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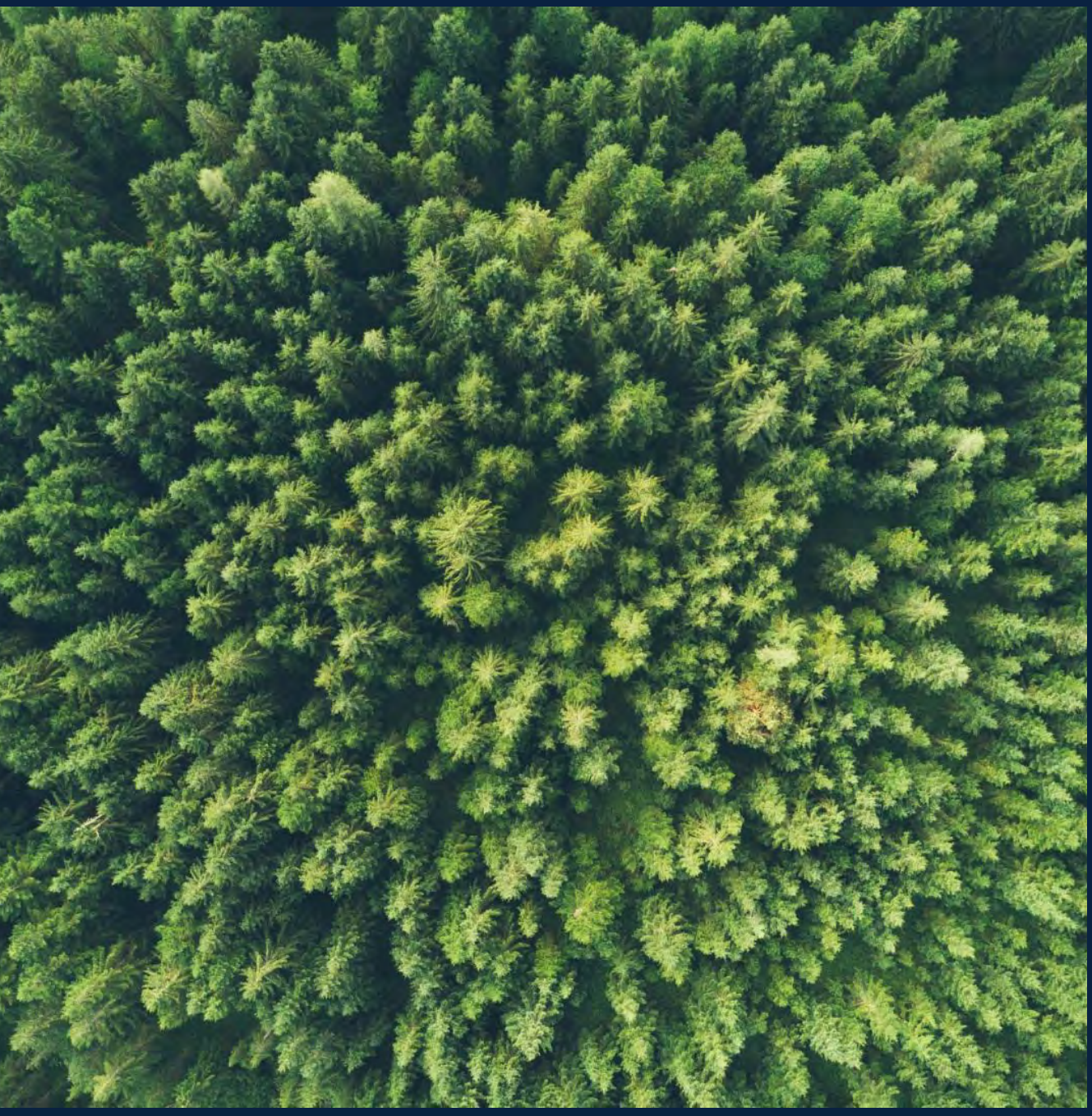

SMEC INTERNAL REF. 30034151

Ecological Assessment Report

EPW00390 – Ecological Assessment Report (30034151-RPT-12.0-001) – Revision 0

Client Reference No. 30034151
Prepared for: Department of Housing, Local Government, Planning and Public Works
24 May 2024

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1. Introduction

The Queensland Government, is investigating options to address flood risk to the Bundaberg region and are proposing the design and construction of a levee at Bundaberg East. Bundaberg has had a number of flood events with the most recent in 2013 (Tropical Cyclone Oswald) causing widespread flooding to homes, and businesses throughout Bundaberg.

