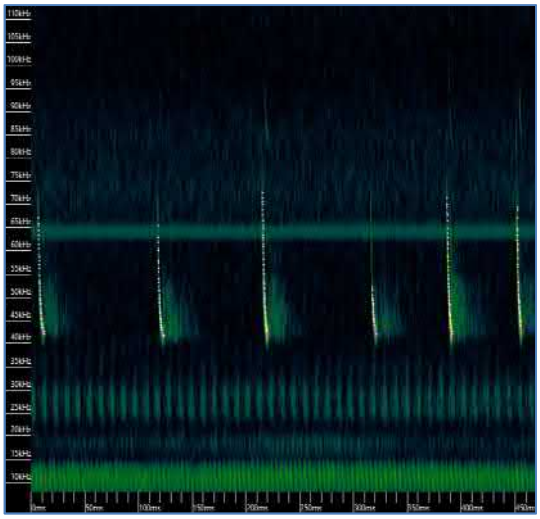
Chalinolobus gouldii



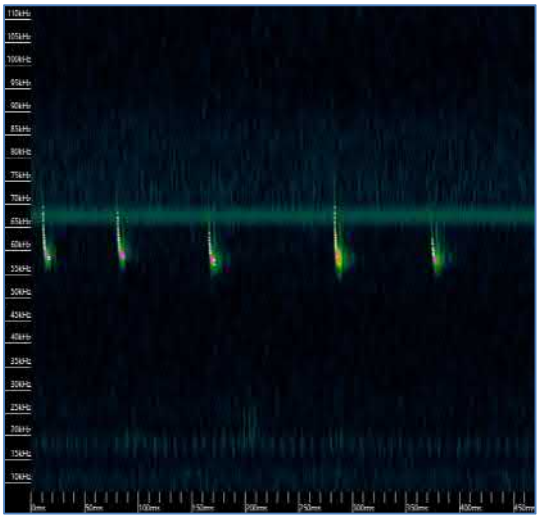
C. gouldii or *Scotorepens balstoni*



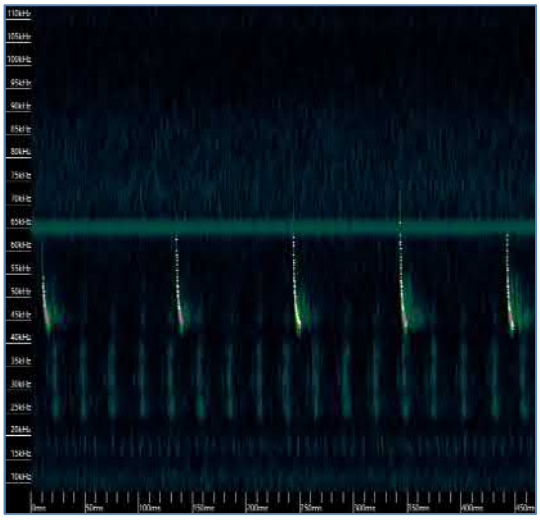
Chalinolobus nigrogriseus



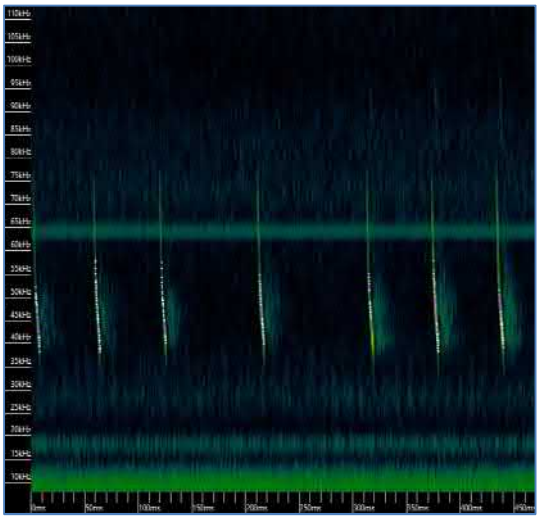
Scotorepens sanborni



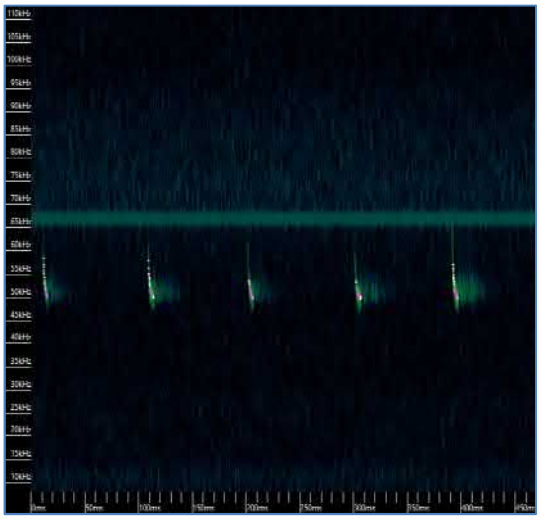
Miniopterus australis



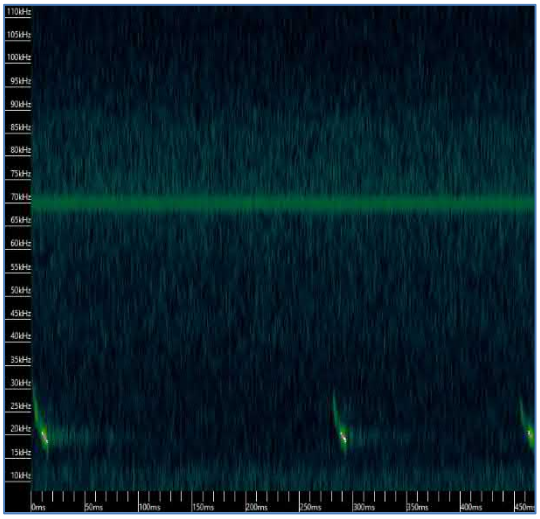
Miniopterus orianae



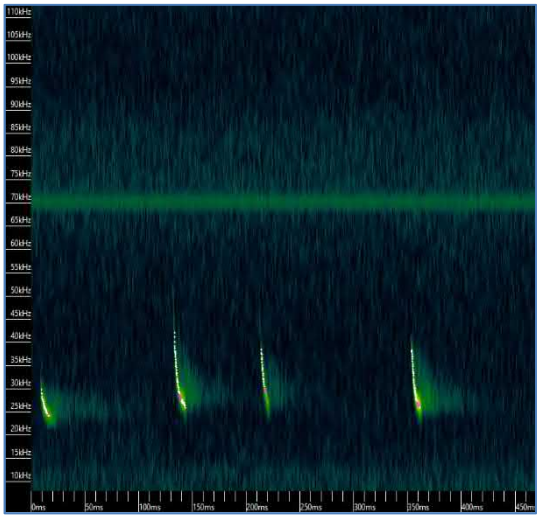
Nyctophilus species



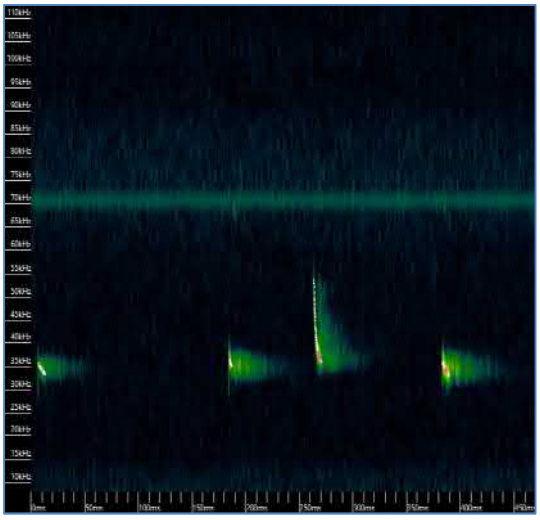
Vespadelus troughtoni / Chalinolobus morio



Chaerephon jobensis



Ozimops lumsdenae



Ozimops ridei

Appendix B

Likelihood of Occurrence Assessment

Appendix B Likelihood of Occurrence Assessment

Table 25 Likelihood of occurrence assessment – conservation significant species

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Birds				
Botaurus poiciloptilus	Australasian bittern	Endangered; -	In Australia, the Australasian bittern's core range is the south and east (including Tasmania) and the south-west of western Australia, with apparently isolated records and perhaps populations elsewhere around coastal regions. This species favours freshwater wetlands and rarely, estuarine or tidal wetlands. Its preferred microhabitats are shallow water with tall vegetation such as rushes, reeds and sedges or trampled vegetation adjacent to deep-water pools (Department of the Environment, 2019).	**Moderate.** Lacustrine wetlands intersect the Project Area, however dense and tall vegetation in the fringes was generally uncommon. The closest record is at Thompsons Point along the Fitzroy River (2003), approximately 30 km from the Project Area.
Calidris canutus	Red knot	Endangered & Migratory; Endangered	This species has a large, global range and is found in the Arctic, Americas, Africa, Europe and Australasia. In Queensland, the red knot is widespread along the coast south of Townsville. This species mainly inhabits intertidal mudflats, sandflats and sandy beaches and flooded pastures. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps (Department of the Environment, 2019).	**Low.** Habitat in the Project Area is not preferred by this species. No nearby records exist.
Calidris ferruginea	Curlew sandpiper	Critically Endangered & Migratory; Endangered	In Australia, curlew sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. This species mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They occur in both fresh and brackish waters (Department of the Environment, 2019).	**Moderate.** Suitable habitat for this species is found within the Survey Area. A record of this species occurs along the Fitzroy River (1979), at Murray Lagoon (2012) and Gracemere Lagoon (undated).

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Epthianura crocea macgregori	Dawson yellow chat	Critically Endangered; Endangered	Distribution of this species includes northern Australia from Kimberley in Western Australia to western Queensland. This subspecies is restricted to coastal areas of central Queensland and is known to breed at three locations: Torilla Plain, Fitzroy River Delta and Curtis Island. This subspecies inhabits wetlands in marine plain areas that have variable tidal inputs and are seasonally inundated. Yellow chats are typically associated with more coastal systems; however are known to also utilise freshwater systems when food sources and habitat availability are low (Department of the Environment, 2019).	**Low.** No suitable habitat for this species was recorded within the Project Area. This species is typically known from south of Rockhampton. The holotype of the species was recorded adjacent to the South Rockhampton Cemetery (undated record) and no other records exist in the surrounding area.
Erythrotriorchis radiatus	Red goshawk	Vulnerable; Endangered	This species is sparsely distributed across coastal and sub-coastal Australia, from the western Kimberly to northern New South Wales. There appears to have been a contraction in range in recent years. Occasionally recorded from gorge country in central Australia and western Queensland. In northern and central Queensland, red goshawks are mainly associated with extensive, uncleared, mosaics of native vegetation, especially riparian vegetation, open forest and woodland that contain a mix of eucalypt, ironbark and bloodwood species. Permanent water (watercourses and wetlands) is usually present in close proximity, with tall emergent trees used for nesting. The red goshawk is thought to have a very large home range covering between 50 and 220 square kilometres (Department of the Environment, 2019).	**Low.** Permanent water occurs within and adjacent to the Project Area; however habitat within the Project Area lacks the extensive mosaics of native vegetation and tall emergent trees required by this species. No nearby records exist.
Fregetta grallaria grallaria	White-bellied storm petrel	Vulnerable; -	The white-bellied storm-petrel breeds on small offshore islets and rocks in the Lord Howe Island group, including Roach Island and Balls Pyramid. In Australia, white- bellied storm petrels are only occasionally found in inshore waters and more commonly along the edge of the continental shelf and further out to sea (Department of the Environment, 2019).	**Unlikely.** This species is marine and therefore unlikely to be present or impacted by the project.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Geophaps scripta scripta	Squatter pigeon (southern)	Vulnerable; Vulnerable	This species is now largely (if not wholly) restricted to Queensland, from the New South Wales border, north to the Burdekin River, west to Charleville and Longreach, and east to the coast to Townsville and Proserpine. The squatter pigeon (southern) occurs in dry grassy woodland and open forest, mostly in sandy areas close to water (Department of the Environment, 2019).	**High.** Identified by AECOM during a survey near Gracemere Lagoon south west of the Project Area in 2019. Suitable dispersal habitat for this species is found within the Project Area.
Hirundapus caudacutus	White-throated needletail	Vulnerable / Migratory; -	This species is widespread in eastern and south-eastern Australia. In eastern Australia, it is recorded in all coastal regions of Queensland and New South Wales, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains. The white-throated needletail is found across a range of habitats, more often over wooded areas, where it is almost exclusively aerial, though does occasionally roost in tree hollows and the foliage canopy. It forages for insects on the wing; flying anywhere between “cloud level” and “ground level” and readily forms mixed feeding flocks with other aerial insectivores (Department of the Environment, 2019).	**Moderate.** This species may overfly the Project Area. Scattered records occur in the wider Rockhampton area; the most recent record occurs north of the Project Area along a tributary of the Fitzroy River (2006).
Limosa lapponica baueri	Western Alaskan bar-tailed godwit	Vulnerable / Migratory; Vulnerable	During the non-breeding period, the distribution of the western Alaskan bar-tailed godwit is predominantly New Zealand and northern and eastern Australia. Habitat for this species includes tidal mudflats, estuaries, shallow river margins and inland on large shallow fresh or brackish waters along the Queensland coast (Department of the Environment, 2019).	**High.** Identified by AECOM during a separate survey in 2019 at Gracemere Lagoon. Suitable habitat for this species is found within the Project Area, particularly in Pink Lily lagoon.
Limosa lapponica menzbieri	Northern Siberian bar-tailed godwit	Critically Endangered / Migratory; Endangered	During the non-breeding period, the distribution of the northern Siberian bar-tailed godwit is predominantly in the north and north-west of Western Australia and in south-eastern Asia. Habitat for this species includes tidal mudflats, estuaries, shallow river margins and inland on large shallow fresh or brackish waters along the Queensland coast (Department of the Environment, 2019).	**Unlikely.** Suitable habitat for this species is found within the Project Area; however this species is typically found in Western Australia. No nearby records exist.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Macronectes giganteus	Southern giant-petrel	Endangered & Migratory; Endangered	The southern giant-petrel breeds on six subantarctic and Antarctic islands in Australian territory: Macquarie Island, Heard Island and McDonald Island in the Southern Ocean, and Giganteus Island, Hawker Island, and Frazier Island in the Australian Antarctic Territories. Habitat includes inshore and open sea areas, favouring the edges of the continental shelf (Department of the Environment, 2019).	**Unlikely.** This species is marine and therefore unlikely to be present or impacted by the Project.
Neochmia ruficauda ruficauda	Star finch (eastern)	Endangered; Endangered	The star finch (eastern) occurs in central Queensland and its population is extremely limited. The distribution of this subspecies is poorly known, and it has disappeared from much of its former range. The most recent records occur in an area from near Wowan, north to Bowen, west to beyond Winton. This species occurs mainly in grasslands and grassy woodlands that are located close to bodies of fresh water. It also occurs in cleared or suburban areas such as along roadsides and in towns (Department of the Environment, 2019).	**Unlikely.** Suitable habitat for this species is found within the Project Area; however this species is not known to the Rockhampton region and records only occur in a few scattered locations.
Numenius madagascariensis	Eastern curlew	Critically Endangered & Migratory; Endangered	Within Australia, the eastern curlew has a primarily coastal distribution, they are rarely recorded inland. During the non-breeding season in Australia, the eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (*Zosteraceae*). Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets (Department of the Environment, 2019).	**Low.** The wetlands within the Project Area are freshwater which are not preferred by this species. Records occur along the Fitzroy River (1955) and at Woolwash Lagoon (1997).
Pachyptila turtur subantarctica	Fairy prion (southern)	Vulnerable; -	This species as a whole has a circumpolar distribution, and probably frequents subtropical waters during the non-breeding period. Breeding is currently known from only from two rock stacks off Macquarie Island, and on Bishop and Clerk Islands nearby (Department of the Environment, 2019).	**Unlikely.** This species is marine and therefore unlikely to be present or impacted by the Project.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Poephila cincta cincta	Black-throated finch (southern)	Endangered; Endangered	The black-throated finch's (southern) primary stronghold is the region surrounding Townsville; however it is also known to occur in scattered locations across central-eastern Queensland. Mapping indicates this subspecies has not been found around Rockhampton since 1995. The black-throated finch's (southern) preferred habitat is grassy open woodland/forest dominated by *Eucalyptus*, *Melaleuca* or *Acacia*, but they are also known from pandanus flats and scrubby plains. The black-throated finch (southern) feeds on the seed of native grasses from the ground. Three resources are required for the species to persist: water, grass seeds and trees providing suitable habitat (Department of the Environment, 2019).	**Low.** Although some suitable habitat is present within the Project Area, this species is no longer known from the Rockhampton region.
Pterodroma neglecta neglecta	Kermadec Petrel (western)	Vulnerable; -	The Kermadec petrel (western) is a pelagic seabird that occurs in tropical, subtropical and temperate waters of the Pacific Ocean. It breeds on islands, atolls and islets in the southern Pacific Ocean (Department of the Environment, 2019).	**Unlikely.** This species is marine and therefore unlikely to be present or impacted by the Project.
Rostratula australis	Australian painted snipe	Endangered; Vulnerable	The Australian painted snipe has been recorded from wetlands in all Australian states, however is most common in eastern Australia, especially the Murray-Darling Basin. Individuals are nomadic, and there is some evidence of partial migration from south-eastern wetlands to coastal central and northern Queensland in autumn and winter. Preferred habitat includes shallow inland wetlands, brackish or freshwater, that are permanently or temporarily inundated. Breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby (Department of the Environment, 2019).	**High.** Habitat across the Project Area is likely suited to this species. This species is also known from the Rockhampton region, with relatively recent records occurring at Murray Lagoon and Kawana (both 2013).
Thalassarche impavida	Campbell albatross	Vulnerable & Migratory; -	The Campbell albatross is a non-breeding visitor to Australian waters. Breeding birds are most commonly seen foraging over the oceanic continental slopes off Tasmania, Victoria and New South Wales. After breeding, birds move north and may enter Australia's temperate shelf waters (Department of the Environment, 2019).	**Unlikely.** This species is marine and therefore unlikely to be present or impacted by the Project.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Turnix melanogaster	Black-breasted button quail	Vulnerable; Vulnerable	The black-breasted button-quail is endemic to eastern Australia. It is restricted to coastal and near-coastal regions of south-eastern Queensland and north-eastern New South Wales. The main populations occur within south-east Queensland. This species is restricted to rainforests and forests including semi-evergreen vine thicket, low microphyll vine forest and araucarian microphyll vine forest, and occasionally dense thickets of *Acacia* and in vegetation behind sand dunes. Dense layer of leaf litter is crucial in order for the quail to forage (Department of the Environment, 2019).	**Low.** Some marginal habitat occurs within the Project Area. An undated record occurs in Rockhampton City.
Mammals				
Chalinolobus dwyeri	Large-eared pied bat	Vulnerable; Vulnerable	This species' current distribution is also poorly known. Records exist from Shoalwater Bay, north of Rockhampton, Queensland, through to the vicinity of Ulladulla, New South Wales in the south. Despite the large range, it has been suggested that the species is far more restricted within the species' range than previously understood. Sandstone cliffs and fertile woodland valley habitat within close proximity of each other is habitat of importance to the large-eared pied bat (Department of the Environment, 2019).	**Low.** The Project Area is located in a floodplain with no significant topography features other than the Fitzroy River. As majority of the Project Area is non-remnant or disturbed, suitable habitat is unlikely. No nearby records exist. This species was not identified as potentially occuring based on calls detected on the song meters (Appendix A).