In 2019, a Business Case was finalised for the BEL project. This included a levee concept design, founded on flood studies (hydrological and hydraulic), geotechnical investigations, desktop studies and community engagement. The primary aim of the levee is to reduce the impacts of flooding from the Burnett River on Bundaberg East and Bundaberg South.

The Bundaberg East Levee (BEL) design will feature approximately 1.6 kilometres of levee near the Burnett River's southern bank, a flood gate and pump station at the outlets of both Saltwater Creek and the unnamed "Distillery Creek." These floodgates will be closed during regional flood events to prevent backwater flooding from the Burnett River, safeguarding the Bundaberg CBD and East/South Bundaberg areas. This system is designed to protect against a flood event comparable to the 2013 event, with approximately 150mm of freeboard.

1.1 Purpose

SMEC was engaged by Department of Housing, Local Government, Planning and Public Works to undertake an ecological assessment report (EAR) for the Project.

The purpose of the EAR is to support a successful and timely Ministerial Infrastructure Designation (MID). In particular we note that the purpose of this task is to:

- Determine and describe the terrestrial ecological characteristics of the Project locality;
- Inform the design of the Project to help ensure impacts are avoided, minimised and mitigated as far as practicable; and
- Identify the likely and known permit and/or approval requirements associated with the Project and collect preliminary data to help inform preparation of same.

1.2 Project Scope

The scope of the assessment was as follows;

- To complete an ecological field assessment targeting the matters identified within the Terms of Reference – with a particular focus on the presence or likely presence of threatened species or communities and their habitat, breeding habitat for native fauna and watercourses, waterways and wetlands.
- To undertake a marine plant and desktop fish habitat and passage assessment of the site, to establish the likely impacts to these matters as a result of the Project.
- To complete a protected plants flora survey in accordance with the *Flora Survey Guidelines – Protected Plants, Nature Conservation Act 1992* of the whole of the development footprint and 100m buffer to same excluding those areas that can reasonably be excluded due to being consistent with a 'highly modified environment'.

The assessment of impacts to fish passage and fish community has been addressed within the Bundaberg East Levee Fish Community and Passage Assessment (Aquatic Biopassage Services 2024) provided herein as Appendix A.

1.3 Site Context

The Project is to be constructed alongside the Burnett River in Bundaberg East. The currently proposed construction footprint is illustrated in Figure 1. The Project is located within an urban, residential, and mixed-use area and bound by Walla Street to the west, Bourbong and Cran Streets to the South, the Millaquin Sugar Mill to the east, and the Burnett River to the north. The Project area incorporates the downstream portions of Saltwater Creek and Distillery Creeks at their confluence with the Burnett River. The project supports predominantly cleared and developed land

with small areas of regrowth and remnant vegetation – generally associated with the riparian zones of the river and creeks.

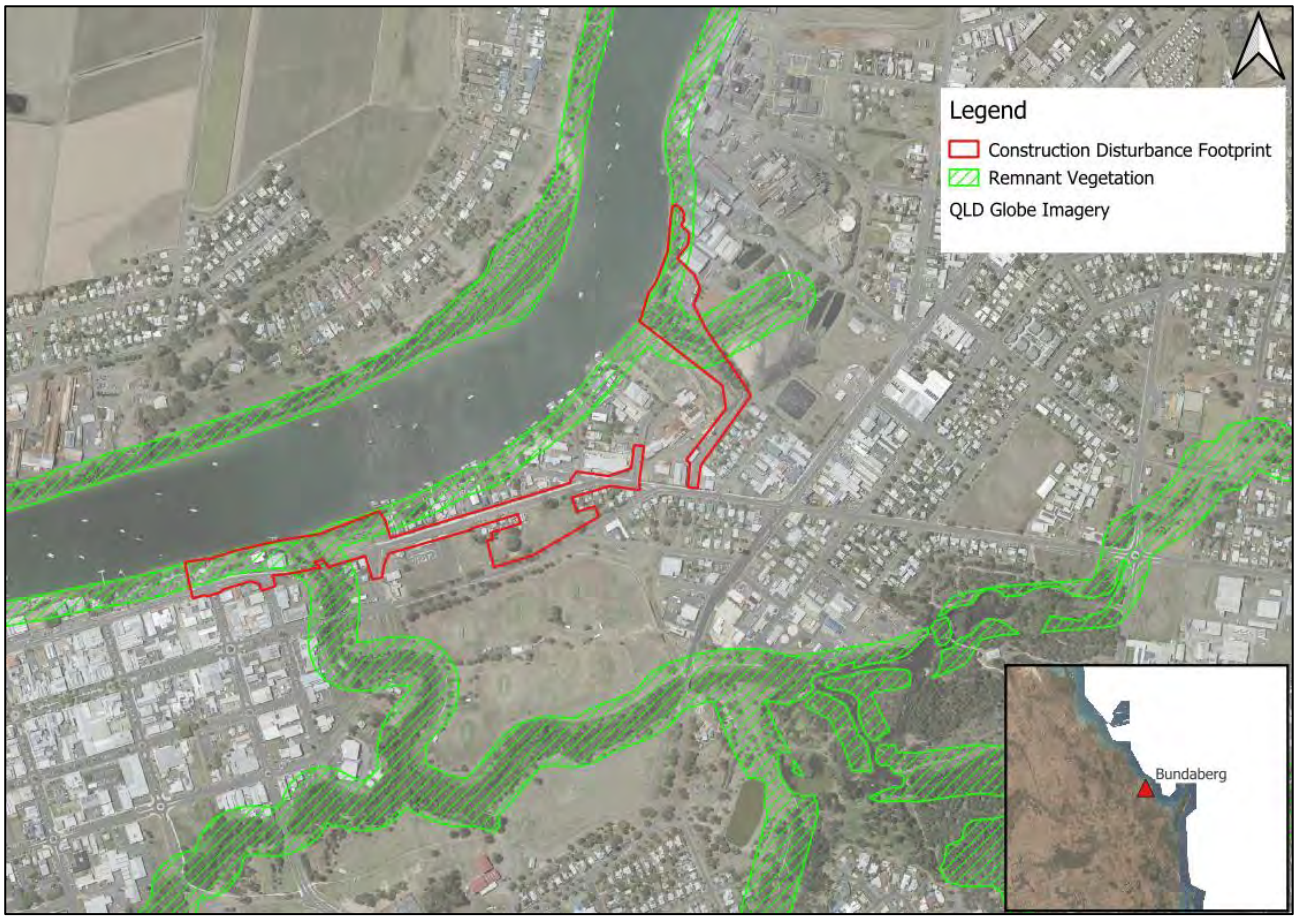

Figure 1: Site Context

2. Methodology

2.1 Desktop Assessment

Prior to undertaking the field ecological assessment, a review of contemporary desktop information was completed by a suitably qualified ecologist. The desktop assessment involved collation and review of relevant information concerning critically endangered, endangered, vulnerable and near threatened (CEEVNT) flora and fauna species likely to occur within the locality of the Site. The purpose of the desktop assessment was to:

- refine a list of CEEVNT species to be targeted during the field assessment which had the highest likelihood of occurring on the Site; and
- source available information concerning the specific habitat requirements of the CEEVNT species to aid in their identification and habitat suitability.

A range of database resources and mapping products were utilised as part of the desktop review, including the below-listed contemporary database and mapping resources.

- The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) Protected Matters Search Tool (PMST) which returns results of Matters of National Environmental Significance (MNES) that may occur within the Site locality.
- The Queensland Department of Environment and Science (DES) Wildlife Online database.
- The Atlas of Living Australia (ALA) and Australia's Herbarium databases to identify known records of CEEVNT, least concern and pest species recorded within the vicinity of the Site (these resources include Herbarium HERBREC's records).
- The *Vegetation Management Act 1999* (VM Act) Regulated Vegetation Management and Pre-Clearing Supporting Maps produced by the Department of Resources (DoR).
- The Department of Environment and Science's Protected Flora Survey Trigger Map to identify survey and permit requirements relating to CEEVNT plants.
- The Queensland Government's regulatory Koala habitat maps for South East Queensland (SEQ)
- State Planning Policy (SPP) and Development Assessment Mapping System (DAMS) maintained by the Queensland Government's State Assessment and Referral Agency (SARA).
- High resolution aerial photography sourced from MetroMap.
- The DES map of referable wetlands request to identify Wetland Protection Areas (WPA) and referable wetlands for the *Environmental Protection Act 1994* (EP Act).
- The DA Online Mapping system to identify matters of interest to the state in assessing development applications including information pertaining to priority development areas, the *Regional Planning Interests Act 2014* and the *Sustainable Planning Regulation 2009*.