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Dasyurus hallucatus	Northern quoll	Endangered; -	In Queensland, the northern quoll is known to occur as far south as Gracemere and Mount Morgan, south of Rockhampton, as far north as Weipa in Queensland and extends as far west into central Queensland to the vicinity of Carnarvon Range National Park. The northern quoll occupies a diversity of habitats across its range which includes rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert. Northern quoll are also known to occupy non rocky lowland habitats such as beachscrub communities in central Queensland. Northern quoll habitat generally encompasses some form of rocky area for denning purposes with surrounding vegetated habitats used for foraging and dispersal. Eucalypt forest or woodland habitats usually have a high structural diversity containing large diameter trees, termite mounds or hollow logs for denning purposes (Department of the Environment, 2019).	**Low.** Rocky areas are largely absent, and Eucalypt woodlands are typically highly modified therefore do not provide suitable denning habitat. Historical records are found around Rockhampton City (1964).
Macroderma gigas	Ghost bat	Vulnerable; Endangered	This species' current range is discontinuous, with geographically disjunct colonies occurring in the Pilbara, Kimberley, Northern Territory, the Gulf of Carpentaria, coastal and near coastal eastern Queensland from Cape York to near Rockhampton, and western Queensland. The ghost bat currently occupies habitats ranging from the arid Pilbara to tropical savanna woodlands and rainforests. During the daytime they roost in caves, rock crevices and old mines. Roost areas used permanently are generally deep natural caves or disused mines with a relatively stable temperature of 23°−28°C and a moderate to high relative humidity of 50−100% (Department of the Environment, 2019).	**Low.** The Project Area is located in a floodplain with no significant topography features other than the Fitzroy River. No caves or old mines required by this species are present within the Project Area. However, some marginal foraging habitat occurs within the Project Area. An undated record occurs at Berserker. This species was not identified as potentially occuring based on calls detected on the song meters (Appendix A).

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Nyctophilus corbeni	Corben's long-eared bat	Vulnerable; Vulnerable	The Corben's long-eared bat is found in southern central Queensland, central western New South Wales, north-western Victoria and eastern South Australia, where it is patchily distributed, with most of its range in the Murray Darling Basin. Most records are from inland of the Great Dividing Range. This species is found in a wide range of inland woodland vegetation types. These include box/ironbark/cypress pine woodlands, *Allocasuarina luehmannii* woodlands, *Acacia harpophylla* woodland, *Casuarina cristata* woodland, *Angophora costata* woodland, *Eucalyptus camaldulensis* forest, *Eucalyptus largiflorens* woodland, and various types of tree mallee (Department of the Environment, 2019).	**Low.** Some marginal habitat is found within the Project Area. However, no nearby records exist. Although *Nyctophilus* calls are often unable to be distinguished, this species was not identified as a potential based on calls detected on the song meters (Appendix A).
Petauroides volans	Greater glider	Vulnerable; Vulnerable	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria, with an elevational range from sea level to 1200 m above sea level. An isolated inland subpopulation occurs in the Gregory Range west of Townsville, and another in the Einasleigh Uplands. The greater glider is largely restricted to eucalypt forests. It is typically found in highest abundance in taller, montane, moist eucalypt forests with relatively old trees and abundant hollows (Department of the Environment, 2019).	**Low.** Some suitable foraging habitat is present in the northern section of the Project Area, however vegetation communities did not support a high density of hollows which are required for breeding and shelter. No recent nearby records exist.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Phascolarctos cinereus	Koala	Vulnerable; Vulnerable	In Queensland, the koala's distribution extends inland from the east coast: from the Wet Tropics interim biogeographic regionalisation of Australia bioregion, into the Einasleigh Uplands bioregion in the north of the state; from the Central Mackay Coast bioregion, through the Brigalow Belt North bioregion to the Desert Uplands and Mitchell Grass Downs bioregions, and from the Southeast Queensland bioregion, through the Brigalow Belt to the Mulga Lands and Channel Country bioregions in the southwest of the state. Koalas inhabit a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities. Koalas eat a variety of eucalypt leaves and a few other related tree species, including *Lophostemon*, *Melaleuca* and *Corymbia* species. Koalas are found in higher densities where food trees are growing on more fertile soils and along watercourses. They do, however, remain in areas where their habitat has been partially cleared and in urban areas (Department of the Environment, 2019).	**Moderate.** Some habitat across the Project Area is suited to this species, although fragmented and disturbed. The open woodland habitat located in the Project Area is dominated by *Eucalyptus tereticornis*, a primary food tree for the koala in the region. This species may also occur within the *Eucalyptus crebra* woodland in the north of the Project Area.
Pteropus poliocephalus	Grey-headed flying-fox	Vulnerable; -	Grey-headed flying-foxes occupy the coastal lowlands and slopes of south-eastern Australia from Bundaberg to Geelong and are usually found at altitudes < 200 m. Areas of repeated occupation extend inland to the tablelands and western slopes in northern New South Wales and the tablelands in southern Queensland. The grey-headed flying-fox requires foraging resources and roosting sites. It is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps and *Banksia* woodlands. The primary food source is blossom from *Eucalyptus* and related genera but in some areas it also utilises a wide range of rainforest fruits (Department of the Environment, 2019).	**High.** Suitable habitat is found within the Project Area. A roost record from 2017 is located approximately 10 km south west of the Project Area.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Xeromys myoides	Water mouse	Vulnerable; Vulnerable	The water mouse occurs in three regions of coastal Australia: The Northern Territory, central south Queensland and south-east Queensland. Within its range, it is patchily distributed and nowhere is it particularly abundant. Although the water mouse had been documented in three distinct locations, they require similar habitat including mangroves and the associated saltmarsh, sedgelands, clay pans, heathlands and freshwater wetlands. The main habitat difference at each location is the littoral, supra-littoral and terrestrial vegetation which differs in structure and composition (Department of the Environment, 2019).	**Low.** Marginal habitat is found within the Project Area. No nearby records exist.
Reptiles				
Crocodylus porosus	Salt-water crocodile	Migratory; Vulnerable	In Queensland the saltwater crocodile inhabits reef, coastal and inland waterways from Gladstone on the east coast, throughout the Cape York Peninsula and west to the Queensland-Northern Territory border. A seven-year survey recorded 6,444 sightings of the species in the waterways of the Southern Gulf Plains, Northern Gulf Plains, north-west and north-east Cape York Peninsula, Lakefield National Park, East Coast Plains, the Burdekin River catchment and the Fitzroy River catchment. The saltwater crocodile mostly occurs in tidal rivers, coastal floodplains and channels, billabongs and swamps up to 150 km inland from the coast. Preferred nesting habitat includes elevated, isolated freshwater swamps that do not experience the influence of tidal movements (Department of the Environment, 2019).	**High.** Although not recorded during surveying, this species is known to occur in the Fitzroy River. It is unlikely to be found in the freshwater wetlands in the Project Area, especially during drought periods.
Delma torquata	Collared delma	Vulnerable; Vulnerable	This species has been recorded at the following sites: the Bunya Mountains, Blackdown Tablelands National Park, Expedition National Park, Western Creek, and the Toowoomba Range. The collared delma normally inhabits eucalypt-dominated woodlands and open-forests in Queensland RE Land Zones 3, 9, and 10. The presence of rocks, logs, bark and other coarse woody debris, and mats of leaf litter (typically 30–100 mm thick) appears to be an essential characteristic of the adorned delma microhabitat and is always present where the species occurs (Department of the Environment, 2019).	**Low.** Marginal habitat for this species was located within the Project Area. However, almost all areas had been highly disturbed by intensive grazing and lacked significant leaf litter. No nearby records exist.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Denisonia maculata	Ornamental snake	Vulnerable; Vulnerable	This species is known only from the Brigalow Belt North and parts of the Brigalow Belt South biogeographical regions. The core of the species' distribution occurs within the drainage system of the Fitzroy and Dawson Rivers. This species is known to prefer woodlands and open forests associated with moist areas, particularly gilgai mounds and depressions in Queensland RE Land Zone 4, but also lake margins and wetlands. This species' habitat is likely to be found in *Acacia harpophylla*, *Acacia cambagei*, *Acacia argyrodendron* or *Eucalyptus coolabah*-dominated vegetation communities, or pure grassland associated with gilgais (Department of the Environment, 2019).	**Moderate.** Suitable habitat occurs across the Project Area. No gilgai was present; however cracking clays were recorded around some mapped wetlands including Pink Lily lagoon. Historic records occur surrounding the Project Area, including at Berserker and one adjacent to the Bruce Highway at Port Curtis (1974).
Egernia rugosa	Yakka skink	Vulnerable; Vulnerable	The known distribution of the yakka skink extends from the coast to the hinterland of sub-humid to semi-arid eastern Queensland. This vast area covers portions of the Brigalow Belt, Mulga Lands, South-east Queensland, Einasleigh Uplands, Wet Tropics and Cape York Peninsula Biogeographical Regions. Habitat requirements are poorly known, however this species is known from rocky outcrops, sand plain areas and dense ground vegetation, in association with open dry sclerophyll forest (ironbark) or woodland, brigalow forest and open shrubland (Department of the Environment, 2019).	**Low.** Marginal habitat for this species is located in Project Area. No nearby records exist.
Elseya albagula	White-throated snapping turtle	Critically Endangered; Endangered	This species occurs only in three catchments (Burnett, Mary and Fitzroy) and is considered a habitat specialist. The white-throated snapping turtle prefers clear, flowing, well-oxygenated water associated with their ability to extract oxygen from the water via cloacal respiration. Populations occur at much lower densities where flow is reduced (upstream of dams, weirs etc.) (Department of the Environment, 2019).	**High.** This species may occur in the Fitzroy River. Multiple records of the species occur in the wider Rockhampton region, the closest being north west near Mount Zion.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Furina dunmalli	Dunmall's snake	Vulnerable; Vulnerable	The Dunmall's snake occurs primarily in the Brigalow Belt region in the south-eastern interior of Queensland. Records indicate sites at elevations between 200–500 m above sea level. This species has been found in a broad range of habitats, including: forests and woodlands on black alluvial cracking clay and clay loams dominated by *Acacia harpophylla*, *Acacia burrowii, Acacia deanei, Acacia leiocalyx*, *Callitris* spp. or *Allocasuarina luehmannii*; and various *Corymbia citriodora*, *Eucalyptus crebra* and *Eucalyptus melanophloia*, *Callitris glaucophylla* and *Allocasuarina luehmannii* open forest and woodland associations on sandstone derived soils (Department of the Environment, 2019).	**Low.** Marginal habitat for this species was located in open woodland and brigalow woodland habitats within the Project Area. However, these areas are impacted by grazing and open woodlands on alluvial plains are seasonally inundated. Furthermore, brigalow woodlands were only present in a very small, disconnected patch. A record from 1992 is located east of the Project Area near Mount Archer.
Rheodytes leukops	Fitzroy River turtle	Vulnerable; Vulnerable	The bulk of records for this species are associated with the large primary streams of the Fitzroy River system: the Nogoa, Comet, MacKenzie, Connors, Isaac, Dawson and Fitzroy Rivers. Fitzroy River turtles are generally attributed to fast-flowing clear freshwater rivers and rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles, commonly in association with *Eucalyptus tereticornis, Casuarina cunninghamiana, Callistemon viminalis, Melaleuca linariifolia* and *Vallisneria* sp (Department of the Environment, 2019).	**High.** This species may occur in the Fitzroy River. Multiple records near the Project Area exist.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Fish				
Maccullochella peelii	Murray cod	Vulnerable; -	The Murray cod was historically distributed throughout the Murray-Darling Basin, which extends from southern Queensland, through New South Wales, the Australian Capital Territory and Victoria to South Australia, with the exception of the upper reaches of some tributaries. The species still occurs in most parts of this natural distribution up to approximately 1000 m above sea level. Murray cod are frequently found in the main channels of rivers and larger tributaries. The species is, therefore, considered a main-channel specialist. Murray cod tend to occur in floodplain channels and anabranches when they are inundated, but the species' use of these floodplain habitats appears limited (Department of the Environment, 2019).	**Unlikely.** Natural distribution of the Murray Cod (*Maccullochella peelii*) does not extend into the Fitzroy River system (Department of the Environment (2019)). There have been numerous attempts to translocate hatchery-bred and wild-caught Murray Cod by government authorities, acclimatisation societies and private individuals outside the species' natural range. In Queensland, the Murray Cod has been introduced into the Fitzroy River system (Department of the Environment (2019)). Extensive studies have been undertaken within the Fitzroy River system, with no records of Murray Cod occurring (Marsden, Tim, Berghuis, A & I Stuart, 2017) and based on this, the species is not considered likely to occur within the Project area.

Table 26 Likelihood of occurrence assessment - migratory species

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Migratory Marine Birds				
Apus pacificus	Fork-tailed swift	Migratory, Special Least Concern	The fork-tailed swift is recorded generally east of the Great Dividing Range from Cooktown to the New South Wales border, but extends further west in southern Queensland. The fork-tailed swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. This species mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes (Department of the Environment, 2019).	**Low.** This species may exist in airspace above the Project but is unlikely to roost or otherwise depend on the habitat within the Project Area.
Calonectris leucomelas	Streaked shearwater	Migratory, Special Least Concern	The streaked shearwater is a pelagic seabird that feeds mainly on fish and squid (Department of the Environment, 2019).	**Unlikely.** This species is largely marine and therefore unlikely to be present or impacted by the Project.
Hydroprogne caspia	Caspian tern	Migratory, Special Least Concern	In Queensland, this species is widespread in coastal regions from the southern Gulf of Carpentaria to the Torres Strait, and along the eastern coast. It has been recorded in the western districts, especially the Lake Eyre Drainage Basin, north-west to the Gulf Country north of Mount Isa and Cloncurry, and there are also scattered records from central Queensland. The caspian tern is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks (Department of the Environment, 2019).	**Present.** This species was identified flying over the Project Area during the field survey.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Plegadis falcinellus	Glossy ibis	Migratory, Special Least Concern	Within Australia, this species moves in response to good rainfalls, expanding its range, however the core breeding areas used are within the Murray-Darling Basin region of New South Wales and Victoria, the Macquarie Marshes in New South Wales, and in southern Queensland. The Glossy Ibis often moves north in autumn, then return south to the main breeding areas in spring and summer. The glossy ibis' preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons (Department of the Environment, 2019).	**Present.** This species was identified at Lotus, Pink Lily and Nelson Lagoon during the field survey.
Sterna albifrons	Little tern	Migratory, Special Least Concern	The Australian breeding population can be divided into two major subpopulations: (1) a northern subpopulation that breeds across northern Australia, from about Broome in north-western Western Australia, through coastal Northern Territory to the Gulf of Carpentaria and eastern Cape York Peninsula; and (2) an eastern subpopulation that breeds on the eastern and south-eastern coast of the mainland and northern and eastern Tasmania. In Australia, little terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches (Department of the Environment, 2019).	**High.** Suitable habitat for this species is found within the Project Area. A record occurs at Murray Lagoon (2017).
Thalassarche impavida	Campbell albatross	Migratory, Special Least Concern	Campbell albatross is a marine species inhabiting sub-Antarctic and sub-tropical waters from pelagic to shelf-break water habitats. The species is a non-breeding visitor to Australian waters, most commonly observed over the oceanic continental slopes off Tasmania, Victoria and NSW. The birds move north after breeding and may enter Australia's temperate shelf waters (DoEE, 2019).	**Unlikely.** No marine habitat is available within the Project Area. No suitable habitat is available for this species.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Migratory Terrestrial Species				
Cuculus optatus	Oriental cuckoo	Migratory, Special Least Concern	The oriental cuckoo is a regular migrant to Australia, where it spends the non-breeding season (Sept- May) in coastal regions across northern and eastern Australia as well as offshore islands. This species uses a range of vegetated habitats such as monsoon rainforest, wet sclerophyll forest, open woodlands and appears quite often along edges of forests, or ecotones between forest types (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project Area. No nearby records exist.
Monarcha melanopsis	Black-faced monarch	Migratory, Special Least Concern	In Queensland, the black-faced monarch is widespread from the islands of the Torres Strait and on Cape York Peninsula, south along the coasts (occasionally including offshore islands) and the eastern slopes of the Great Divide, to the New South Wales border. The black-faced monarch is a wet forest specialist, occurring mainly in rainforests and riparian vegetation. This species mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrub land, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest (Department of the Environment, 2019).	**Low.** Scattered records occur in the Rockhampton area; however the Project Area does not contain the preferred habitat to support this species.
Monarcha trivirgatus	Spectacled monarch	Migratory, Special Least Concern	The spectacled monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. This species occupies dense vegetation, mainly in rainforest but also in moist or wet sclerophyll forest and occasionally in other densely vegetated habitats such as mangroves, drier forest, woodlands, parks and gardens (Department of the Environment, 2019).	**Unlikely.** No suitable habitat is found within the Project Area. No recent nearby records exists.
Myiagra cyanoleuca	Satin flycatcher	Migratory, Special Least Concern	In Queensland, this species is widespread but scattered in the east, being recorded on passage on a few islands in the western Torres Strait. Satin flycatchers are also found extensively along the Great Dividing Range.	**Low.** Marginal suitable habitat is found within the Project Area. No nearby records exist.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
			Satin flycatchers are eucalypt forest and woodland inhabitants. During the non-breeding period, some individuals winter in northern Queensland around Innisfail and farther north around Atherton; however their movements are described as erratic. Wintering birds in northern Queensland will use rainforest - gallery forests interfaces, and birds have been recorded wintering in mangroves and paperbark swamps (Department of the Environment, 2019).	
Rhipidura rufifrons	Rufous fantail	Migratory, Special Least Concern	The rufous fantail is found in northern and eastern coastal Australia, being more common in the north. This species migrates to south-east Australia in October-April to breed, mostly in or on the coastal side of the Great Dividing Range. In east and south-east Australia, the rufous fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts, usually with a dense shrubby understorey often including ferns (Department of the Environment, 2019).	**Low.** Marginal suitable habitat is found within the Project Area. Scattered records occur around Rockhampton City and the Botanic Gardens.
Migratory Wetland Species				
Actitis hypoleucos	Common sandpiper	Migratory, Special Least Concern	Found along all coastlines of Australia and in inland areas, the common sandpiper is widespread in small numbers. The population when in Australia is concentrated in northern and western Australia. The common sandpiper is known to occur in a range of wetland environments, both coastal and inland. Their primary habitat is rocky shorelines and narrow muddy margins of billabongs, lakes, estuaries and mangroves (Department of the Environment, 2019). As stated by Department of the Environment (2019), the muddy margins utilised by the species are often narrow and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags.	**Moderate.** Suitable habitat for this species is found within the Project Area, however no nearby records exist.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Calidris acuminata	Sharp-tailed sandpiper	Migratory, Special Least Concern	In Queensland, the sharp-tailed sandpiper is recorded in most regions, being widespread along much of the coast and are very sparsely scattered inland, particularly in central and south-western regions. In Australasia, the sharp-tailed sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland (Department of the Environment, 2019).	**High.** Suitable habitat exists in the Project Area and numerous records occur in the surrounding area, including from Woolwash Lagoon (2014) and Murray Lagoon (2018).
Calidris melanotos	Pectoral sandpiper	Migratory, Special Least Concern	In Queensland, most records for the pectoral sandpiper occur around Cairns. There are scattered records elsewhere, mainly from east of the Great Divide between Townsville and Yeppoon. Records also exist in the south-east of the state as well as a few inland records at Mount Isa, Longreach and Oakley. This species is usually found in coastal or near coastal habitat but very occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire (Department of the Environment, 2019).	**High.** Suitable habitat for this species is found within the Project Area. No nearby records exist.
Calidris ruficollis	Red-necked stint	Migratory, Special Least Concern	This species is distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts. The red-necked stint has been recorded in all coastal regions, and found inland in all states when conditions are suitable. In Australasia, the red-necked stint is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores (Department of the Environment, 2019).	**High.** Suitable habitat for this species is found within the Project Area. A record occurs at Murray Lagoon (2018).

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Gallinago hardwickii	Latham's snipe	Migratory, Special Least Concern	Latham's snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia. This species has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. In Queensland, the range extends inland over the eastern tablelands in south-eastern Queensland. In Australia, the Latham's snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Department of the Environment, 2019).	**Present.** This species was identified at two locations during the field survey.
Limosa limosa	Black-tailed godwit	Migratory, Special Least Concern	The black-tailed godwit is found in all states and territories of Australia, however, it prefers coastal regions and the largest populations are found on the north coast between Darwin and Weipa. In Australia the black-tailed godwit has a primarily coastal habitat environment. This species is commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud, sand or shell-grit; occasionally recorded on rocky coasts or coral islets (Department of the Environment, 2019).	**High.** Suitable habitat for this species occurs within the Project Area. A record of this species occurs at Murray Lagoon (2018) and Gracemere Lagoon (2003).
Numenius minutus	Little curlew	Migratory, Special Least Concern	Little curlews generally spend the non-breeding season in northern Australia from Port Hedland in Western Australia to the Queensland coast. There are records of the species from inland Australia, and widespread but scattered records on the east coast. The little curlew is most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated. Open woodlands with a grassy or burnt understorey, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts, mown lawns, gardens, recreational areas, ovals, racecourses and verges of roads and airstrips are also used (Department of the Environment, 2019).	**High.** Suitable habitat for this species is found within the Project Area. An undated record occurs near Gracemere Lagoon.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Pandion cristatus	Eastern osprey	Migratory, Special Least Concern	The breeding range of the eastern osprey extends around the northern coast of Australia (including many offshore islands) from Albany in Western Australia to Lake Macquarie in New South Wales; with a second isolated breeding population on the coast of South Australia, extending from Head of Bight east to Cape Spencer and Kangaroo Island. Eastern ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging (Department of the Environment, 2019).	**Present.** Suitable habitat is found within the Project Area and this species was identified during the 2014 survey. Records of this species also occur at Woolwash Lagoon (2017) and Murray Lagoon (2012).
Tringa glareola	Wood sandpiper	Migratory, Special Least Concern	In Queensland, there are sparsely scattered records, generally south of 17° S, but also around Cairns. The wood sandpiper uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation and often with fallen timber. They also frequent inundated grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops. This species uses artificial wetlands, including open sewage ponds, reservoirs, large farm dams, and bore drains (Department of the Environment, 2019).	**Moderate.** Suitable habitat for this species is found within the Project Area, although most wetlands lacked tall vegetation in fringes. No nearby records exist.

Scientific Name	Common Name	Status (EPBC Act; NC Act)	Discussion	Likelihood
Tringa nebularia	Common greenshank	Migratory, Special Least Concern	In Queensland, this species is widespread in the Gulf country and eastern Gulf of Carpentaria. It has been recorded in most coastal regions, possibly with a gap between north Cape York Peninsula and Cooktown. Inland, there have been a few records south of a line from near Dalby to Mount Guide, and sparsely scattered records elsewhere. The common greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms (Department of the Environment, 2019).	**High.** Habitat across the Project Area is well suited to this species and it is known from the Rockhampton region in recent years, including at Murray Lagoon in 2016.
Tringa stagnatilis	Marsh sandpiper	Migratory, Special Least Concern	The marsh sandpiper is found on coastal and inland wetlands throughout Australia. The species is widespread in coastal Queensland, but few records exist north of Cooktown. This species lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks (Department of the Environment, 2019).	**Present.** One individual recorded at Pink Lily lagoon during the field survey. Suitable habitat for this species is found within the Project Area. Numerous recent records occur surrounding the Project Area, including at Murray Lagoon (2018) and Gracemere Lagoon (2003).

Appendix C

Significant Impact Assessment

Appendix C Significant Impact Assessment

Introduction

Under the EPBC Act, a referral to DoEE will be required if the Project has the potential to cause a 'significant impact' on MNES. In relation to listed conservation significant and migratory 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
- Migratory (species which are native to Australia and are included in the appendices to the Bonn Convention, and/or included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA), and/or native, migratory species identified in a list established under an international agreement such as the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

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)?

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)?

Vulnerable Species

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 Water Heritage and the Arts, 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.

Squatter pigeon (southern) (*Geophaps scripta scripta*)

The squatter pigeon (southern) is a ground-dwelling bird that inhabits the grassy understorey of open woodland (mostly dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* in the canopy), as well as sown grasslands with scattered remnant trees, disturbed areas (such as roads, railways, settlements and stockyards), scrubland, and *Acacia* regrowth (Department of the Environment, 2019). It forages for seeds among sparse and low grass, in improved pastures, and disturbed habitats such as road reserves.

It is nearly always found near permanent water such as rivers, creeks, wetlands and waterholes. However, to be utilised by the squatter pigeon (southern), waterbodies must have gentle slopes to the water's edge and some bare ground in the margin. Suitable waterbodies are accessed daily to drink, and as such vegetation patches adjacent to waterbodies may be considered dispersal habitat for this species (Department of the Environment, 2019).

The squatter pigeon (southern) nests on the ground, and usually lays two eggs among or under vegetation. This species will breed throughout the year; however breeding is influenced by heavy rainfall and most commonly occurs during the dry season between May to June. In Queensland, foraging and breeding habitat is known to be associated with the soil landscapes of Land Zone 5 (well drained sandy or loamy soils on undulating plains and foothills) and Land Zone 7 (lateritic soils on low jump-ups and escarpments) (Department of the Environment, 2019).

Occurrence and Potential Habitat

Squatter pigeon (southern) was identified as being highly likely to occur in the Project Area due to the close locality of a 2018 record (A. Mack, Pers comms) and presence of some suitable habitat features. These include the number of permanent wetlands and creeks near the Project Area, as well as woodlands with native grasses in the ground layer. However, the Project Area occurs entirely on Land Zones 3 and 11, not the preferred geology for foraging and breeding (which is Land Zone 5 or 7 as detailed by the SPRAT) and as such is considered dispersal habitat with the wetland areas providing a permanent water source for the species.

Dispersal habitat is defined as areas of forest or woodland occurring between patches of foraging and breeding habitat and suitable waterbodies (Department of the Environment, 2019). The lagoons (with the exception of Dunganweate and Nelsons Lagoons which lacked riparian vegetation) in the Project Area constitute suitable waterbodies for the species requirements and as such any forest or woodland surrounding these lagoons may be used for dispersal. However, it should be noted that the southern section of Pink Lily Lagoon was verified only from adjacent properties or roads, and the Capricorn Highway Wetland was unable to be accessed.

All potential habitat within the Project Area that may be directly impacted is detailed in Table 27 below.

Table 27 Squatter pigeon (southern) potential dispersal habitat

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
1	Open woodland to low open woodland on alluvial floodplains	11.3.3 HVR, 11.3.4 & 11.3.4 HVR	18.05
2	Lacustrine wetland	11.3.27a	0.85
3	Palustrine wetland	11.3.27c	5.92
4	Fringing riparian woodland	11.3.25 & 11.3.25a	2.23
5	Woodland dominated by *Eucalyptus crebra* and *Corymbia dallachiana* on metamorphics	11.11.15	6.28
6	Brigalow low woodland	11.3.1 HVR	0.42
		Total area	**33.75**

Habitat Critical to the Survival of the Species

Habitat critical to the survival of the squatter pigeon (southern) is not defined, however for this species it is considered to be limited to breeding habitat only. Breeding habitat is found on Land Zones 5 and 7 within 1km of permanent or semi-permanent water.

Breeding habitat is not available within the Project Area and as such no habitat critical to the survival of the species is present. However, the squatter pigeon (southern) is known to access suitable waterbodies to drink on a daily basis and as such water resources within the Project Area may be important for the species.

Important Population

As this species currently has no adopted recovery plan, 'important populations' of squatter pigeon (southern) have been defined as per those listed in the Species Profile and Threats (SPRAT) database (Department of the Environment, 2019):

- Populations occurring in the Condamine River catchment and Darling Downs of southern Queensland
- The populations known to occur in the Warwick-Inglewood-Texas region of southern Queensland, and
- Any populations potentially occurring in northern NSW.

None of the aforementioned important populations occur within or in proximity to the Project Area. This species remains common north of the Carnarvon Ranges in Central Queensland and is considered to be distributed as a single, continuous (i.e. inter-breeding) sub-population. Any population of squatter pigeon (southern) in the Project Area does not meet the definition of an important population.

Significant Impact Assessment

An assessment against the *EPBC Act Significant Impact Guidelines 1.1* for this species is provided in Table 28. The outcome of this assessment was that the Project is unlikely to result in a significant impact to the species.

Table 28 Significant impact assessment - squatter pigeon (southern)

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of an important population of a species?	**No.** As detailed above, any population of squatter pigeons (southern) occurring within the Project Area is not considered an important population. Nonetheless, the clearing of dispersal habitat especially near wetland locations has been minimised during the detailed design via the use of bridges. Therefore, it is unlikely that the Project will lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population?	**No.** The area of occupancy of the squatter pigeon (southern) was estimated to be 10,000 km² in the year 2000. The Project Area does not occur near the limits of the species' distribution. Any population of squatter pigeons (southern) in the Project Area is not considered an important population. Therefore, it is unlikely that the Project will reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations?	**No.** Although the Project is linear it is unlikely to form a barrier to movement to the species which is highly mobile and will have opportunities to disperse. The clearing of dispersal habitat especially near wetland locations has been minimised during the detailed design via the use of bridges. Furthermore, any population of squatter pigeons (southern) in the Project Area is not considered an important population. Therefore, it is unlikely that the Project will fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species?	**No.** Habitat critical to the survival of this species is not present within the Project Area. Dispersal habitat consists of forest or woodland occurring between patches of foraging and breeding habitat and suitable waterbodies. Waterbodies in the Project Area may be used by the species however, no foraging or breeding habitat is present within the Project Area. Dispersal habitat is present, however this is not considered to be habitat critical to the survival of the species. Some impacts to the dispersal habitat are expected as a result of the Project. Detailed design of the Project Area currently includes approximately 14 bridges which should allow existing waterbodies to persist; however direct clearing and cut and fill impacts to wetlands may still occur for the installation of bridge hardstands. The clearing of vegetation adjacent to wetlands may reduce the availability of dispersal habitat, however in the context of the already fragmented landscape this impact is expected to be minimal and is not expected to impact on accessibility of the water bodies. Findings from the C&R Consulting Wetlands Assessment have indicated that the Project should not significantly alter the hydrological conditions (including water quality) of the wetlands within and adjacent to the Project Area. The operation of the Project will result in an increase in lighting as well as increased noise due to traffic. However, given the species' known utilisation of disturbed habitats including road reserves, it is considered unlikely this will reduce habitat suitability.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Disrupt the breeding cycle of an important population?	**No.** Habitat within the Project Area is not considered to be suitable for breeding as preferred soil substrates are not present (Land Zone 5 or 7). Furthermore, any population of squatter pigeons (southern) in the Project Area is not considered 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?	**No.** No breeding or foraging habitat is present however the Project Area may be used for dispersal and waterbodies may be used for the species requirement to drink daily. No significant hydrological impacts (including water quality) are expected to occur as a result of the Project, indicating that permanent waterbodies should remain suitable. In addition, the species is known to persist in areas of active grazing and substantial habitat degradation and is resilient to impacts. As such the Project is unlikely to 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?	**No.** Invasive flora and fauna species (i.e. buffel grass, cattle) have been identified on the SPRAT database as a key threat to the species; however it is unlikely that the Project will exacerbate invasive species beyond current levels as a range of pest and weed species are already prevalent across the Project Area and management measures to reduce this risk will be implemented. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Introduce disease that may cause the species to decline?	**No.** Disease has not been identified as a main threat to the species. The Weed and Pest Management Plan for the Project will detail the measures to ensure best practice with site hygiene.
Interfere substantially with the recovery of the species?	**No.** The federal environment minister has declared that a national recovery plan for the squatter pigeon (southern) is not required; however current threats to this species include loss and fragmentation of habitat due to clearing for agricultural purposes, the degradation of habitat by overgrazing by domesticated herbivores, the degradation of habitat by invasive weeds, and predation by numerous avian and terrestrial predators. While some habitat may be impacted by the Project (directly through clearing and indirectly during operation), these areas are minimal and limited to dispersal habitat only. Higher value habitat is widely available in the surrounding region. In addition, the species is known to utilise a wide range of different habitats including highly disturbed areas, minimising the severity of impact of habitat clearing on the species. Given this, the Project is unlikely to interfere with the recovery of the squatter pigeon (southern) at the species level.

1. Western Alaskan bar-tailed godwit (*Limosa lapponica baueri*)

The Western Alaskan bar-tailed godwit (sub-species of the bar-tailed godwit) is a migratory shorebird found in Australia during the non-breeding period, typically from August to March. Breeding occurs in the northern hemisphere (Scandinavia, northern Asia and Alaska) before they migrate southwards for the boreal winter.

In Australia, the species mainly occurs along the north and east coasts in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. However, they have also been recorded in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats (Higgins & Davies, 1996a).

This species is carnivorous, and forages in the littoral zone and muddy margins mainly in tidal estuaries and harbours. Foraging generally occurs during the day but can also occur by moonlight (Higgins & Davies, 1996b).They prefer exposed sandy or soft mud substrates on intertidal flats, banks and beaches. Roosting habitat consists of sandy beaches, sandbars, spits and near-coastal saltmarsh.

Occurrence and Potential Habitat

The Western Alaskan bar-tailed godwit was identified as being highly likely to occur in the Project Area due to the close locality of a 2018 record (A.Mack, Pers comms) and the availability of freshwater wetlands. No individuals were identified during the field survey; however climatic conditions present prior and during the surveys were unseasonably dry and potentially not representative of typical wet season habitat condition and species utilisation.

The species shows preference for coastal and estuarine habitats for roosting and foraging however freshwater wetlands at Pink Lily, Lotus, Dunganweate, Nelson and Black Duck Lagoon may provide marginal foraging and dispersal habitat for individuals in transit. The amount of foraging and dispersal habitat within the Project Area that may be directly impacted is detailed in Table 29 below.

It should be noted that due to land access restrictions, the southern area of Pink Lily Lagoon was verified from adjacent properties and roads only, and Capricorn Highway Wetland could not be accessed at all. Wetlands adjacent to the Project Area are not included in the table below but are displayed on Figure 6. Given the migratory habits of the species, it is likely that existing resources within the Project Area would be utilised infrequently and on a transitory basis only. All potential habitat within the Project Area that may be directly impacted is detailed in Table 29

Table 29 Western Alaskan bar-tailed godwit potential foraging habitat

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
2	Lacustrine wetland	11.3.27a	0.85
3	Palustrine wetland	11.3.27c	5.92
		Total area	**6.77**

Habitat Critical to the Survival of the Species

Habitat critical to the survival of the species has not been defined by DoEE and as such the generic definition has been used. Important habitat does include suitable foraging intertidal habitats that allow birds to sufficiently fuel before commencing non-stop migratory flights to northern breeding sites (Department of the Environment and Energy, 2017). No intertidal foraging habitat is present and all habitat is present is considered marginal and likely to be used on a transitory basis for a few individuals only. As such wetlands within the Project Area are not considered to be habitat critical to the survival of the species.

Important Population

The SPRAT database does not identify ‘important populations’ of this species (Department of the Environment, 2019) and there is currently no adopted recovery plan. As habitat is marginal it is unlikely to support the number of individuals that would constitute an important population. Any

population of Western Alaskan bar-tailed godwit that may utilise the Project Area is not considered to meet the definition of an important population.

Significant Impact Assessment

An assessment against the *EPBC Act Significant Impact Guidelines 1.1* is provided in Table 30. The outcome of this assessment was that the Project is unlikely to result in a significant impact to the species.

Table 30 Significant impact assessment for western Alaskan bar-tailed godwit (*Limosa lapponica bauera*)

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of an important population of a species?	**No.** Any population of Western Alaskan bar-tailed godwits within the Project Area is not considered an important population. Nonetheless, the clearing of suitable foraging and dispersal habitat at wetland locations has been minimised during the detailed design via the use of bridges. Results from the C&R Consulting Wetlands Assessment have indicated no significant hydrological changes (including water quality) will occur at wetlands within and adjacent to the Project Area. Potential impacts to wetlands during construction will be managed as per the CEMP, to be developed prior to work commencing. Furthermore, the narrow and linear nature of the Project is unlikely to result in habitat fragmentation for a highly mobile species. Therefore, it is unlikely that the Project will lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population?	**No.** The area of occupancy of the western Alaskan bar-tailed godwit while in Australia is estimated at 8,100 km^2. Records of this species occur along most of the Queensland coast. Any population of Western Alaskan bar-tailed godwits within the Project Area are not considered an important population. Therefore, it is unlikely that the Project will reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations?	**No.** Although the Project Area directly intersects some of the mapped wetland extents, this species is highly mobile and the shape and extent of the Project Area will not create barriers to movement. Additionally, as discussed above significant hydrological impacts are not expected, so wetland characteristics within the Rockhampton area should be largely maintained. Any population of Western Alaskan bar-tailed godwits within the Project Area is not considered an important population. Therefore, it is unlikely that the Project will fragment an existing important population into two or more populations.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Adversely affect habitat critical to the survival of a species?	**No.** Critical habitat for the survival of this species has not been defined; however intertidal habitats used by the godwits in Australasia are considered of critical importance as this species relies on the food obtained during the non-breeding season to fuel the return journey back to the northern hemisphere. No individuals were identified during the field survey. However, given the limitations associated with the survey (not ideal climatic conditions prior to and during), additional survey effort may be required under more representative climatic conditions to confirm this. Wetlands within and adjacent to the Project Area are largely freshwater and as such not considered intertidal. These may provide refuge and marginal foraging habitat for individuals on a transitory basis but is unlikely to support a population or provide habitat critical to the survival of the species. Regardless, mitigation measures have been implemented to reduce impacts. Direct impacts (vegetation clearing) at wetlands are likely to be minimal given the inclusion of bridges in the design of the Project (6.77 ha under worst-case scenario/no bridges). As discussed, results from the C&R Consulting Wetlands Assessment have indicated no significant hydrological changes (including water quality) should occur at wetlands within and adjacent to the Project Area. Considering this, and the avoidance and mitigation measures that have been proposed, the Project will not adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population?	**No.** This species does not breed in Australia. Any population of Western Alaskan bar-tailed godwits in the Project Area is not considered an important population. Therefore, the Project is unlikely to 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?	**No.** Direct impacts (vegetation clearing) on marginal habitat within wetlands are likely to be minimal in the context of the wider landscape and available habitat (6.77 ha under worst-case scenario/no bridges). Additionally, no significant hydrological changes (including water quality) are predicted to occur at wetlands within and adjacent to the Project Area. Potential impacts to wetlands during construction will be managed as per the CEMP, to be developed prior to work commencing. The operation of the Project may indirectly impact the wetland habitats with increased noise and light, however as only vagrant individuals are expected to utilise these marginal habitats, this will not impact any population present to the extent that the species is likely to decline. As such, it is considered unlikely that the Project may modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species' habitat?	**No.** Invasion of intertidal mudflats by weeds have been identified on the SPRAT database as a key threat to the species. However, wetlands within the Project Area are freshwater and therefore are not intertidal. A range of weeds are already present within and adjacent wetland habitats in the Project Area. Nonetheless, a Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion such as the wetlands.
Introduce disease that may cause the species to decline?	**No.** The Western Alaskan bar-tailed godwit is susceptible to avian influenza and so may be threatened by future outbreaks of the virus. The Weed and Pest Management Plan for the Project will detail the measures to ensure best practice site hygiene.
Interfere substantially with the recovery of the species?	**No.** The federal environment minister has declared that a national recovery plan for the Western Alaskan bar-tailed godwit is not required; however current threats to this species include loss and fragmentation of habitat, climate change, pollution/contamination, human disturbance, disease and direct mortality as a result of collisions with large structures. Some direct impacts to wetland habitat and indirect impacts such as increased noise and light are expected as a result of the Project. However, given the marginal value of habitat for this species, the Project may only have minor impacts to a small number of individuals and will not to the species as a whole.

2. Ornamental snake (*Denisonia maculata*)

The ornamental snake is found only in the Brigalow Belt North and some parts of the Brigalow Belt South biogeographical regions. The core distribution of this species in the aforementioned areas is within the Fitzroy and Dawson River drainage systems (Department of the Environment, 2019). Within the known localities list on the species' SPRAT, the Rockhampton region is listed.

Suitable habitat for the ornamental snake is low-lying areas with deep-cracking clay soils that are subject to seasonal flooding, and in adjacent areas of clay and sandy loams. The species is found in woodlands and shrublands, such as brigalow, and in riverine habitats, and lives in soil cracks and under fallen timber. It is also known to persist in cleared, disturbed habitats, particularly where brigalow communities have been cleared.