Where applicable the outputs from these searches have been presented in Appendix B.

All mapping searches were centred on -24.865, 152.366 or using Lot 33 on RP24800 with a 5km buffer.

2.1.1 Likelihood of Occurrence Assessment

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 in Table 1.

Table 1: Likelihood of occurrence criteria

	Suitable habitat exists	Suitable habitat may exist	Suitable habitat not present
Recorded in the Site during the past 30 years	**Known**	**Known**	**Known**
Recorded within the 5 km search buffer within the past 30 years	**Likely**	*Possible*	Unlikely
No records within the 5 km search buffer but Site is within the known distribution	*Possible*	*Possible*	Unlikely
No records within the 5 km search buffer and Site is outside the known distribution	Unlikely	Unlikely	Unlikely

2.2 Field Assessment

An ecological field assessment was undertaken between 15 and 18 April 2024. Broadly the field assessments sought to:

- Groundtruth the desktop findings particularly with respect to flora and fauna species of conservation significance;
- Undertake an assessment of possible fauna breeding places, as well as fauna habitat quality and extent within the Site; and
- Assess the vegetation communities present within the Site (including areas containing regulated vegetation pursuant to the VM Act), using Quaternary plots as described within the Methodology for surveying and mapping Regional Ecosystems (REs) and vegetation communities in Queensland (Neldner *et al.* 2022).

2.2.1 Flora

The flora survey was conducted to classify, map and verify REs within the Project site and to identify flora species, including conservation significant species and marine plants. This survey employed an assessment of the REs and flora in accordance with the methodology developed by the Queensland Herbarium, Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland (Neldner *et al.* 2022).

The vegetation was sampled at a number of quaternary level sites across the Project site, selected to sample the variation in vegetation observed, including both remnant and non-remnant areas, and targeting each RE identified across the Site.

At each quaternary site, the dominant species were recorded including a vegetation structural description of the dominant overstorey species. For each area of marine plants identified, the species present were recorded, as well as the extent and condition (e.g. presence of weeds, rubbish, evidence of fire etc.).

Each site was attributed to an RE based on the land zone and dominant species data, using the Queensland Herbarium RE classification. RE mapping boundaries were adjusted based on field verification. An incidental list of flora species was also recorded.

A protected plants flora survey in accordance with the *Flora Survey Guidelines – Protected Plants, Nature Conservation Act 1992* of the portion of the development footprint mapped as being within a high risk area and 100m buffer to same excluding those areas that can reasonably be excluded due to being consistent with a 'highly modified environment' was also undertaken.

2.2.2 Fauna

The assessment of fauna habitat values within the Project site was limited to observations of terrestrial vertebrate fauna assemblages (birds, mammals, reptiles and amphibians) and habitat. Survey tasks included:

- daytime bird census;
- fauna habitat assessments; and
- scans of the canopy and shrub layer for nests, hollows and arboreal fauna.

2.2.3 Habitat Assessments

Habitat assessments which characterised fauna habitat values were undertaken across the Site. The assessment locations typically coincided with the quaternary flora assessments. Habitat assessments can provide an indication of fauna and habitat suitability for threatened fauna.

Habitat assessments involved identifying available habitat for a range of taxonomic groups including birds, reptiles, amphibians and mammals (both ground dwelling and arboreal). Complexity of the understory, availability of woody debris, hollows, stags, fallen logs, cracking clay soils, leaf and exfoliating bark were all noted. Scans of the canopy and shrub layer for nests and arboreal fauna were also undertaken and all incidental fauna sightings were recorded

2.2.4 Limitations

The field assessments were designed and completed in a manner that is consistent with the expected ecological values and the nature and magnitude of the impacts. However there are a number of limitations that may impact the detectability of certain flora and fauna species including:

- The field assessments were completed over three days in early Autumn, certain species that are inactive during this time may be less detectable.
- Cryptic flora species or winter and spring flowering species that require the presence of reproductive material for positive identification may be less detectable.
- The fauna surveys were limited to visual assessments and habitat assessments, this may limit the detectability of certain fauna groups including small terrestrial mammals and reptiles.

Notwithstanding the limitations identified above, the survey methods and effort used are generally in accordance with relevant published guidelines and are considered adequate for the detection of those species identified during the desktop likelihood of occurrence assessment as ‘known’ or ‘likely’ to occur within the locality, with surveys on foot across the site ensuring adequate coverage and mapping of ecological constraints.