The ornamental snake's preferred habitat is within, or close to, habitat that is favoured by its prey - frogs. The species is known to prefer woodlands and open forests associated with moist areas, particularly gilgai mounds and depressions in Queensland Regional Ecosystem Land Zone 4, but also lake margins and wetlands.

Occurrence and Potential Habitat

Although the ornamental snake was not recorded during field investigations, this species was considered a moderate occurrence within the Project Area due to the presence of suitable microhabitat features and nearby records. An undated record occurs immediately south of the Project Area adjacent to the Bruce Highway at Port Curtis, and several historical records occur in the wider Rockhampton region. Essential habitat for the species is also mapped throughout the Project Area and is associated with open *Eucalyptus* alluvial woodlands.

Within the Project Area, some habitat for this species occurs in some wetland (primarily Pink Lily Lagoon and Lotus Lagoons) and riparian communities. Cracking clays ranging from shallow to deep were present adjacent these wetlands with some fallen timber also available in the vegetated margins, particularly at Pink Lily Lagoon. This could provide breeding, foraging and dispersal habitat for the species. However, habitat encountered is considered marginal due to the high level of disturbance from cattle use, and the lack of native frogs (cane toads were prolific).

To determine maximum potential habitat that may be disturbed as a result of the Project, all wetland and riparian vegetation within the Project Area has been included in Table 31 below.

Table 31 Ornamental snake potential habitat

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
1	Open woodland to low open woodland on alluvial floodplains	11.3.3 HVR, 11.3.4 & 11.3.4 HVR	18.05
2	Lacustrine wetland	11.3.27a	0.85
3	Palustrine wetland	11.3.27c	5.92
4	Fringing riparian woodland	11.3.25 & 11.3.25a	2.23
		Total area	**27.05**

Habitat Critical to the Survival of the Species

There is no species-specific guidelines for determining habitat critical to the survival of the ornamental snake, and at present no recovery plan exists. However, important habitat has been defined in the *Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* (Department of Sustainability Environment Water Population and Communities, 2011) as gilgai depressions and mounds and habitat connectivity between gilgais and other suitable habitats.

Gilgai was not present within the Project Area. Further, native frog abundance, the primary prey for the species, was low. As such, habitat within the Project Area is not considered to be critical to the survival of the ornamental snake.

Important Population

DoEE considers that an occurrence of important habitat for the ornamental snake is a surrogate for an 'important population' of the species. Suitable habitat for the ornamental snake is considered important if it is (Department of Sustainability Environment Water Population and Communities, 2011):

- Habitat where the species has been identified during a survey
- Near the limit of the species' known range
- Large patches of contiguous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations) **or**
- A habitat type where the species is identified during a survey, but which was previously thought not to support the species.

The habitat available within the Project Area does not meet the criteria to be considered important habitat. Habitat is considered to be marginal based on significant impacts from cattle grazing, low abundance of native prey and high abundance of toxic cane toads. No important habitat or an important population of the species are expected to be impacted as a result of the Project.

Significant Impact Assessment

An assessment against the *EPBC Act Significant Impact Guidelines 1.1* for this species is provided in Table 32. The outcome of this assessment was that the Project is considered unlikely to result in a significant impact to the species.

Table 32 Significant impact assessment for ornamental snake (*Denisonia maculata*)

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of an important population of a species?	**No.** The Project Area does not contain large patches of contiguous suitable habitat and where habitat does exist, it is considered to be marginal and not suitable to support an important population. The scale of habitat impact would not reduce the carrying capacity of habitat in the Project Area to the extent that it would reduce the size of a population. Therefore, the Project is unlikely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population?	**No.** The area of occupancy of this species is unknown, however the habitat within the Project Area is not suitable to support an important population. Regardless, measures will be implemented to reduce potential impacts to the species. Retaining and relocating microhabitat features such as felled trees and logs to other areas will be considered.
Fragment an existing important population into two or more populations?	**No.** The potential habitat within the Project Area (27.05 ha) is severely fragmented and disturbed and is not suitable to sustain an important population. The Project has been designed to avoid dissecting remnant vegetation where possible, with large patches of adjacent remnant vegetation unaffected by the Project. Additionally, at wetland and creek locations the Project has incorporated bridges and culverts into the design to minimise fragmentation and changes to the floodplain hydrology. Roads and other barriers to ornamental snake movement currently exist in the Project Area.
Adversely affect habitat critical to the survival of a species?	**No.** The majority of habitat for the ornamental snake across the Project Area is highly degraded and of poor quality due to existing fragmentation and grazing impacts. Habitat is not considered to be important habitat for the species as defined in the *Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* (Department of Sustainability Environment Water Population and Communities, 2011) and is therefore not considered to be habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population?	**No.** There is no information on the breeding season of the species however breeding and foraging habitat is interchangeable and as such breeding habitat may be impacted by the Project. This potential habitat is considered to be marginal due to the high level of disturbance and areas with the greatest abundance of microhabitat features have been avoided in the Project design (i.e. the margins of Pink Lily Lagoon). As no important population of the species has been identified within the Project Area, the Project is unlikely to disrupt the breeding cycle of an important population.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	**No.** Direct disturbance to habitat is minimal and the majority of habitat for this species within the Project Area is highly degraded and of poor quality due to existing fragmentation, weed incursion, grazing impacts and lack of suitable prey species. Findings from the C&R Consulting Wetlands Assessment indicate that no significant hydrological changes will occur at wetlands. Therefore, the Project is unlikely to result in the modification, destruction, removal, isolation or decrease to 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?	**No.** Key threats to this species include destruction of wetland habitat by feral pigs (*Sus scrofa*) and poisoning resulting from the ingestion of cane toads (*Rhinella marina*). Both species are prevalent within the Project Area. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through project activities. Control efforts will be increased in areas particularly sensitive to invasion, such as wetlands.
Introduce disease that may cause the species to decline?	**No.** Disease has not been identified as a main threat to the species. The Weed and Pest Management Plan for the Project will detail the measures to ensure best practice for site hygiene.
Interfere substantially with the recovery of the species?	**No.** The federal environment minister has declared that that a national recovery plan for the ornamental snake is not required. Current threats to this species include loss and fragmentation of habitat, alteration of landscape hydrology in and around gilgai environments, and alteration of water quality through chemical and sediment pollution of wet areas. Potential impacts to wetlands and riparian habitats during construction will be managed as per the CEMP, to be developed prior to work commencing. Considering the habitat is marginal for the species and with the implementation of the mitigation measures suggested, the Project is unlikely to interfere with the recovery of the species.

Koala (*Phascolarctos cinereus*)

The koala is a leaf-eating specialist that feeds primarily during dawn, dusk or night. Its diet is restricted mainly to foliage of *Eucalyptus* spp; however, it may also consume foliage of related genera, including *Corymbia* spp., *Angophora* spp. and *Lophostemon* spp, and may, at times, supplement its diet with other species, including *Leptospermum* spp. and *Melaleuca* spp.

Occurrence and Potential Habitat

The Project Area is situated near the city of Rockhampton, Queensland, with an average annual rainfall of approximately 815 mm (Bureau of Meteorology, 2019b). This indicates that koala habitat is to be assessed with respect to the coastal context described in the Koala EPBC referral guidelines (Department of the Environment, 2014). Thus, koala habitat is defined as including large, connected areas of native vegetation including in forests and woodlands where logging has altered tree species composition. These areas may be remnant, regrowth or plantation vegetation. Habitat also includes: small, isolated patches of native vegetation in rural, urban or peri-urban areas, windbreaks and narrow

areas of native vegetation along riparian areas or linear infrastructure and isolated food and/or shelter trees (i.e. on farm lands, in suburban streetscapes, parks and yards).

Koala food trees are species of tree whose leaves are consumed by koalas. Koala food trees are considered to be those of the following genus: *Angophora, Corymbia, Eucalyptus, Lophostemon* and *Melaleuca*. Some resources separate individual species per region as 'primary' and 'secondary' food trees based on known utilisation in each region.

Koala habitat within the Project Area is considered to be all remnant and high value regrowth communities which contain koala food trees including the primary food tree *Eucalyptus tereticornis* and other known food trees such as *Eucalyptus coolabah* and *Eucalyptus populnea*. All habitat is suitable for foraging, breeding and dispersal which equates to approximately 26.56 ha within the Project Area, which may be directly impacted by the Project (Table 33). Habitat is not considered to be refuge habitat for the species due to the fragmented nature of the habitat. During the field survey, no koalas were observed in the Project Area; however one recent record (2011) is available within 10km.

Table 33 Potential habitat for koala within the Project Area

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
1	Open woodland to low open woodland on alluvial floodplains	11.3.3 HVR, 11.3.4 & 11.3.4 HVR	18.05
4	Fringing riparian woodland	11.3.25 & 11.3.25a	2.23
5	Woodland dominated by *Eucalyptus crebra* and *Corymbia dallachiana* on metamorphics	11.11.15	6.28
		Total area	**26.56**

Habitat Critical to the Survival of Koala

Before assessing the significance of potential impacts on koala habitat, an assessment against the *EPBC Act Referral Guidelines for the Vulnerable Koala* (Department of the Environment, 2014) must be undertaken. These guidelines inform significant impact assessment through the assessment of habitat as being 'critical to the survival of the species'.

The Koala EPBC referral guidelines define habitat as 'critical to the survival of the koala' if a score of five or more using the koala habitat assessment tool is obtained for the whole of the site. This assessment is presented in Table 34 below. The assessment determined that habitat within the Project Area is not habitat critical to the survival of the koala (due to a total score of 4).

Table 34 Koala habitat assessment tool

Attribute	Score	Description
Koala occurrence	0	• The field survey did not find evidence of one or more koalas occurring within the Project Area. • The Atlas of Living Australia has no koala records within 5 km of the Project Area within the last 2 years (excluding the Rockhampton Zoo).
Vegetation composition	+2 (high)	• The Project Area has remnant vegetation with two or more known koala food trees.
Habitat connectivity	+1 (medium)	• Remnant woodlands within the Project Area are part of a contiguous patch larger than < 500 ha, but ≥ 300 ha.
Key existing threats	0 (low)	• There are no known data on koala mortality from vehicle strike or dog attack. • Wild dogs occur within the Project Area. • The Project Area occurs in close proximity to the Capricorn Highway (a major arterial road).

Attribute	Score	Description
		• The Project is not expected to increase the threat of mortality from dog attack, however there will be an increase in vehicular traffic.
Recovery value	+1 (medium)	• The vegetation within the Project Area has limited potential to support a viable breeding population and allow movement of koalas between large areas of habitat.
Total	**4**	**Decision: Habitat is Not Critical to the Survival of the Koala**

Interference to the Recovery of Koala

In addition to considering adverse effects on habitat critical to the survival of the koala, the Project must be assessed for its potential to interfere substantially with the recovery of the koala. This assessment is presented in Table 35 below.

Table 35 Assessment of the Project against the recovery of the koala

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Increase koala fatalities in habitat critical to the survival of the koala due to dog attacks to a level that is likely to result in multiple, ongoing mortalities?	**No.** The Project Area does not contain habitat that is critical to the survival of the species. Additionally, the Project is unlikely to result in the introduction or increase in the number of dogs to the local area. Therefore, the Project is unlikely to cause multiple, ongoing mortalities.
Increase koala fatalities in habitat critical to the survival of the koala due to vehicle-strikes to a level that is likely to result in multiple, ongoing mortalities?	**No.** The Project Area does not contain habitat that is critical to the survival of the species. The Project will result in a development of a major road, with increased vehicular traffic to current levels and higher speeds. Fauna-sensitive road design principles will be considered to reduce the impact of vehicle collision, however there is a possibility for mortality from vehicle strike.
Facilitate the introduction or spread of disease or pathogens, for example Chlamydia or *Phytophthora cinnamomi*, to habitat critical to the survival of the koala, that are likely to significantly reduce the reproductive output of koalas or reduce the carrying capacity of the habitat?	**No.** The Project Area does not contain habitat that is critical to the survival of the species. The Project is not expected to facilitate the introduction or spread of disease or pathogens such as Chlamydia or *Phytophthora cinnamomi*. Standard vehicle hygiene practices will be implemented as part of the CEMP to ensure best practice hygiene.
Create a barrier to movement to, between or within habitat critical to the survival of the koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala?	**No.** The Project Area does not contain habitat that is critical to the survival of the species. The potential habitat within the Project Area is severely fragmented. The Project has been designed to avoid dissecting remnant vegetation where possible, with large patches of habitat unaffected by the Project. Roads and other barriers to koala movement currently exist in the Project Area. Therefore, the Project is not expected to result in a long-term reduction in genetic fitness or access to critical habitat areas.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Change hydrology which degrades habitat critical to the survival of the koala to the extent that the carrying capacity of the habitat is reduced in the long-term?	**No.** The Project Area does not contain habitat that is critical to the survival of the species. Findings from the C&R Consulting Wetlands Assessment indicates that no significant changes to the floodplains hydrology (including water quality) will occur as a result of the Project. Therefore, the Project is not expected to result in degradation of habitat that would lead to a long-term reduction in the carrying capacity of critical habitat for this species.

The impacts of the Project are not expected to result in substantial interference to the recovery of the koala.

Important Population

The SPRAT database does not identify 'important populations' of koala (Department of the Environment, 2019). Therefore, any population potentially occurring within the Project Area has been assessed against the generic definition in the *EPBC Act Significant Impact Guidelines 1.1.* Koalas are expected to occur in low-density in this region. The limited vegetation within the Project Area and the existing barriers to movement (high fragmentation and the existing Capricorn Highway) mean that the Project Area is unlikely to support an important population.

Significant Impact Assessment

The potential impact of the Project on the koala includes indirect impacts associated with adjacent vegetation clearing. This vegetation was not deemed habitat critical to the survival of the koala. Recommended mitigation measures for this species include:

- If an individual is found prior to or during clearing activities, it must not be forcibly relocated. Any tree that has a koala present, as well as any tree with its crown overlapping that tree, must not be removed and remain in place until the koala vacates the tree of its own accord
- Fauna sensitive road design principles will be considered during detailed design to reduce the potential for direct mortality from vehicle strike (i.e. installation of fauna exclusion fencing).

An assessment against the *EPBC Act Significant Impact Guidelines 1.1* for this species is provided in Table 36. The outcome of this assessment was that the Project is considered unlikely to result in a significant impact to the species.

Table 36 Significant impact assessment - koala

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of an important population of a species?	**No.** The habitat identified during the field surveys is not considered extensive and, if present, koalas are expected to occur in low densities. If present within the Project Area, the koala population does not meet the definition of an important population. Therefore, the Project is unlikely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population?	**No.** The area of occupancy of this species is unknown. If present within the Project Area, the population does not meet the definition of an important population. The Project is unlikely to reduce the area of occupancy of an important population.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Fragment an existing important population into two or more populations?	**No.** The construction of a major arterial will reduce the ability of any potentially present population to move in an east-west direction. However, numerous bridges have been incorporated into the design of the Project which may facilitate underpass for koalas. If present within the Project Area, the population does not meet the definition of an important population. Therefore, the Project is unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species?	**No.** The assessment of the Project Area against the Habitat Assessment Tool determined that it does not contain habitat that is critical to the survival of the koala (Table 34 above).
Disrupt the breeding cycle of an important population?	**No.** Koalas give birth between October and May each year. This species does not use a habitual breeding place. If present within the Project Area, the population does not meet the definition of an important population. The Project is unlikely to 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?	**No.** The potential habitat within the Project Area is severely fragmented and not considered to be of a high quality. The Project has been designed to minimise impacts on potential koala habitat and avoid large patches of remnant vegetation. The Project is unlikely to 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?	**No.** Dog attack is a key threat to the species. Dogs are known to exist within the Project Area however populations are not expected to be exacerbated beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Introduce disease that may cause the species to decline?	**No.** Threats to the koala include the root fungus *Phytophthora*, Bell Miner Associated Dieback and myrtle rust, all of which are known to impact on the health of eucalypts. The koala is known to contract strains of Chlamydia and the koala retrovirus. Chlamydia infections are known to cause reduced fertility in females of the species and are expected to reduce the reproductive potential of koala populations. The koala retrovirus can cause a range of conditions including leukaemia and immunodeficiency syndrome. The Project does not involve any processes that are likely to introduce a disease that may result in the decline of the koala.
Interfere substantially with the recovery of the species?	**No.** Assessment of the Project against the Referral Guidelines for the koala determined that the Project is not likely to substantially interfere with the recovery of this species (Table 35 above).

3. Grey-headed flying-fox (*Pteropus poliocephalus*)

The grey-headed flying-fox is Australia's only endemic flying-fox and occurs in the coastal belt from Bundaberg in central Queensland to Melbourne in Victoria. The northern range of this species once extended to Rockhampton, however as detailed by the species' listing advice (Threatened Species Scientific Committee, 2001) it is not considered to permanently occupy roosting sites in this location today. Only a small proportion of this range is used at any one time, as the species selectively forages where food is available. As a result, patterns of occurrence and relative abundance within its distribution vary widely between seasons and between years. At a local scale, the species is generally present intermittently and irregularly (Eby & Lunney, 2002). At a regional scale, broad trends in the distribution of plants with similar flowering and fruiting times support regular annual cycles of migration (Eby & Lunney, 2002).

The grey-headed flying-fox requires foraging resources and roosting sites. It is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps and *Banksia* woodlands. It also feeds on commercial fruit crops and on introduced tree species in urban areas. The primary food source is blossom from *Eucalyptus* and related genera but in some areas it also utilises a wide range of rainforest fruits (Eby, 1991). None of the vegetation communities used by the grey-headed flying-fox produce continuous foraging resources throughout the year. As a result, the species has adopted complex migration traits in response to ephemeral and patchy food resources (Eby, 1991).

Grey-headed flying-foxes commute daily to foraging areas, usually within 15 km of the day roost site (Tidemann, 1998). This species is capable of nightly flights of up to 50 km from their roost to different feeding areas as food resources change. Previous studies of movements of the species in northern New South Wales and southern Queensland have also indicated that various seasonal movements occur among camps. It is believed that grey-headed flying-foxes respond to changes in the amount of available food by migrating between camps in irregular patterns (Eby, 1991).

Occurrence and Potential Habitat

This species is considered likely to occur within the Project Area due to the presence of suitable habitat and a known roost record nearby.

Grey-headed flying-fox may forage within the Project Area and opportunistically roost in the canopy trees, though no known regular roosts occur within the Project Area. A flying-fox camp is found 10 km south west of the Project Area near Kabra, and grey-headed flying-foxes were recorded at this location in 2017. Approximately 25.56 ha of foraging habitat for this species is mapped within the Project Area, which may be directly impacted (Table 37 below).

Table 37 Grey-headed flying fox potential habitat

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
1	Open woodland to low open woodland on alluvial floodplains	11.3.3 HVR, 11.3.4 & 11.3.4 HVR	18.05
4	Fringing riparian woodland	11.3.25 & 11.3.25a	2.23
5	Woodland dominated by *Eucalyptus crebra* and *Corymbia dallachiana* on metamorphics	11.11.15	6.28
		Total area	**25.56**

Habitat Critical to the Survival of the Species

As detailed on the SPRAT, habitat critical to the survival of the grey-headed flying-fox is considered to be spring foraging and roosting resources, as reliable resources during late gestation, birth and early lactation are required to avoid rapid weight loss in adults and poor reproductive success (Department of the Environment, 2019). *Eucalyptus tereticornis* (one of the dominant tree species within habitat 1 and 4) flowers from June to November, and *Eucalyptus crebra* (dominant tree species within habitat 5) flowers in all months except February. As spring-flowering canopy trees are present in the potential habitat of the Project Area, this habitat is considered to be habitat critical to the survival of the species.

Important Population

The SPRAT database does not identify 'important populations' of the grey-headed flying-fox (Department of the Environment, 2019). Therefore, any population potentially occurring within the Project Area has been assessed against the generic definition in the *EPBC Act Significant Impact Guidelines 1.1.* The SPRAT profile states that there are no separate or distinct populations of this species due to the constant genetic exchange and movement between camps throughout their entire geographic range. Although the Project Area does not contain a known roost, it may occur at the northern limit of the species range. Although the species are highly mobile and move throughout their range, any population potentially present within the Project Area is considered an 'important population'.