3. Results

3.1 Flora

3.1.1 Regional Ecosystems

3.1.1.1 Desktop Results

The Regulated Vegetation management map (RV Map), prepared for the Study area under *the Vegetation Management Act 1999* (VM Act) identified four Regional Ecosystems (REs) in the 2024 desktop results. Short descriptions for the four RE within the Study area has been provided in Table 2.

Table 2: RE's within the study area

Regional Ecosystem	Description	VM Act Status
12.3.3	*Eucalyptus tereticornis* woodland on Quaternary alluvium	Endangered
12.3.17	Simple notophyll fringing forest usually dominated by *Waterhousea floribunda*	Of concern
12.1.3	Mangrove shrubland to low closed forest on marine clay plains and estuaries	Least concern
12.5.4	*Eucalyptus latisinensis* +/- *Corymbia intermedia, C. trachyphloia* subsp. *trachyphloia, Angophora leiocarpa*, *Eucalyptus exserta* woodland on complex of remnant Tertiary surfaces and Cainozoic and Mesozoic sediments	Least concern

3.1.1.2 Field Survey

Most of the alignment has been cleared of native vegetation and now supports a mix of residential and commercial land uses. However, there are three distinct vegetation communities within the Site, including:

- cleared and grassed land that supports a mix of native and introduced species;
- marine plant community along the banks of the Burnett River, Saltwater Creek and Distillery Creek; and
- disturbed riparian community supporting regrowth eucalypt and acacia species.

Each of these communities have been described further in the following sections.

3.1.1.2.1 Cleared and Disturbed Grassland supporting Native and Introduced Species

Most of the Site, outside of areas of existing built form, supports cleared and grassed land with a mix of scattered native and introduced trees. The dominant native species include blue gum (*Eucalyptus tereticornis*), Moreton Bay fig (*Ficus macrophylla*), rusty oak (*Grevillia robusta*) and hoop pine (*Araucaria cunninghamii*). These typically occur as isolated individuals, or in certain instances in small linear patches along the banks of the Burnett River. Commonly occurring introduced species poinciana (*Delonix regia*), leopard tree (*Caesalpinia ferrea*) and the native but non-indigenous umbrella tree (*Schefflera actinophylla*). Commonly encountered introduced grass species include Rhodes grass (*Chloris gayana*), guinea grass (*Megathyrsus maximus*), red natal grass (*Melinis repens*) and green couch (*Cynodon dactylon*). Figure 2 illustrates the extent of this community within the Site. Figure 3 and Figure 4 illustrates typical examples of this community.

3.1.1.2.2 Marine plant community lining tidal creeks and rivers

The marine plant community within the Site is reasonably consistent with respect to structure and composition, noting however that it occurs in a patchier distribution along the Burnett River. It is possible that this is due to the historical disturbance associated with the main river flood events combined with historical clearing along the banks of the Burnett River.

The marine plant community generally occurs as a very narrow strip, typically less than 5 m wide and often narrower. The canopy is dominated by grey mangrove (*Avicenna marina*) with average heights between 6 m and 10 m and cover mostly exceeding 70 %. A sub-canopy is typically only present within Saltwater and Distillery Creeks and supports grey mangrove to an average height of 5 m. Scattered blind-your-eye mangrove (*Excoecaria agallocha*) occurs as scattered

individuals throughout the sub-canopy of the community with average heights of 5 m. A shrub layer is typically present throughout and supports river mangrove (*Aegiceras corniculatum*) to an average height of 2 m and cover of approximately 40 %. The ground layer is typically very sparse, with some smaller patches near the rowing club where cover increases notably. This layer supports typical species such as salt couch (*Sporobolus virginicus*), sea purslane (*Sesuvium portulacastrum*), ruby saltbush (*Enchylaena tomentosa*) and rusty sedge (*Fimbristylis ferrugineum*). Weed species occur throughout the marine community, typically on the landward margin. Dominant species include broad-leaved peppertree (*Schinus terebinthifolius*), guinea grass, para grass (*Urochloa mutica*), Japanese sunflower (*Tithonia diversifolia*). Figure 5 and Figure 6 illustrates typical examples of this community and Figure 2 illustrates the extent of this community within the Site.