Significant Impact Assessment

An assessment against the *EPBC Act Significant Impact Guidelines 1.1* is provided in Table 38. The outcome of this assessment was that the Project is considered unlikely to result in a significant impact to the species.

Table 38 Significant impact assessment – grey-headed flying-fox (*Pteropus poliocephalus*)

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Lead to a long-term decrease in the size of an important population of a species?	**No.** Foraging habitat only was identified within the Project Area. Grey-headed flying-foxes commute daily to foraging areas, usually within 15 km of the day roost site. Previous studies of movements of the species in northern New South Wales and southern Queensland have indicated that various seasonal movements occur between camps. The Project is narrow and linear in nature and has avoided large tracts of remnant vegetation. In the context of the surrounding landscape, habitat within the Project Area is already highly fragmented and higher quality roosting habitat occurs in the surrounding region outside of the Project Area. As grey-headed flying-foxes are not restricted in their dispersal ability and regularly move between foraging areas, impacts to an important population as a result of the Project would be negligible and are unlikely to occur.
Reduce the area of occupancy of an important population?	**No**. The area of occupancy is not known for this species; however the Project Area is located at the northern limit of the species' distribution. Approximately 25.56 ha of foraging habitat for this species may be required to be cleared for the Project, however the surrounding landscape is already highly fragmented and areas of continuous habitat have been avoided. Due to the absence of roosts within the Project Area and the limited amount of clearing required, it is unlikely that the Project will result in a reduction to the area of occupancy of an important population.
Fragment an existing important population into two or more populations?	**No.** The species is highly mobile and limited vegetation clearing will occur as a result of the Project (approximately 25.56 ha). Project activities would not result in dispersal challenges for any important population that may exist.

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Adversely affect habitat critical to the survival of a species?	**No.** The habitat within the Project Area was assessed against the generic *EPBC Act Significant Impact Guidelines 1.1* definition of habitat critical to the survival of a species. Flowering tree species during spring is considered habitat critical to the survival of the species. Approximately 25.56 ha of foraging habitat for this species will be cleared for the Project. No roosting habitat was identified within the Project Area for this species. Grey-headed flying-fox presence is dependent on food resources, and sites noted as important in one year or period may not be visited again in the following year. Based on this and the limited amount of clearing that will occur as a result of the Project, it is unlikely that the Project will adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population?	**No.** Mating occurs in early autumn, after which time the larger camps begin to break up, reforming in late spring/early summer, as food resources become more abundant. Males and females segregate in October when females usually give birth. Fauna spotter catchers during clearing activities, particularly during these seasons, will ensure disruptions to this species are reduced. The closest known camp is located 10 km from the Project Area near Kabra. Due to the distance from the Project Area, noise and lighting associated with construction/operation of the Project is not anticipated to have a significant impact on known roost sites. Impacts to any important population present as a result of the Project are likely to be minimal.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	**No.** Some suitable foraging habitat occurs within the Project Area, but no roosting camps were identified. Given the species extensive range and the mitigation measures proposed, including retaining large habitat trees and avoiding impacts wherever possible, it is unlikely the Project will 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?	**No.** No invasive species are known to be harmful to the grey-headed flying-fox. A detailed Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Introduce disease that may cause the species to decline?	**No.** Disease has not been identified as a threat to the grey-headed flying-fox. The Weed and Pest Management Plan for the Project will ensure best practice with site hygiene measures.

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Interfere with the recovery of the species?	**No.** No recovery plan has been developed for this species; however, the Conservation Advice (Threatened Species Scientific Committee, 2001) provides information on priority actions, direction to mitigate against key threats and enable recovery. Key threats that have been identified including habitat loss and fragmentation, exploitation, competition and hybridisation, and pollutants and electrocution. Threat abatement and recovery actions include: • Stabilise the population at its 1999 level. • Define patterns of landscape use, and identify and protect essential habitat. • Develop non-destructive methods for crop protection. • Develop non-destructive methods for management of camps in problem areas. • Ensure consistent management of the species across relevant States. Mitigation measures proposed will reduce impacts to potential habitat on site. The Project is not expected to significantly increase threats to the species to the extent that it will interfere with the recovery of the species.

4. White-throated needletail (*Hirundapus caudacutus*)

The white-throated needletail is generally gregarious when in Australia, sometimes occurring in large flocks, comprising hundreds or thousands of birds. In Australia, this species is mostly aerial, flying from heights of less than 1 m up to more than 1,000 m above the ground. For a time it was commonly believed that this species did not land while in Australia; however it is now accepted that birds will roost in trees (Tarburton, 1993), particularly in tree hollows in tall trees on ridge-tops, on bark or rock faces (Department of the Environment, 2019).

Although this species occurs over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland (Higgins & Davies, 1996b). Important habitat includes large tracts of native vegetation, particularly forest.

The white-throated needletail does not breed in Australia and is a trans-equatorial migrant which breeds in the northern hemisphere before flying south for the boreal winter. During the non-breeding season, this species is widespread in eastern and south-eastern Australia. In eastern Australia, it is recorded in all coastal regions of Queensland and New South Wales, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains (Department of the Environment, 2019). While in Australia it has been recorded feeding on a range of insects.

Occurrence and Potential Habitat

This species is a non-breeding visitor within Australia, however it may forage above the Project Area and opportunistically roost in the small hollows in tall trees. The white-throated needletail has highly diverse foraging habitat requirements, therefore it has conservatively been assumed all remnant and non-remnant areas within the Project Area are suitable foraging habitat (Table 39 below). The species was not recorded during surveys however multiple recent records are available within 10km. All potential habitat within the Project Area that may be directly impacted is detailed in Table 39.

Table 39 White-throated needletail potential habitat

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
1	Open woodland to low open woodland on alluvial floodplains	11.3.3 HVR, 11.3.4 & 11.3.4 HVR	18.05
3	Palustrine wetland	11.3.27c	5.92
4	Fringing riparian woodland	11.3.25 & 11.3.25a	2.23
5	Woodland dominated by *Eucalyptus crebra* and *Corymbia dallachiana* on metamorphics	11.11.15	6.28
		Total roosting habitat	**32.48**
2	Lacustrine wetland	11.3.27a	0.85
6	Brigalow low woodland	11.3.1 HVR	0.42
7	Modified grasslands	Non-remnant	165.31
		Total foraging habitat	**199.07**

Habitat Critical to the Survival of the Species

There is no species-specific guidelines for determining habitat critical to the survival of the white-throated needletail and at present no recovery plan exists. Therefore, the generic *EPBC Act Significant Impact Guidelines 1.1* definition of habitat critical to the survival of a species has been applied. The species does not breed in Australia and is predominantly aerial. It is highly mobile and can easily access required roosting habitat which is not available in the Project Area. Based on the ecological requirements of the species, the definition has not been met and no habitat critical to the survival of the species is present within the Project Area.

Important Population

The SPRAT does not identify 'important populations' of the white-throated needletail (Department of the Environment, 2019). Therefore, any population potentially occurring within the Project Area has been assessed against the generic definition in the *EPBC Act Significant Impact Guidelines 1.1.* As records are widely available within the region, the species does not breed in Australia and the Project Area is not near the limit of the species range, no 'important populations' are expected to occur.

Significant Impact Assessment

An assessment against the *EPBC Act Significant Impact Guidelines 1.1* is provided in Table 40. The outcome of this assessment is that the Project is considered unlikely to result in a significant impact to the species.

Table 40 Significant impact assessment - white-throated needletail (*Hirundapus caudacutus*)

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Lead to a long-term decrease in the size of an important population of a species?	**No.** Foraging and opportunistic roosting habitat only was identified within / above the Project Area. This species forages aerially and can utilise highly diverse habitats, including remnant and non-remnant areas. The white-throated needletail has highly diverse habitat requirements and can disperse easily over large distances. Impacts to any population as a result of the Project would be negligible and no important populations are expected to occur within the Project Area.

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Reduce the area of occupancy of an important population?	**No**. The area of occupancy of the white-throated needletail has been estimated at 126,200 km^2. This figure is significantly greater than the required element of the criterion for listing as vulnerable under the EPBC Act (<2,000 km^2). The conservation advice has identified loss of habitat in the non-breeding range as a potential threat. This is based on loss of roosting sites in forest and woodland habitats and how loss of these habitats may result in reduction of invertebrate prey. Within the Project Area, approximately 26.98 ha of woodland habitat will be cleared for the Project. The Project is not expected to significantly reduce roosting habitat or invertebrate prey to the extent that it would result in a reduction to the area of occupancy of the species. Further, no important populations are expected to occur within or above the Project Area.
Fragment an existing important population into two or more populations?	**No.** The species is highly mobile and predominantly aerial. Inclusive of non-remnant grasslands, the entire Project area is considered to contain potential foraging habitat for the white-throated needletail (199.07 ha). Of this total area, only 26.98 ha is woodland habitat. It is unlikely that any population of white-throated needletail depends on the habitat found within the Project Area due to its large area of occupancy and wide habitat tolerance. No important populations are expected to occur within, above or adjacent to the Project Area and Project activities would not result in dispersal challenges for any population that may exist.
Adversely affect habitat critical to the survival of a species?	**No.** The habitat within the Project Area was assessed against the generic *EPBC Act Significant Impact Guidelines 1.1* definition of habitat critical to the survival of a species. Based on the ecological requirements of the species, it's mostly aerial nature and high mobility, the definition has not been met and no habitat critical to the survival of the species is present within the Project Area.
Disrupt the breeding cycle of an important population?	**No.** The white-throated needletail is a non-breeding visitor to Australia. As the species breeds in the northern hemisphere, the Project will not disrupt the breeding cycle of any population of this species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	**No.** Some suitable foraging and roosting habitat occur within the Project Area. However, woodland habitats are highly fragmented and occur largely in disjunct patches. This species forages on insects aerially from 1 m to 1,000 m above the ground. Given the species large area of occupancy, extensive range and mitigation measures proposed, it is unlikely the Project will 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?	**No.** No invasive species are known to be harmful to the white-throated needletail. A detailed Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Introduce disease that may cause the species to decline?	**No.** Disease has not been identified as a threat to the white-throated needletail. The Weed and Pest Management Plan for the Project will ensure best practice site hygiene measures.
Interfere with the recovery of the species?	**No.** No recovery plan has been developed for this species; however, the Conservation Advice (Threatened Species Scientific Committee, 2019a) provides information on priority actions, direction to mitigate against key threats and enable recovery. Key threats that have been identified including habitat loss and fragmentation, direct mortality and poisoning from insecticides, particularly, organochlorines. The Project will not result in exacerbation of any of these threats to the Project. Due to the limited nature of any threats to the species and its mobility, no threat abatement, recovery actions or mitigations have been developed specifically for this species. Regardless, mitigation measures proposed will reduce impacts to potential habitat on site. The Project is not expected to significantly increase threats to the species to the extent that it will interfere with the recovery of the species.

5. Fitzroy River turtle (*Rheodytes leukops*)

The Fitzroy River turtle is a freshwater turtle with a light to dark brown carapace that grows to a maximum of 26 cm in length. It is endemic to the Fitzroy Basin catchment, Queensland, with the species' distribution extending over a total area of less than 10,000 km^2 (Cogger, Cameron, Sadlier, & Eggler, 1993). Known sites include Boolburra, Gainsford, Glenroy Crossing, Theodore, Baralba, the Mackenzie River, the Connors River, Duaringa, Marlborough Creek, and Gogango (Venz, Mathieson, & Schulz, 2002).

Preferred habitat areas have high water clarity, and are often associated with Ribbon weed (*Vallisneria sp.*) beds (Cogger et al., 1993). Common riparian vegetation associated with the Fitzroy River turtle includes *Eucalyptus tereticornis* (river red gum), *Casuarina cunninghamiana* (river sheoak), *Melaleuca viminalis* (weeping bottlebrush) and paperbark species including *Melaleuca linariifolia* (Tucker et al., 2001).

While riffle zones are considered particularly important habitat, the species also inhabits pools, runs and creeks (Legler & Cann, 1980). Undercut banks, root mats, logs and rocks provide important sheltering habitat. Whilst flowing waters are thought to be preferred by the species, the Fitzroy River turtle retreats into non-flowing, potentially isolated pools during the dry season (Tucker et al., 2001).

Nesting occurs between September and October (Legler, 1985) on river sandbanks 1 to 4 m above water level. Nests have been found up to 15 m from water on flat sandbanks (Cann, 1998). There is insufficient evidence available on species specific nesting requirements to accurately describe optimal nesting bank conditions; however, banks with a relatively steep slope, low density of ground/understorey vegetation and partial shade cover appear to be preferred (Limpus, 2011).

Occurrence and Potential Habitat

As detailed in the *Threatened Turtle & Fish Habitat Assessment* (AECOM, 2019b), trapping and habitat assessments were completed at select locations within the Project Area to assess potential Project impacts on the Fitzroy River turtle. Although the species presence was not confirmed, it was determined that Limestone Creek provides marginal foraging habitat, and the Fitzroy River provides foraging and dispersal habitat. The closest known records are approximately 20km up and downstream from the Project Area.

The Project Area overlaps Limestone Creek and the Fitzroy River. However, detailed design of the Project has included the installation of bridges at each of these locations. All potential habitat within the Project Area that may be directly impacted is detailed in Table 41 below.

Table 41 Potential Fitzroy River turtle foraging and dispersal habitat within the Project Area

Waterway location - banks and riparian vegetation	Size (ha) within Project Area
Fitzroy River	1.15
Limestone Creek	0.61
Total area	**1.76**

Habitat Critical to the Survival of the Species

There is no species-specific guidelines for determining habitat critical to the survival of the Fitzroy River turtle and at present no recovery plan exists. Therefore, the generic *EPBC Act Significant Impact Guidelines 1.1* definition of habitat critical to the survival of a species has been applied. Based on the ecological requirements of the species and the identified key threat of egg predation, nesting habitat is considered habitat critical to the survival of the species. No nesting habitat occurs within the Project Area and therefore no habitat critical to the survival of the species is considered to occur.

Important Population

The SPRAT does not identify 'important populations' of the Fitzroy River turtle (Department of the Environment, 2019). Therefore, any population potentially occurring within the Project Area has been assessed against the generic definition in the *EPBC Act Significant Impact Guidelines 1.1.* As this species has a restricted distribution and is known to the drainage basin in which the Project Area occurs, any potential population present is considered an 'important population'.

Significant Impact Assessment

An assessment against the *EPBC Act Significant Impact Guidelines 1.1* is provided in **Table 42**. The outcome of this assessment is that the Project is considered unlikely to result in a significant impact to the species.

Table 42 Significant impact assessment – Fitzroy River turtle

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Lead to a long-term decrease in the size of an important population of a species?	**No.** Any population of Fitzroy River turtle that occurs within the Project Area is considered an important population. Potential habitat within the Project Area was identified at two locations (marginal foraging at one location; foraging and dispersal at the other), both of which will have reduced direct (clearing) impacts due to the inclusion of bridges in the design of the Project. Findings from the C&R Consulting Wetlands Assessment have indicated that no significant hydrological impacts should occur to the surrounding Project Area (including potential Fitzroy River turtle habitat) as a result of the Project. A CEMP will be developed and implemented prior to construction commencing. Potential impacts to habitat quality through increased sediment and erosion will be managed as per the CEMP. Additionally, large trees in the riparian zones will be retained wherever possible ensuring shade is still provided and bank structure maintained. Therefore, due to the limited clearing required, the marginal nature of the habitat, lack of nesting habitat and the mitigation measures proposed, the Project is unlikely to lead to a long-term decrease in the size of an important population.

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Reduce the area of occupancy of an important population?	**No.** The primary Fitzroy River turtle habitat identified within the Project Area is the Fitzroy River. The Fitzroy River is a major watercourse with a large volume carrying capacity, and steep banks where it traverses through the city of Rockhampton. The Project will involve the creation of a new bridge across the Fitzroy River. Some localised impacts may occur to the banks where hardstands are created. However, large trees in the riparian zones will be retained wherever possible ensuring shade is still provided and bank structure maintained. Potential construction impacts such as sedimentation and erosion at this location especially are likely to have minimal impact due to the small area of construction and the characteristics of the river. Where marginal habitat is present (Limestone Creek), direct clearing impacts will also be minimised by the inclusion of bridges in the design. As detailed above, no significant hydrological impacts are expected as a result of the Project. Therefore, it is unlikely the Project will reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations?	**No.** The Fitzroy River turtle prefers habitats with flowing waters, but will retreat to non-flowing, potentially isolated pools during the dry season (Tucker et al., 2001). In order to maintain the current hydrological characteristics of the area, numerous bridges and culverts have been incorporated into the design of the Project. Findings from the C&R Consulting Wetlands Assessment have indicated that no significant hydrological impacts should occur to the surrounding Project Area as a result of the Project. Given this, and the fact that the Project will not create barriers to movement at wetlands and waterways, the Project is unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species?	**No.** Although not defined, habitat considered critical to the survival of this species is breeding habitat. No breeding habitat occurs within the Project Area. Additionally, all potential habitat within the Project Area is disturbed to some extent and considered marginal except at the Fitzroy River. Potential impacts to habitat along the Fitzroy River especially are expected to be localised and temporary. Therefore, the Project is unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population?	**No.** Breeding habitat for the Fitzroy River turtle does not occur within the Project Area. Potential habitat within the Project Area should have minimal clearing impacts due to the inclusion of bridges in the design. Findings from the C&R Consulting Wetlands Assessment indicates that no significant hydrological changes to wetland and watercourses will occur as a result of the Project. Therefore, as impacts to foraging and dispersal habitat will be minimal and no breeding habitat occurs, the Project is unlikely to disrupt the breeding cycle of an important population.

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	**No.** Potential habitat within the Project Area was identified in two locations, both of which will have reduced direct (clearing) impacts due to the inclusion of bridges in the design of the Project. Habitat in Limestone Creek was considered to be marginally suitable for foraging only and impacts are limited due to inclusion of bridge design. Impacts to the habitat at the Fitzroy River are likely to be minimal due to its large size and high banks. Findings from the C&R Consulting Wetlands Assessment have indicated that no significant hydrological impacts should occur to the surrounding Project Area (including potential Fitzroy River turtle habitat) as a result of the Project. A CEMP will be developed and implemented prior to construction commencing. Potential impacts to habitat quality through increased sediment and erosion will be managed as per the CEMP. As such, it is considered unlikely the Project will 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?	**No.** The greatest threat to this species currently is nest destruction and egg predation by feral pigs (*Sus scrofa*), foxes (*Vulpes vulpes*) and dogs (*Canis lupus*). These species are present within the Project Area and it is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through project activities. Control efforts will be increased in areas particularly sensitive to invasion, riparian and wetland habitats.
Introduce disease that may cause the species to decline?	**No.** Disease has not been identified as a threat to the Fitzroy River turtle. The Weed and Pest Management Plan for the Project ensure best practice with site hygiene measures.
Interfere with the recovery of the species?	**No.** No recovery plan has been developed for this species; however, the Conservation Advice (Department of the Environment, Water, 2008) provides information on priority actions, direction to mitigate against key threats and enable recovery. Key threats that have been identified including habitat loss disturbance and modification, trampling and animal predation. Threat abatement and recovery actions include: identify populations of high conservation priority, protect areas of riparian habitat where the species may occur, ensure mining operations and other infrastructure does not impact on known populations, mange changes to hydrology that may result in changes to the water table levels, investigate formal conservation arrangements, develop and implement a stock management plan for riparian habitats and develop a pest fauna management plan for areas of potential nesting. Mitigation measures proposed will reduce impacts to potential habitat on site. The Project is not expected to significantly increase threats to the species to the extent that it will interfere with the recovery of the species.

Critically Endangered or Endangered Species Criteria

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

- Lead to a long-term decrease in the size of a population
- Reduce the area of occupancy of the species
- Fragment an existing population into two or more populations
- Adversely affect habitat critical to the survival of a species
- Disrupt the breeding cycle of a 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 Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat
- Introduce disease that may cause the species to decline **or**
- Interfere with the recovery of the species.

'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.

6. Australian painted snipe (*Rostratula australis*)

The Australian painted snipe is a wading bird found predominantly across eastern Australia in wetland habitats. They generally inhabit shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. However, they have also been known to utilise areas lined with trees, as well as modified habitats such as low-lying woodlands converted to grazing pasture, sewage farms, dams, bores and irrigation schemes.

Breeding habitat requirements are shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. Nest records are nearly all from or near small islands in freshwater wetlands, provided that these islands are a combination of very shallow water, exposed mud, dense low cover and sometimes some tall dense cover. The nest is usually placed in a scrape in the ground.

The Australian painted snipe forage on vegetation, seeds, insects, worms and molluscs, crustaceans and other invertebrates. This species is mainly crepuscular (active at dawn and dusk), preferring to sit quietly under cover of grass, reeds or other dense cover during day, becoming more active at dawn, dusk and during night. They generally remain in dense cover when feeding, although may forage over nearby mudflats and other open areas such as ploughed land or grassland.

The movements of the Australian painted snipe are poorly known and it may be a migratory species. Sightings of individuals are erratic, and it is thought the species is likely to be nomadic in response to suitable conditions, such as floods.

Occurrence and Potential Habitat

This species is considered likely to occur in the Project Area based on the availability of suitable habitat only at Pink Lily Lagoon. This habitat provides shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby which can be utilised for foraging. Small exposed islands with areas of dense low vegetation that could be utilised for breeding / nesting do not occur within the Project Area. The species was not recorded during the surveys however a recent record is present at Murray Lagoon adjacent to the Project Area. It should also be noted that the southern section of Pink

Lily Lagoon was verified only from adjacent properties or roads, and the Capricorn Highway Wetland was unable to be accessed. All potential habitat within the Project Area that may be directly impacted is detailed in Table 43.

Table 43 Australian painted snipe potential foraging habitat within the Project Area

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
3	Palustrine wetland	11.3.27c	0.07
		Total area	**0.07**

Habitat Critical to the Survival of the Species

There is no species-specific guidelines for determining habitat critical to the survival of the Australian painted snipe and at present no recovery plan exists. Therefore, the generic *EPBC Act Significant Impact Guidelines 1.1* definition of habitat critical to the survival of a species has been applied. Based on the specific habitat requirements of the species, shallow wetlands in eastern Australia are considered habitat critical to the survival of the species which are present in Pink Lily Lagoon.

Significant Impact Assessment

An assessment against the *EPBC Act Significant Impact Guidelines 1.1* is provided in Table 44. The outcome of this assessment was that the Project is unlikely to result in a significant impact to the species, due to minimal impact to suitable habitat for the species.

Table 44 Significant impact assessment - Australian painted snipe

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of a population?	**No.** The Australian painted snipe is inferred to have undergone a severe decline in the number of mature individuals since the 1950s and specifically over the last three generations (~26 years) due to the loss and degradation of its wetland habitat. The clearing of suitable breeding, foraging and dispersal habitat at Pink Lily Lagoon has been minimised during the detailed design of the Project through the inclusion of bridges and micro-siting to non-remnant areas within the corridor. However, some vegetation clearing and cut and fill impacts at Pink Lily Lagoon may occur to create hardstands. Results from the C&R Consulting Wetlands Assessment have indicated no significant hydrological changes (including water quality) will occur at wetlands within and adjacent to the Project Area. Potential impacts to wetlands during construction will be managed as per the CEMP, to be developed prior to work commencing. However, the operation of the Project may indirectly impact the wetland habitats with increased permanent lighting and traffic noise. Although a small area of habitat may be subjected to direct and indirect impacts, these impacts are unlikely to be of the size and scale that would lead to a long-term decrease in the size of a population.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Reduce the area of occupancy of the species?	**No.** The area of occupancy of the Australian painted snipe is estimated, with low reliability, to be 1,000 km². The area of occupancy has undoubtedly declined as approximately 50% of wetlands in Australia have been removed since European settlement. Detailed design of the Project has included bridges at all wetland locations within the Project Area, including Pink Lily. The direct impacts to habitat are limited to 0.07 ha with some indirect impacts expected including increased noise and lighting. These impacts are not of the size and scale that are considered likely to reduce the area of occupancy of the species.
Fragment an existing population into two or more populations?	**No.** The Project Area is narrow and linear and will not result in barriers to movement within or between habitat for this species which is highly mobile. Therefore it is unlikely the Project will fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of a species?	**No.** Critical habitat for the survival of this species is defined as shallow wetlands suitable for foraging and breeding. This habitat is present at Pink Lily Lagoon within the Project Area. However, only 0.07 ha will be impacted by vegetation clearing where hardstands are created for bridges. Potential impacts to wetlands during construction such as increased erosion and sedimentation will be managed as per the CEMP, to be developed prior to work commencing As discussed above, no significant hydrological impacts are expected to occur at wetlands as a result of the Project. However, operation of the Project will result in increased noise due to traffic and lighting across the entire Project Area. Considering the minimal impacts to critical habitat are of a small magnitude, the Project is unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population?	**No.** The Australian painted snipe may breed in response to favourable wetland conditions rather than during a particular season. Breeding in northern Queensland has been recorded between May and October. Project related impacts such as removal of vegetation and access by vehicles may impact on local breeding cycles or individual pairs; however this is unlikely to disrupt the breeding cycle at a population scale.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	**No.** No records of the species occur within the Project Area and it is uncertain if an ecologically significant proportion of the population could be supported in this habitat. Additional survey effort under ideal climatic conditions may allow for greater certainty of habitat condition and potential utilisation. Wetland habitat at Pink Lily Lagoon was already degraded by cattle pugging, weeds and thinning and clearing of vegetation. However microhabitat features suitable to support the species were still present at Pink Lily Lagoon. Although minor clearing and indirect impacts are expected, these are not of the magnitude that would reduce habitat to the extent that the species is likely to decline.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat?	**No.** The replacement of endemic wetland vegetation by invasive, noxious weeds could render habitats less suitable or unsuitable. Weeds and pest fauna species are already prevalent across the Project Area, however Project activities have the potential to exacerbate weed species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion, such as wetlands. With these mitigation measures in place, it is considered unlikely that the Project would result in further proliferation of invasive species.
Introduce disease that may cause the species to decline?	**No.** Disease has not been identified as a key threat to the species. The Weed and Pest Management Plan for the Project will detail the measures to prevent the introduction and spread of disease.
Interfere with the recovery of the species?	**No.** The SPRAT profile identifies that a Recovery Plan for the Australian painted snipe is required; however no such plan exists at the time of this report. In 2001, a project was initiated by the Threatened Bird Network and Australasian Wader Studies Group to improve knowledge of the Australian painted snipe so that meaningful conservation actions could be proposed. Recovery actions implemented as part of this project include: the development of a database of records; the introduction of national targeted surveys conducted twice per year at important historic and contemporary sites and other sites of interest; and an assessment of habitat preferences. Based on these objectives, the Project is unlikely to interfere with the recovery of the species and will not exacerbate known threats to the species.

7. Curlew sandpiper (*Calidris ferruginea*)

The curlew sandpiper is a non-breeding migrant to Australia. Whilst in Australia the species prefers coastal areas but can also occur inland in lesser numbers. In Queensland there are scattered records in the Gulf of Carpentaria, along the coast between Torres Straight to south of Cairns. Sparsely scattered records also occur inland with regular sightings around Mt. Isa (Higgins & Davies, 1996a).

Breeding occurs in northern Siberia before migrating to Australia in July. Individuals begin to arrive in northern Australia in late August but continue to move south reaching south-east Australia in September. This route from northern Australia to south eastern Australia is can differ among individuals, with most likely travelling coastal but some inland. Occasionally, if weather and wind condition deteriorate, individuals and small flocks will descend to rest and forage for short periods on inland wetlands. This generally occurs during southward migration, particularly between September and November(Department of the Environment, 2019).

Curlew sandpipers are predominately found on intertidal mudflats in sheltered coastal areas such as estuaries, bays, inlets and lagoons, as well as non-tidal swamps, lakes and lagoons near the coast (Department of the Environment, 2019). They occur in both fresh and brackish waters. They are also known to inhabit artificial environments such as salt works and sewage farms. Although not utilised as frequently as coastal environments, curlew sandpipers have been recorded far inland at ephemeral or permanent lakes or dams with bare edges of mud or sand (Higgins & Davies, 1996a).

Curlew sandpipers forage on mudflats and nearby shallow water (Higgins & Davies 1996). In non-tidal wetlands, they usually wade, mostly in water 15–30 mm, but up to 60 mm deep. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores. At high tide, they forage among low sparse emergent vegetation, such as saltmarsh, and sometimes forage in flooded paddocks or inundated saltflats.

Curlew sandpipers are omnivorous, feeding mainly on invertebrates including worms, molluscs, crustaceans and insects, as well as seeds (Higgins & Davies 1996). They are gregarious in nature, often occurring in large flocks and mixing freely with other small waders when feeding and roosting (Higgins & Davies 1996). Roosting generally occurs on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh.

Occurrence and Potential Habitat

Foraging and dispersal habitat for this species occurs at Pink Lily, Lotus, Dunganweate, Nelson and possibly Black Duck Lagoon. Majority of this habitat (with the exception of Pink Lily) is considered to be marginal due to the high level of disturbance. Although Pink Lily Lagoon is also disturbed by cattle pugging, vegetation thinning and weed incursion, it does provide a relatively large area of shallow, permanent wetland habitat, wide muddy margins for foraging and fringing vegetation suitable for refuge. The amount of foraging and dispersal habitat within the Project Area that may be directly impacted is detailed in Table 45 below. Wetlands adjacent to the Project Area are not included in the table below.

Given the migratory habits of the species, it is likely that existing resources within the Project Area would be utilised infrequently and on a transitory basis only. No individuals were identified during the field survey. The nearest record for this species is approximately 80 km northeast of the Project Area in Byfield National Park. It should be noted that the climatic conditions prior and during surveying were unseasonably dry and potentially not representative of usual habitat condition or species utilisation.

Table 45 Curlew sandpiper potential foraging habitat within the Project Area

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
2	Lacustrine wetland	11.3.27a	0.85
3	Palustrine wetland	11.3.27c	5.92
		Total area	**6.77**

Habitat Critical to the Survival of the Species

Habitat critical to the survival of the curlew sandpiper is not formally defined, and there is currently no recovery plan for this species. However, the Conservation Advice for the curlew sandpiper details that 22 internationally important sites for south-ward migration occur within Australia. Therefore, habitat considered critical to the survival of the species are ‘important sites’ as recognised by the Conservation Advice. None of these sites are within the Project Area.

Significant Impact Assessment

An assessment against the *EPBC Act Significant Impact Guidelines 1.1* is provided in Table 46. The outcome of this assessment was that the Project is unlikely to result in a significant impact to the species.

Table 46 Significant impact assessment – curlew sandpiper

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of a population?	**No.** The observed decline in curlew sandpiper numbers across Australia is attributed to the ongoing loss of intertidal mudflat habitat at key migration staging sites in the Yellow Sea. Direct impacts at wetlands are likely to be minimal given the inclusion of bridges in the design of the Project (6.77 ha under worst-case scenario/no bridges). However, some vegetation clearing and cut and fill impacts at wetlands within the Project Area may occur to create hardstands. Results from the C&R Consulting Wetlands Assessment have indicated no significant hydrological changes (including water quality) will occur at wetlands within and adjacent to the Project Area. Potential impacts to wetlands during construction will be managed as per the CEMP, to be developed prior to work commencing. The operation of the Project is likely to result in indirect impacts (increase noise and lighting) to wetland habitats, however it is unlikely this will lead to an overall decrease in the size of a population given the species preference for coastal habitats which are available in the wider area. Therefore, it is unlikely the Project will lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species?	**No.** The area of occupancy in Australia is estimated at 6,800 km^2. Detailed design of the Project has included bridges at all wetland locations within the Project Area. As discussed above, no significant hydrological impacts are expected to occur at wetlands as a result of the Project. The operation of the Project is likely to result in indirect impacts (increase noise and lighting) to wetland habitats, however it is unlikely this will lead to an overall decrease in the size of a population given the lack of preferred habitat within the Project area and availability of preferred habitat in the wider area. Therefore, it is unlikely the Project will lead to a long-term decrease in the size of a population.
Fragment an existing population into two or more populations?	**No.** Curlew sandpipers are highly mobile and likely to fly at considerable height while migrating. No local populations are known to occur. Although the Project Area directly intersects a number of mapped wetland areas, the use of bridges over these areas should maximise connectivity opportunities for fauna in wetted areas. Where bridges are installed, vegetation clearing will only occur to create hardstand areas at each end (thereby minimising the clearing extents of the wetland areas). It is therefore considered unlikely the Project will result in the creation of barriers to movement to, between or within habitat. Therefore, it is unlikely that the Project will fragment an existing population into two or more populations.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Adversely affect habitat critical to the survival of a species?	**No.** Critical habitat for the survival of this species has not been defined, however 22 internationally important curlew sandpiper sites occur within Australia. The Project Area is not situated near an internationally significant sites; the closest is Morten Bay, located approximately 500 km south. No significant roosting population was identified during the field survey. However, given the limitations associated with the survey (not ideal climatic conditions prior to and during), additional survey effort may be required under more representative climatic conditions to confirm this. Direct impacts (vegetation clearing) at wetlands are likely to be minimal given the inclusion of bridges in the design of the Project (6.77 ha under worst-case scenario/no bridges). Additionally, results from the C&R Consulting Wetlands Assessment have indicated no significant hydrological changes (including water quality) will occur at wetlands within and adjacent to the Project Area. Considering this, and the avoidance and mitigation measures that have been proposed, the Project is unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population?	**No.** This species does not breed in Australia. The Project is unlikely to disrupt the breeding cycle of a population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	**No.** Potential habitat for the curlew sandpiper within the Project Area is considered marginally suitable for foraging and dispersal and are likely used on a transitory basis only. Direct impacts (vegetation clearing) at wetlands are likely to be minimal given the inclusion of bridges in the design of the Project (6.77 ha under worst-case scenario/no bridges). Additionally, results from the C&R Consulting Wetlands Assessment have indicated no significant hydrological changes (including water quality) will occur at wetlands within and adjacent to the Project Area. Potential impacts to wetlands during construction will be managed as per the CEMP, to be developed prior to work commencing. The operation of the Project may indirectly impact the wetland habitats with increased noise and light, however this will not impact to the extent that the species is likely to decline. As such, it is considered unlikely that the Project may 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 Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat?	**No.** Disturbance by dogs (*Canis lupus*) at roost and feeding sites is a listed threat to the curlew sandpiper This species, as well as other pest fauna are prevalent within the Project Area and it is unlikely that the Project will exacerbate invasive species beyond current levels. Nonetheless, a Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion such as the wetlands.
Introduce disease that may cause the species to decline?	**No.** Disease has not been identified as a main threat to the species. The Weed and Pest Management Plan for the Project will detail the measures to prevent the introduction and spread of disease.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Interfere with the recovery of the species?	**No.** The federal environment minister has declared that that a national recovery plan for the curlew sandpiper is not required; however key threats are identified as loss of breeding sites outside of Australia, habitat alteration and a rise in sea level. Direct impacts (vegetation clearing) at wetlands are likely to be minimal given the inclusion of bridges in the design of the Project (6.77 ha under worst-case scenario/no bridges). Additionally, results from the C&R Consulting Wetlands Assessment have indicated no significant hydrological changes (including water quality) will occur at wetlands within and adjacent to the Project Area. Potential impacts to wetlands during construction will be managed as per the CEMP, to be developed prior to work commencing. The operation of the Project may indirectly impact the wetland habitats with increased noise and light, however this is only expected to affect the small number of individuals that may use the sites. Therefore, the Project is considered unlikely to interfere substantially with the recovery of the species.

8. Australasian bittern (*Botaurus poiciloptilus*)

The Australasian bittern is secretive and stocky bird found in Australia, New Zealand and New Caledonia. Within Australia, it inhabits wetlands in south-east Queensland to south-east South Australia, however vagrants have also been recorded in northern Australian, including in the north-east of Western Australia. The population is considered to comprise of two subpopulations: the south-eastern and the south-western.

Australasian bitterns are generally solitary, but sometimes occurs in pairs or dispersed aggregations of up to 12 birds. The Australasian bittern occurs mainly in freshwater wetlands and, rarely, in estuaries or tidal wetlands. It favours wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and reeds (e.g. *Phragmites, Cyperus, Eleocharis, Juncus, Typha, Baumea, Bolboschoenus*) or cutting grass (*Gahnia*) growing over a muddy or peaty substrate.

The Australasian bittern breeds from October to February in solitary pairs. This species nests adjacent to relatively deep, densely vegetated freshwater swamps and pools, building its nests under dense cover over shallow water. They prefer to nest in vegetation that is up to 2.5 m tall.

This species is considered capable of moving between habitats as suitability changes and has been recorded completing movements of several hundred kilometres.

Occurrence and Potential Habitat

The species was not identified during the field survey and the closest record is approximately 40km southeast of the Project Area. This species is considered as potentially occurring in the Project Area due to the presence of some marginal habitat. Breeding, foraging and dispersal habitat for this species occurs in the mapped lacustrine wetland vegetation areas of Pink Lily Lagoon (potentially also at Lotus Lagoon during favourable wet seasons) which provide shallow wetland habitat with some areas of tall, dense *Persicaria orientalis*. The amount of foraging and dispersal habitat within the Project Area that may be directly impacted is detailed in Table 47 below. Wetlands adjacent to the Project Area are not included in the table below.

Given the high mobility of the species and its ability to move to suitable habitat, it is likely that existing resources within the Project Area would be utilised infrequently and on a transitory basis only.

Table 47 Potential Australasian bittern habitat within the Project Area

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
3	Palustrine wetland	11.3.27c	0.07
		Total area	**0.07**

Habitat Critical to the Survival of the Species

Habitat critical to the survival of the Australasian bittern is defined in the species' approved Conservation Advice (Threatened Species Scientific Committee, 2019b) as "all natural habitat (including constructed wetlands with suitable habitat) in which the Australasian bittern is known or likely to occur should be considered critical to the survival of the species". Habitat within the Project Area is considered to be marginal for this species and as such is not habitat critical to the survival of the species.

Significant Impact Assessment

An assessment against the *EPBC Act Significant Impact Guidelines 1.1* is provided in Table 48. The outcome of this assessment was that the Project is unlikely to result in a significant impact to the species, due to the minimal impact to marginal habitat for the species.

Table 48 Significant impact assessment – Australasian bittern

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of a population?	**No.** As detailed in the species' approved Conservation Advice (Threatened Species Scientific Committee, 2019b), the major factor in the decline of the Australasian bittern population in Australia is the reduction in extent of available habitat due to the long-term diversion of water away from wetlands and floodplains to support irrigated agriculture and urban water supplies; and the permanent loss of wetlands through conversion to other purposes, such as agricultural and urban development. Direct impacts at Pink Lily Lagoon is expected to be minimal given the inclusion of bridges in the design of the Project (0.07 ha of palustrine wetland under worst-case scenario/no bridges). Results from the C&R Consulting Wetlands Assessment have indicated no significant hydrological changes (including water quality) will occur at wetlands within and adjacent to the Project Area. Potential impacts to wetlands during construction will be managed as per the CEMP, to be developed prior to work commencing. The operation of the Project is likely to result in indirect impacts (increase noise and lighting) to wetland habitats, however it is unlikely this will lead to an overall decrease in the size of a population given the amount of available habitat in the wider area. Therefore, it is unlikely the Project will lead to a long-term decrease in the size of a population.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Reduce the area of occupancy of the species?	**No.** The Australasian bittern's area of occupancy within Australia is estimated to have declined by approximately 70% between 1977 and 2008. The listing advice for the species (Threatened Species Scientific Committee, 2011) states "in Queensland, clearing of coastal wetlands for urban development, particularly around the Sunshine Coast, has greatly reduced the species' area of occupancy". Other than the Townsville region, Rockhampton is the northern-most area in the species distribution (Department of the Environment, 2019). Detailed design of the Project has included bridges at all wetland locations within the Project Area, including Pink Lily. This has resulted in minimal direct impact (0.07ha) to potential habitat for the species. Habitats are already highly disturbed, and no significant hydrological impacts are expected to occur at wetlands as a result of the Project. Operation of the Project will result in increased noise and lighting at night across the entire Project Area. Impacts on not expected to be of sufficient magnitude to reduce the area of occupancy of the species.
Fragment an existing population into two or more populations?	**No.** Through the inclusion of bridges in the design of the Project, no barriers to movement to, between or within wetland habitats will be created for the species and is therefore it is unlikely the Project will fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of a species?	**No.** Critical habitat for the survival of this species is defined as any potential habitat where the Australasian bittern is known to or is likely to occur. Habitat within the Project Area is highly degraded and considered to be marginal. As such it does not meet the criteria to be considered habitat critical to the survival of the species. Regardless, potential impacts to wetlands during construction such as increased erosion and sedimentation will be managed as per the CEMP, to be developed prior to work commencing. As discussed above, no significant hydrological impacts are expected to occur at wetlands as a result of the Project.
Disrupt the breeding cycle of a population?	**No.** Breeding habitat is marginal and impacts are limited. Therefore, the Project is unlikely to disrupt the breeding cycle of a population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	**No.** Potential habitat for the Australasian bittern within the Project Area is considered marginal and are already degraded by cattle pugging, the presence of weeds and thinning of vegetation. Direct impacts (vegetation clearing) at wetlands are likely to be minimal given the inclusion of bridges in the design of the Project (0.07 ha of palustrine wetland). Additionally, results from the C&R Consulting Wetlands Assessment have indicated no significant hydrological changes (including water quality) will occur at wetlands within and adjacent to the Project Area. Potential impacts to wetlands during construction such as increased erosion and sedimentation will be managed as per the CEMP, to be developed prior to work commencing.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat?	**No.** Predation by foxes (*Vulpes vulpes*) and cats (*Felis catus*), as well as habitat degradation by cattle are recognised threats to the Australasian bittern. Evidence of pest fauna at wetland locations was common, and it is likely that these species are present within the Project Area. The Project is not expected to result in exacerbation of these invasive species beyond current levels. Nonetheless, a Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion such as the wetlands. Additionally, should properties containing wetlands be acquired, it is recommended that cattle be excluded to ensure future grazing impacts are reduced.
Introduce disease that may cause the species to decline?	**No.** Disease has not been identified as a key threat to the species. The Weed and Pest Management Plan for the Project will ensure best practice site hygiene measures.
Interfere with the recovery of the species?	**No.** The approved Conservation Advice for this species lists key strategies to expand the range and number of Australasian bitterns in Australia. Key strategies include: • Identifying key sites where Australasian bitterns occur throughout their range and establish a baseline measure of abundance. This baseline will then be used to track change over time. • Managing key sites to ensure habitat is suitable for Australasian Bitterns. This will require measures that primarily target adequate water flow and quality, and measures to ensure weed species and grazing animals do not compromise wetland structure and function. • Improve understanding of foraging and breeding behaviour, in order to better design recovery actions. Wetlands within the Project Area have experienced significant grazing impacts which have compromised the wetland structure and reduced their value as habitat for the species. Given the degraded nature of the wetlands in the Project Area, the lack of records and the presence of a number of key threats, the impacted wetlands are unlikely to be considered a key site which requires identification, baseline abundance measurement or habitat management. Results from the C&R Consulting Wetlands Assessment have indicated no significant hydrological changes (including water quality) will occur at wetlands within and adjacent to the Project Area. Potential impacts to wetlands during construction such as increased erosion and sedimentation will be managed as per the CEMP, to be developed prior to work commencing. It is considered unlikely the Project will interfere with the recovery of the species as a whole.

9. White-throated snapping turtle (*Elseya albagula*)

The white-throated snapping turtle is one of Australia's largest freshwater turtle species. It occurs throughout the Fitzroy, Burnett and Mary River catchments, with an area of occupancy of an estimated less than 500 km^2 (Threatened Species Scientific Committee, 2014).

The white-throated snapping turtle is a habitat specialist (Todd et al., 2013). Within the river system it prefers clear, flowing, well-oxygenated waters. It prefers waters with complex subsurface structure in the form of log tangles, undercut banks, and irregular rocky substrata. It is typically absent or rare in standing waters impounded by dams or weirs, unless associated with free-flowing streams.

This species has not been recorded where there are no permanent pools during the dry season and has not been recorded inhabiting ephemeral water bodies away from main watercourses, indicating that it has a limited capacity to cross dry paddocks or follow dry streambeds for extended distances (Threatened Species Scientific Committee, 2014). The home range of the white-throated snapping turtle is generally less than 500 m and is usually restricted to the one pool. During dry periods turtles may move into deeper pools which function as a dry season refuge.

The white-throated snapping turtle has an extended breeding season that occurs between March and September. Once they reach sexual maturity (at least 18 years of age) female turtles are thought to breed annually. Almost all nesting occurs on alluvial sand-loam banks deposited by floodwaters, which are often reworked with each significant flooding event (Limpus, 2008). Nests may occur in loose or compact soils, under a closed canopy or with less than 50% canopy cover, with a dense covering of grasses or with low or no vegetation (Limpus, 2011). In the Fitzroy catchment, nests are constructed on average at 17 m (with a range of 1-86 m) from the water's edge (Limpus, 2011). Nests are shallow, with a mean depth of 23 cm, and most nesting occurs on sloped banks with an average slope of 27 degrees.

The species changes its diet from being largely carnivorous (feeding on benthic invertebrates) when young, to largely herbivorous as it gets older. Their primarily diet for adults is the fruit and buds of riparian vegetation that fall on the water (such as *Livistona*, *Ficus*, *Syzygium* and *Castanospermum australe*), leaves and stems of terrestrial plants, tree roots, filamentous algae (including *Mougeotia* and *Spirogyra*). Animal material forms a small part of the diet of adults and includes freshwater sponges, carrion, cane toads and insect larvae (Thomson, Georges, & Limpus, 2006).

Occurrence and Potential Habitat

As detailed in the *Threatened Turtle and Fish Habitat Assessment* (AECOM, 2019b), trapping and habitat assessments were completed in the Project Area to assess potential Project impacts on the white-throated snapping turtle. Although the species presence was not confirmed, it was determined that Limestone Creek provides marginal foraging habitat, and the Fitzroy River provides foraging and dispersal habitat. No suitable breeding habitat is present within the Project Area.

The Project Area overlaps Limestone Creek and the Fitzroy River. However, detailed design of the Project has included the installation of bridges at each of these locations. All potential habitat within the Project Area that may be directly impacted is detailed in Table 49 below.

Table 49 Potential white-throated snapping turtle foraging and dispersal habitat within the Project Area

Waterway location - banks and riparian vegetation	Size (ha) within Project Area
Fitzroy River	1.15
Limestone Creek	0.61
Total area	**1.76**

Habitat Critical to the Survival of the Species

There is no species-specific guidelines for determining habitat critical to the survival of the Australian painted snipe and at present no recovery plan exists. Therefore, the generic *EPBC Act Significant Impact Guidelines 1.1* definition of habitat critical to the survival of a species has been applied. No nesting habitat is available in the Project Area, although marginal foraging habitat is present in

Limestone Creek and foraging and dispersal opportunities are available in the Fitzroy River. The Fitzroy River may provide a valuable dispersal pathway for this species and as such is considered to be habitat critical to the survival of the species.

Significant Impact Assessment

An assessment against the *Significant Impact Guidelines 1.1* is provided in Table 50. The outcome of this assessment was that the Project is considered unlikely to result in a significant impact to the species.

Table 50 Significant impact assessment – white-throated snapping turtle

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Lead to a long-term decrease in the size of a population?	**No.** Potential white-throated snapping turtle habitat within the Project Area was identified in two locations. At both locations, direct (clearing) impacts will be reduced due to the inclusion of bridges in the design of the Project. Findings from the C&R Consulting Wetlands Assessment have indicated that no significant hydrological impacts should occur to the surrounding Project Area (including potential white-throated snapping turtle habitat) as a result of the Project. A CEMP will be developed and implemented prior to construction commencing. Potential impacts to habitat quality through increased sediment and erosion will be managed as per the CEMP. Additionally, large trees in the riparian zones will be retained wherever possible ensuring shade is still provided and bank structure maintained. Therefore, due to the limited clearing required and the mitigation measures proposed, the Project is unlikely to lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species?	**No.** The primary white-throated snapping turtle habitat identified within the Project Area is the Fitzroy River. The Fitzroy River is a major watercourse with a large volume carrying capacity, and steep banks where it traverses through the city of Rockhampton. The Project will involve the creation of a new bridge across the Fitzroy River. Some localised impacts may occur to the banks where hardstands are created. However, large trees in the riparian zones will be retained wherever possible ensuring shade is still provided and bank structure maintained. Potential construction impacts such as sedimentation and erosion at this location especially are likely to have minimal impact due to the small area of construction and the characteristics of the river. Where marginal habitat is present (Limestone Creek), direct clearing impacts will also be minimised by the inclusion of bridges in the design. As detailed above, no significant hydrological impacts are expected as a result of the Project. Therefore, it is unlikely the Project will reduce the area of occupancy of the species.
Fragment an existing population into two or more populations?	**No.** The white-throated snapping turtle prefers habitats with clear, flowing, well-oxygenated waters, and complex subsurface structures. In order to maintain the current hydrological characteristics of the area, numerous bridges and culverts have been incorporated into the design of the Project. Findings from the C&R Consulting Wetlands Assessment have indicated that no significant hydrological impacts should occur to the surrounding Project Area as a result of the Project. Given this, and the fact that the Project will not create barriers to movement at wetlands and waterways, the Project is unlikely to fragment an existing population into two or more populations.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Adversely affect habitat critical to the survival of a species?	**No.** The Fitzroy River is considered to be habitat critical to the survival of this species. Limestone Creek is marginal for foraging only and as such is not considered to be critical habitat. Potential impacts to habitat are expected to be contained to the construction of hardstands for the new bridges. Potential construction impacts such as increased sedimentation and erosion at are likely to have minimal impact due to the small area of construction and implementation of suitable erosion and sediment control measures. A CEMP will be developed and implemented prior to construction commencing to manage such risks. Additionally, large trees in the riparian zones will be retained wherever possible ensuring shade is still provided and bank structure maintained. Therefore, the Project is unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population?	**No.** Breeding habitat for the white-throated snapping turtle does not occur within the Project Area. Potential habitat within the Project Area should have minimal clearing impacts due to the inclusion of bridges in the design. As discussed above, no significant hydrological changes to wetland and watercourses should occur as a result of the Project. Therefore, as impacts to foraging and dispersal habitat will be minimal and no breeding habitat occurs, the Project is unlikely to 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?	**No.** Potential habitat within the Project Area was identified in two locations, both of which will have reduced direct (clearing) impacts due to the inclusion of bridges in the design of the Project. In both locations, habitat was highly disturbed with weeds and/or grazing impacts evident, and thus considered marginal. Impacts to the habitat at the Fitzroy River are likely to be minimal due to its large size and high banks. As discussed above, no significant hydrological impacts should occur to the surrounding Project Area (including potential white-throated snapping turtle habitat) as a result of the Project. A CEMP will be developed and implemented prior to construction commencing and will include measures to manage potential impacts such as increased sediment and erosion. Additionally, large trees in the riparian zones will be retained wherever possible ensuring shade is still provided and bank structure maintained. As such, it is considered unlikely the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat?	**No.** The greatest threat to this species currently is nest destruction and egg predation by feral pigs (*Sus scrofa*), foxes (*Vulpes vulpes*), dogs (*Canis lupus*) and cats (*Felis catus*). These species are present within the Project Area and it is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through project activities. Control efforts will be increased in areas particularly sensitive to invasion, riparian and wetland habitats.
Introduce disease that may cause the species to decline?	**No.** Disease has not been identified as a threat to the white-throated snapping turtle. The Weed and Pest Management Plan for the Project will ensure best practice with site hygiene measures.
Interfere with the recovery of the species?	**No.** No recovery plan has been developed for this species; however, the Conservation Advice (Threatened Species Scientific Committee, 2014) provides information on priority actions, as well as directions to mitigate against key threats and enable recovery. Key threats that have been identified including habitat loss disturbance and modification, obstruction of migration within rivers, injury and death during over-topping and water releases, inappropriate water allocation, flooding of nesting areas and loss of riparian vegetation leading to reduction in available food. Threat abatement and recovery actions include: • Increased protection of nesting banks from predation and from trampling by herbivores. • Recommence and maintain hatchery programs to supplement recruitment of hatchlings into the population. • Modify water infrastructure design and/or operation to minimise mortality of adult turtles during flood events and water releases. • Ensure that water planning includes allocation for flows that maintain water quality that allows cloacal respiration, particularly during low flow periods. Design of the Project has included features such as bridges to minimise potential hydrological changes to the surrounding environment. Findings from C&R Consulting have indicated that no significant hydrological changes are expected as a result of the Project. Mitigation measures proposed will reduce impacts to potential habitat on site. The Project is not expected to significantly increase threats to the species to the extent that it will interfere with the recovery of the species.

Migratory Species Criteria

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

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; **or**
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

'Important habitat' for a migratory species listed under the EPBC Act is defined in the Commonwealth *Significant Impact Guidelines 1.1* as an area which is:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- Habitat that is of critical importance to the species at particular life-cycle stages and/or
- Habitat utilised by a migratory species which is at the limit of the species range, and or
- Habitat within an area where the species is declining.

'Important habitat' for the 37 migratory shorebirds listed under the EPBC Act, have more specific guidelines which are outlined in *EPBC Act Policy Statement 3.2.1* (Department of the Environment and Energy, 2017). This includes areas recognised as nationally or internationally important (Department of the Environment, 2015b).

Wetland habitat should be considered **internationally important** if it regularly supports:

- 1% of the individuals in a population of one species or subspecies of waterbird; **or**
- A total abundance of at least 20,000 waterbirds;

Wetland habitat should be considered **nationally important** if it regularly supports:

- 0.1% of the flyway population of a single species of migratory shorebird; **or**
- 2,000 migratory shorebirds; **or**
- 15 migratory shorebird species.

Latham's snipe does not commonly aggregate in large flocks or use the same habitats as other migratory shorebird species. Consequently, habitat important to Latham's snipe cannot be identified using the process outlined above and different criteria are necessary. Important habitat for Latham's snipe is described as areas that have previously been identified as internationally important for the species, or areas that support at least 18 individuals of the species (Department of the Environment, 2015b).

'Ecologically significant proportion of the population' refers to the proportions of each migratory species population likely to result in a significant impact if affected. This varies from species to species and as such each species will need to be evaluated based on factors such as the species':

- Population status
- Genetic distinctiveness
- Species specific behavioural patterns (i.e. site fidelity; dispersal rates).

For species that aggregate in flocks, 1% of the population is considered internationally important and 0.1% as nationally important.

Further guidance on 'important habitat' and 'ecological significant proportion' for a number of the migratory species is also provided in the Referral guideline for 14 birds listed as migratory species under the EPBC Act (Department of the Environment, 2015a).

10. Saltwater crocodile (*Crocodylus porosus*)

The saltwater crocodile mostly occurs in tidal rivers, coastal floodplains and channels, billabongs and swamps up to 150 km inland from the coast. In Queensland, the species is usually restricted to coastal waterways and floodplain wetlands. Preferred nesting habitat includes elevated, isolated freshwater swamps that do not experience the influence of tidal movements (Department of the Environment, 2019). They feed primarily on crustaceans and insect and in larger individuals, mammals. They are also known to feed on a variety of prey species including birds, fish, flying foxes, cats, dogs, pigs, cattle, horses and infrequently, humans (Department of Environment and Energy, 2019).

The Australian population has been estimated to be within 100,000 to 200,000 individuals (DoEE, n.d.) across Queensland, Northern Territory and Western Australia. Rockhampton is at the southern extent of the species range and abundance is comparatively low in the Fitzroy Catchment. In a 10 year survey on abundance and distribution of the species in Queensland, 19 non-hatchling crocodiles were sighted in 159 km surveyed (average of 0.12 per km) within the Fitzroy Catchment (Read, Miller, Bell, & Felton, 2004). This represented the equal lowest abundance of the eight areas surveyed.

The major threats to the species within Australia include mortality as by-catch in fishing nets, effects of habitat destruction as well as destruction of wetland habitat by buffalo (*Bubalus bubalis*) by increasing drainage and reducing vegetation (Department of Environment and Energy, 2019).

Occurrence and Potential Habitat

Salt-water crocodile is known to occur in the Fitzroy River and its tributaries and there is anecdotal evidence that the species may occur occasionally in Pink Lilly lagoon following large flood events (pers. comms, Department of Environment and Science, 2019). Spotlighting and habitat assessments were completed in the Project Area to assess potential Project impacts. Although the species presence was not confirmed, it is likely present in low abundance within the Project Area in the Fitzroy River and the large connected tributaries, Lions Creek and Limestone Creek. These waterways and associated backwaters provide suitable foraging and dispersal habitat for the saltwater crocodile. Pink Lily lagoon is potentially suitable for nesting and foraging and the species is likely present on a temporally variable basis after major flow events have connected the lagoon to the main channel of the Fitzroy River.

Detailed design of the Project has included the installation of bridges at each of these waterways. All potential habitat within the Project Area that may be directly impacted is detailed in Table 51

Table 51 Potential saltwater crocodile habitat within the Project Area

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
3	Palustrine wetland	11.3.27c	0.07
		Total nesting habitat	**0.07**
4	Fringing riparian woodland	11.3.25 & 11.3.25a	2.23
		Total foraging habitat	**2.3**

Important Habitat

All habitat within the Project Area meets the criteria of 'important habitat' based on the location of the Project at the southern extent of the species range. This habitat does not meet the other 'important habitat' criteria as outlined in the Commonwealth *Significant Impact Guidelines 1.1.* This is due to the Project Area not supporting an ecologically significant portion of the population, no available evidence of species decline in the catchment and no large extents of habitat that is critically important to the life-cycle of the species.

Significant Impact Assessment

An assessment against the *Significant Impact Guidelines 1.1* is provided in Table 52. The outcome of this assessment was that the Project is considered unlikely to result in a significant impact to the species.

Table 52 Significant impact assessment – salt-water crocodile

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	**No** The saltwater crocodile has been assessed as Known to occur in the area, based on records within the Fitzroy River, at the confluence of Lions Creek and in Pink Lily lagoon. In Queensland this species inhabits reef, coastal and inland waterways from Gladstone on the east coast, throughout the Cape York Peninsula and west to the Queensland-Northern Territory border (Department of the Environment, 2019). The disturbance to suitable habitat is relatively small, and will not support an important population or ecologically significant proportion of the population (1% of the population – approximately 1,000 to 2,000 individuals). Further, the species is primarily aquatic and waterways where potential habitat is present have been avoided through bridge design. Vegetation clearance at these locations for bridge abutments and associated infrastructure are not expected to modify breeding or foraging habitat to the extent that it would impact any local population. No barriers to movement will be created as a result from the Project. Indirect impacts such as noise and lighting may lead to avoidance of areas adjacent to the Project Area. Numerous mitigation measures will also be implemented to ensure the extent and quality of adjacent habitat is maintained. The CEMP will include mitigation measures specific to weed and pest incursion, and erosion and sediment control (which may further alter the surrounding habitat). For the above reasons, and that the Project will not materially change the landscape within which the salt-water crocodile may exist, it is unlikely that the Project will substantially impact on important habitat for the species.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	**No** One invasive species, the water buffalo (*Bubalus bubalis*), has been identified as a threat to the saltwater crocodile because they destroy wetland habitat by increasing drainage and reducing vegetation (Leach, G.J., Delaney, R., Fukuda, 2009). Water buffalo are not present in the region and do not pose a risk to the species within the Project Area. Nonetheless, the risk of establishing further weed or pest species will be managed by applying appropriate and strict weed and pest animal control measures, as well as including rehabilitation measures.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	**No** The Fitzroy River catchment supports a low abundance of saltwater crocodile and impacts to suitable habitat are limited given significant availability of habitat in the region and the high mobility of the species. Given the small amount of habitat being impacted and the significant availability of habitat in the region, the Project is unlikely to disrupt the lifecycle of an ecologically significant proportion of the population.

11. Eastern osprey (*Pandion haliaetus*)

Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging (DotEE, 2019). Their diet primarily consists of fish however they are known to occasionally feed on molluscs, crustaceans, reptiles, birds and mammals (DotEE, 2019).

The breeding range of the osprey extends across the northern coast of Australia (including many offshore islands) from Albany in Western Australia to Lake Macquarie in New South Wales; with a second isolated breeding population on the coast of South Australia, extending from Head of Bight east to Cape Spencer and Kangaroo Island (DotEE, 2019).

Occurrence and Potential Habitat

Suitable habitat is available within the Project Area and this species was recorded at Yeppen Lagoon, located east of the Project Area. Records of this species also occur at Woolwash Lagoon (2017) and Murray Lagoon (2012).

The freshwater lagoons and the Fitzroy River provide suitable foraging habitat for eastern osprey with large open areas and a variety of suitable fish prey species known from the catchment. Nests are constructed in a variety of natural features and manmade structures including dead or partly dead trees; on cliffs and rocks and lighthouses and telecommunication towers. Large trees and stags in the riparian zone of the Fitzroy River and surrounding Pink Lily Lagoon, Lotus Lagoons and Black Duck Lagoon provide potential nesting opportunities however nests are large and conspicuous yet none were observed during the field surveys. The species is highly mobile and may use the airspace above the Project Area across all habitat types when dispersing between foraging locations. However, they are known to travel inland along major rivers, as such the Fitzroy River is likely the primary dispersal pathway.

The species exhibits a preference for coastal areas however they do frequent a variety of habitats including inland wetlands and rivers such as those in the Project Area. As such it is likely that the eastern osprey utilises habitat within the Project Area intermittently for foraging and dispersal predominantly.

All potential habitat within the Project Area that may be directly impacted is detailed in Table 53.

Table 53 Potential eastern osprey habitat within the Project Area

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
3	Palustrine wetland	11.3.27c	5.92
4	Fringing riparian woodland	11.3.25 & 11.3.25a	2.23
		Total nesting habitat	**8.15**
2	Lacustrine wetland	11.3.27a	0.85
		Total foraging habitat	**9**

Important Habitat and Ecological Significant Proportion

Important habitat for the eastern osprey has been identified as (Department of the Environment, 2015a):

- Bays, estuaries, along tidal stretches of large coastal rivers, mangrove swamps, coral and rock reefs, terrestrial wetlands and coastal lands of tropical and temperate Australia and off shore islands
- Nesting habitat is in trees (often dead or with dead tops), rocky coastlines and on artificial structures such as telecommunications towers
- Foraging habitat is primarily in the sea or nearby estuarine waters.

The area threshold for important habitat for this species has been identified as 840 km of coastline (1 %) and 84 km of coastline (0.1 %). An ecologically significant proportion of the eastern osprey population is estimated at 24 individuals (0.1 %).

Based on this definition and ground-truthing of habitat during field surveys, terrestrial wetlands within and adjacent to the Project Area are considered to be important habitat for the species.

Significant Impact Assessment

An assessment against the *Significant Impact Guidelines 1.1* is provided in Table 54. The outcome of this assessment was that the Project is considered unlikely to result in a significant impact to the species as impacts to an ecologically significant proportion of the population will not occur and impacts to important habitat are minimal.

Table 54 Significant impact assessment – Eastern osprey

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	**No.** The area threshold for important habitat for this species has been identified as 840 km of coastline (1 %) and 84 km of coastline (0.1 %) (Department of the Environment, 2015a). The Project will result in some clearing within potential nesting, foraging and dispersal habitat; however, the area to be cleared does not reach the area threshold for this species and is not located on the coastline. Indirect impacts include increased traffic noise, lighting, with no major changes to hydrology expected. The Project is not considered likely to result in the creation of barriers to movement to, between or within habitat. No significant changes to the nutrient cycle or hydrological cycle are expected. Replacement of native ground layer vegetation by exotic species such as buffel grass (*Cenchrus ciliaris*), may result in higher fuel loads and more intense fires. The proliferation of such exotic species will be managed through the implementation of a weed and pest management plan and fire has not been identified as a major threat to the species. Therefore, the Project is unlikely to substantially modify, destroy or isolate an area of important habitat for the Eastern osprey.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	**No.** Any invasive species that greatly reduces fish abundance are considered to be harmful to this species (Department of the Environment, 2015a). No such species are known to be present within the area or will become established in an area of important habitat as a result of the Project. Weed and pest mitigation measures will be developed to mitigate and manage the potential spread of pest flora and fauna species. Control efforts will be increased in areas particularly sensitive to invasion.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	**No.** An ecologically significant proportion of the eastern osprey population is estimated at 24 individuals (0.1 %). Although this species is likely to use wetland and riverine areas for foraging and dispersal, it is unlikely that the Project Area could support an ecologically significant proportion of the population. Impacts associated with the Project are not expected to alter the availability or quality of foraging or dispersal habitat to the extent that it would impact any local population. Visual detection of fish prey may be temporarily compromised during construction when turbidity in waterways and wetlands

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
	may increase. Construction will be staged and hence any impact from increases to turbidity would not impact significant foraging resources simultaneously. Further, the ambient turbidity levels of the Fitzroy River and some wetlands in the Project Area (such as Pink Lily Lagoon) are already high. Erosion and sediment control measures will be developed and implemented to reduce the risk of increased turbidity. Some potential nesting resources may be impacted by direct clearing and increases in noise and light pollution. However, nesting habitat is marginal and high value habitat is widely available in the surrounding region. Further, given the location of the Project Area is inland and separated from preferred coastal habitat, the species is unlikely to occur in high abundance. Therefore, it is unlikely that the Project will result in a serious disruption to the lifecycle of an ecologically significant proportion of the population.

12. White-throated needletail (*Hirundapus caudacutus*)

The white-throated needletail is generally gregarious when in Australia, sometimes occurring in large flocks, comprising hundreds or thousands of birds. In Australia, this species is mostly aerial, flying from heights of less than 1 m up to more than 1,000 m above the ground. For a time it was commonly believed that this species did not land while in Australia; however it has now been observed that birds will roost in trees (Tarburton, 1993), particularly in tree hollows in tall trees on ridge-tops, on bark or rock faces (Department of the Environment, 2019).

Although this species occurs over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland (Higgins & Davies, 1996b). Important habitat includes large tracts of native vegetation, particularly forest.

Occurrence and Potential Habitat

This species is a non-breeding visitor within Australia, however it may forage above the Project Area and opportunistically roost in the small hollows in tall trees. The white-throated needletail has highly diverse foraging habitat requirements, therefore it has conservatively been assumed all remnant and non-remnant areas within the Project Area are suitable foraging habitat (Table 55).

Table 55 White-throated needletail potential habitat

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
1	Open woodland to low open woodland on alluvial floodplains	11.3.3 HVR, 11.3.4 & 11.3.4 HVR	18.05
3	Palustrine wetland	11.3.27c	5.92
4	Fringing riparian woodland	11.3.25 & 11.3.25a	2.23
5	Woodland dominated by *Eucalyptus crebra* and *Corymbia dallachiana* on metamorphics	11.11.15	6.28
		Total roosting habitat	**32.48**
2	Lacustrine wetland	11.3.27a	0.85
6	Brigalow low woodland	11.3.1 HVR	0.42
7	Modified grasslands	Non-remnant	165.31
		Total foraging habitat	**199.07**

Important Habitat and Ecological Significant Proportion

Important habitat for the white-throated needletail has been described as (Department of the Environment, 2015a):

range of habitats, more often over wooded areas, where it is almost exclusively aerial. Large tracts of native vegetation, particularly forest, may be a key habitat requirement for species. Found to roost in tree hollows in tall trees on ridge-tops, on bark or rock faces. Appears to have traditional roost sites.

An ecologically significant proportion of the white-throated needletail population is estimated at 10 individuals (0.1 %).

Based on this definition and ground-truthing of habitat type and extent during field surveys, the majority of habitat within the Project Area would be considered to be important habitat for the species and could potentially support an ecologically significant proportion of the species.

Significant Impact Assessment

This species was assessed against the criteria for a Vulnerable species and the outcome determined that the Project is unlikely to have a significant impact on the species. As the white-throated needletail is also listed as Migratory under the EPBC Act, the *Significant Impact Guidelines 1.1* criteria for Migratory species was also used and the assessment is provided in Table 56. The outcome of this assessment was that the Project is considered unlikely to result in a significant impact to the species.

Table 56 Migratory significant impact assessment - white-throated needletail

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	**No.** The Project is not considered likely to result in the creation of barriers to movement to, between or within habitat, nor will it alter the fire regimes, nutrient cycles or hydrological cycles. No threshold area for important habitat for this species can be determined at this time or has been identified (Department of the Environment, 2015a). It has conservatively been assumed the entire Project Area contains suitable foraging habitat (total area of 199.07 ha). However, majority of this area comprises highly disturbed grazing pasture and is unlikely to be preferred habitat in the context of the wider area. Tracking studies on this species has identified that whilst this species often forages with 100-200 others, only a small proportion will use trees for roosting, suggesting they might roost in many places, to avoid nocturnal predators taking a regular & significant toll (Tarburton, 1993). Therefore, while low numbers of this species may opportunistically roost in the Project Area, the Project is unlikely to substantially modify, destroy or isolate an area of important habitat for the white-throated needletail.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	**No.** Invasive flora and fauna species have not been identified as a key threat to the species and it is unlikely that the Project will exacerbate invasive species beyond current levels. A detailed Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.

EPBC Act Criteria – is there a real possibility that the Project will:	Assessment of Significance
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	**No.** The population is estimated to be at least 10,000 individuals but probably fewer than 100,000. An ecologically significant proportion of the white-throated needletail population is estimated at 100 individuals (1%, lower threshold) and 10 individuals (0.1%, upper threshold) (Department of the Environment, 2015a). At any given time during the non-breeding season, the proportion of white-throated needletails within the Project Area, relative to the national population is likely to be minimal. This species is likely to be an infrequent visitor to the Project Area and only during the non-breeding season. They are highly mobile while in Australia, with large flocks often preceding or following low pressure systems as they cross the country in search of food. For these reasons, it is unlikely that the Project will result in a serious disruption to the lifecycle of an ecologically significant proportion of the population.

13. Listed migratory species

Notwithstanding migratory species already assessed in the previous sections, a number of additional migratory species are considered present or to have moderate or high likelihood of occurrence within the Project Area (Table 57).

Table 57 Summary table of migratory shorebirds likely or present within the Project Area and surrounds

Species name	Summary of habitat requirements	Outcome of the Likelihood of Occurrence
Black-tailed godwit	Commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud, sand or shell-grit; occasionally recorded on rocky coasts or coral islets (Department of the Environment, 2019).	Likely / High
Caspian tern	Mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline.	Present
Common greenshank	Found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms (Department of the Environment, 2019).	Likely / High
Common sandpiper	Occurs in a range of wetland environments, both coastal and inland. Their primary habitat is rocky shorelines and narrow muddy margins of billabongs, lakes, estuaries and mangroves (Department of the Environment, 2019).	Moderate / Potential
Glossy ibis	Preferred habitat are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation.	Present
Latham's snipe	Occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Department of the Environment, 2019).	Present

Species name	Summary of habitat requirements	Outcome of the Likelihood of Occurrence
Little curlew	Often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated.	Likely / High
Little tern	Inhabits sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches (Department of the Environment, 2019).	Likely / High
Marsh sandpiper	Inhabits permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks (Department of the Environment, 2019).	Present
Pectoral sandpiper	Usually found in coastal or near coastal habitat but very occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire (Department of the Environment, 2019).	Likely / High
Red-necked stint	Mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores (Department of the Environment,2019).	Likely / High
Sharp-tailed sandpiper	Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland (Department of the Environment, 2019).	Likely / High
Wood sandpiper	Inhabits well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation and often with fallen timber.	Moderate / Potential
Curlew sandpiper	This species mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They occur in both fresh and brackish waters (Department of the Environment, 2019).	Moderate / Potential
Western Alaskan bar-tailed godwit	Habitat for this species includes tidal mudflats, estuaries, shallow river margins and inland on large shallow fresh or brackish waters along the Queensland coast (Department of the Environment, 2019).	Likely / High

Occurrence and Potential Habitat

The species detailed in above are all considered migratory shorebirds or waders. These birds require aquatic habitats, generally preferring wetlands with varying levels of salinity. Foraging is often completed in the shallow water edges of the wetland or in the adjacent mudflats (Department of the Environment, 2019).

Based on the habitat encountered during surveying, suitable foraging and dispersal habitat occurs at Pink Lily Lagoons and Lotus Lagoons. It should also be noted the southern section of Pink Lily Lagoon was verified only from adjacent properties or roads, and Capricorn Highway Wetland was unable to be accessed. Majority of this habitat (with the exception of Pink Lily) is considered to be marginal due to the high level of disturbance. Pink Lily provides higher value foraging and roosting habitat for wading bird species due to the large area of permanent water, wide muddy margins and shallow sloping banks for foraging, wetland vegetation in the margins for refuge.

The amount of foraging and dispersal habitat within the Project Area that may be directly impacted under-worst case scenario is detailed in Table 58 below. Wetlands adjacent to the Project Area where no direct impacts are expected have not been included in the table below.

Table 58 Migratory shorebird potential habitat within the Project Area

Habitat ID	Habitat Short Description	Analogous RE/s	Size (ha) within Project Area
2	Lacustrine wetland	11.3.27a	0.85
3	Palustrine wetland	11.3.27c	5.92
		Total area	**6.77**

Important Habitat and Ecologically Significant Proportion of a Population

The results of the targeted shorebird surveys suggest that there are no internationally or nationally important sites or locations for migratory shorebirds present within or adjacent to the Project Area.

A key limitation to the migratory bird survey was the climatic conditions prior to and during, which were unseasonably dry. As a result, habitat condition as well as species' utilisation and abundance may not be representative of a typical wet season. Further, wet seasons with particularly high rainfall will result in much greater wetted areas providing temporally abundant habitat for wading birds.

Specifically, in response to the criteria provided by the Commonwealth for assessing important habitat for migratory shorebirds the following is provided.

- The Project Area is not located adjacent to, nor contains within any sites identified as internationally important for migratory shorebirds
- The Project Area is not located adjacent to, nor contains within any sites that support 0.1% or more of the flyway population of any migratory shorebird species, given the very low densities of birds recorded during the survey
- The Project Area is not located adjacent to, nor contains within any sites that were observed to support 2,000 or more individual migratory shorebirds, with the largest group of individuals observed comprising 19 individuals
- The Project Area is not located adjacent to, nor contains any sites that were observed to support 15 or more migratory shorebird species, with the total number of migratory shorebird species recorded for the entire Project Area comprising five species.

Five listed migratory species were identified within or adjacent to the Project Area. Of these and the additional moderate or high likelihood species listed above, the Project Area is unlikely to support an ecologically significant proportion of population, with the exception of Latham's snipe which will be considered separately from this point.

Significant Impact Assessment

Given the large number of migratory bird species to be assessed, one assessment was undertaken for all species (with the exception of Latham's snipe) due to their similar habitat requirements, habitat use and migration patterns. An assessment against the *EPBC Act Significant Impact Guidelines 1.1* for migratory birds is provided in Table 59.

Table 59 Significant impact assessment for migratory birds

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	**No.** The Project Area does not contain 'important habitat' for any of the migratory species listed above (with exception of Latham's snipe). Given their migratory habits and the highly ephemeral nature of food and habitat resources, it is likely that existing resources within the Project Area would be utilised infrequently and on a transitory basis only. Direct impacts (vegetation clearing) at wetlands are likely to be minimal given the inclusion of bridges in the design of the Project (6.77 ha under worst-case scenario/no bridges). The Project Area has been micro-sited to primarily overlap areas of low-value non-remnant grassland. Findings from the C&R Consulting Wetlands Assessment indicates that no significant hydrological impacts (including water quality) to wetlands should occur as a result of the Project. As such, the Project is also considered unlikely to alter the nutrient or hydrological cycles of the wider environment. Potential impacts to wetlands during construction such as increased erosion and sedimentation will be managed as per the CEMP, to be developed prior to work commencing. The Project is unlikely to substantially modify, destroy or isolate an area of important habitat a migratory species.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	**No.** It is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	**No.** The occurrence and abundance of these species within the Project Area within successive years is likely to be highly variable. However, there is currently no evidence to suggest that the Project Area or wetlands directly adjacent to the Project Area support an 'ecologically significant proportion of a population' of any of the migratory species known or considered likely to occur (with the exception of Latham's snipe). Impacts to wetlands will be managed through mitigation measures and avoided wherever practical through design. For these reasons, the Project is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of a migratory species population.

Important habitat and ecologically significant proportion of a population – Latham's snipe

Behaviours and habitats for Latham's snipe do tend to differ to many of the coastal migratory shorebird species. For example, whilst many species aggregate in large flocks, Latham's snipe typically disperse in small numbers across larger habitat areas. Consequently, important habitat for Latham's snipe is identified using a different process to that described above (DEWHA, 2009).

Important habitat for Latham's snipe occurs at sites that have previously been identified as internationally important for the species, or sites that:

- Support at least 18 individuals of the species (ecologically significant proportion of the population), and
- Are naturally occurring open freshwater wetland with vegetation cover nearby (for example, tussock grasslands, sedges, lignum or reeds within 100m of the wetland).

Fourteen individuals of the species were observed foraging at Pink Lily Lagoon on 11 February 2019. It is highly unlikely that all individuals using this lagoon were observed and that these only represented a portion of the total population. Given the size of the lagoon and the amount of representative habitat that was able to be thoroughly surveyed, it is expected that the lagoon supported greater than 18 individuals at the time of survey. This would equate to an ecologically significant proportion of the population for Latham's snipe. As such Pink Lily Lagoon and potentially other wetlands areas within the Project Area is considered to be important habitat for the species.

Pink Lily Lagoon is a naturally occurring wetland with riparian cover surrounding much of the littoral zone. This includes 1-2m tall *Urochloa mutica* and *Persicaria orientalis*. Furthermore, other wetlands within the Project Area also provided suitable habitat for this species, such as Lotus Lagoons.

Significant impact assessment

Based on the threshold criteria detailed above and outlined in the *Significant Impact Guidelines for 36 Migratory Shorebird Species – EPBC Act Policy Statement 3.21,* important habitat for Latham's snipe is present within the Project Area and it is considered a real possibility that the Project will have a significant impact on the species. As such it is recommended that a referral to the Department of Environment and Energy is submitted.

Table 60 Significant impact assessment for Latham's snipe

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	**Possibly.** The Project Area and connecting wetlands are likely to contain 'important habitat' for Latham's snipe as identified above. Direct impacts (vegetation clearing) at all wetlands that the Project Area overlaps are likely to be minimal given the inclusion of bridges in the design of the Project (6.77 ha under worst-case scenario/no bridges). However, some vegetation clearing as well as cut and fill impacts will be required to create hardstands. Findings from the C&R Consulting Wetlands Assessment has indicated that significant hydrological impacts are unlikely to occur as a result of the Project. The operation of the Project will lead to indirect impacts to wetland habitats through the increased lighting and traffic noise. The extent of these impacts has not been determined at this stage. Given that some direct impacts are expected to occur at Pink Lily and Lotus Lagoons (identified as important habitat), and indirect impacts are difficult to qualify, there is a real possibility that the Project will substantially modify, destroy or isolate an area of important habitat for Latham's snipe.

Criterion – "is there a real chance or possibility that the Project will…"	Assessment
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	**No.** It is unlikely that the Project will exacerbate invasive species beyond current levels. A Weed and Pest Management Plan will be developed to mitigate and manage the potential spread of pest flora and fauna species. Species-specific management will be undertaken for identified key weed and pest species at risk of spread through Project activities. Control efforts will be increased in areas particularly sensitive to invasion such as wetlands.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	**Possibly.** As discussed above, the Project Area and connected wetlands are likely to support an ecologically significant proportion of the population of Latham's snipe. Although the occurrence and abundance of this species within the Project Area within successive years is likely to be highly variable, the Project Area does provide high quality habitat for the foraging, feeding and roosting needs of this species. Impacts to wetlands will be managed through mitigation measures and avoided wherever practical through design. However, given the importance of this habitat and number of individuals found to be present during the survey there is a possibility that the Project could seriously disrupt the lifecycle of an ecologically significant proportion of the species.