3.1.1.2.3 Regrowth eucalypt riparian community

A very narrow riparian community occurs along the high bank of the Burnett River and to a lesser extent along Distillery Creek and Saltwater Creek. The occurrence of this community is very patchy within the Site and is highly disturbed. Characteristic species within the canopy include blue gum and Moreton Bay ash (*Corymbia tessellaris*) to an average height of 20 m and average cover of less than 10 %. A sub-canopy is rarely present and is dominated by introduced species including poinciana and native species such as early wattle (*Acacia leiocalyx*) and hickory wattle (*Acacia disparrima*). The shrub layer has a similar composition to the sub-canopy and where is occurs was observed at an average height of 2 m and cover of 20 %. The ground layer is dominated by grass species such as those noted previously along with occurrences of the native blady grass (*Imperata cylindrica*) and introduced forbs such as cindarella weed (*Calyptocarpus vialis*), sida (*Sida cordifolia*). The introduced climber coral vine (*Antigonon leptopus*) occurs frequently throughout this community, often smothering the shrub and sub-canopy layer. Figure 7 and Figure 8 illustrates typical examples of this community and Figure 2 illustrates the extent of this community within the Site.

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Metres

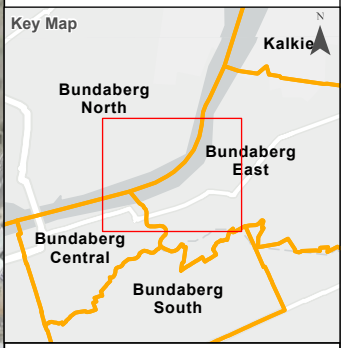
Scale: 1:6,000 @A4
GDA2020 MGA Zone 56, ESPG: 7856

LEGEND

- Construction Disturbance Footprint

Vegetation Communities

- Grey mangrove forest
- Regrowth eucalypt riparian community
- Cleared and Disturbed Grassland



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PROJECT:	Bundaberg East Levee
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FIGURE NO:	2
FIGURE TITLE:	Vegetation Communities
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VERSION:	VERSION 1
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Figure 3: Cleared and disturbed grassland close to the Burnett River

Figure 4: Cleared and disturbed grassland west of the levee alignment

Figure 5: Grey mangrove forest lining the Burnett River

Figure 6: Grey mangrove forest lining Saltwater Creek

Figure 7: Regrowth riparian forest adjacent the sugar mill

Figure 8: Regrowth riparian forest close to the rowing club

3.1.2 Threatened Ecological Communities

3.1.2.1 Desktop search

The 2024 PMST results indicates that the following Threatened Ecological Communities (TECs) are either known or likely to occur within the Site locality:

- Subtropical and Temperate Coastal Saltmarsh
- Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions
- Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland
- Lowland Rainforest of Subtropical Australia

Associated REs as stated in the TEC Conservation Advice that are mapped within the Study area are highlighted in red in Table 3.

Table 3: TECs within the study area

Community	EPBC Act Status	PMST Presence Likelihood	Associated Res in the SEQ Bioregion
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	12.1.2
Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions	Endangered	Community likely to occur within area	12.3.2 12.3.2a **12.3.3** 12.3.3a 12.3.3b 12.3.3d 12.3.7 12.3.7c 12.3.7d 12.3.10 12.3.11 12.3.11a 12.3.11b 12.3.12 12.3.14a 12.3.15 12.3.19
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	Endangered	Community likely to occur within area	12.2.7 12.3.4 12.3.5 12.3.6 12.3.20
Lowland Rainforest of Subtropical Australia	Critically Endangered	Community likely to occur within area	12.3.1 12.3.16 **12.3.17** 12.5.13 12.8.3 12.8.4 12.8.13 12.11.1 12.11.10 12.12.1 21.12.16 12.5.13b

3.1.2.2 Field Survey

The vegetation communities observed within the Site during the field assessment were not consistent with the condition thresholds or key diagnostic criteria for any of the TEC. It is noted that the narrow and disturbed riparian community supports elements of a regrowth example of RE 12.3.3. While this RE can be considered as the Subtropical eucalypt floodplain forest and woodland of the New South Wales North Coast and South East Queensland bioregions (SEFF) TEC, the community present within the Site does not meet the condition thresholds to be the TEC. As such there are no TEC present within the Site. Approximately 2 km upstream of the Site within the Baldwin Swamp Environment Park there are some patches of RE 12.3.3 and RE 12.3.5 that are considered to be consistent with the SEFF TEC and the Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland (SSF) TEC respectively. Both of these patches occur upstream of a small weir located towards the north eastern extent of the parklands and as such are considered to be hydrologically disconnected from the normal tidal fluctuations of Saltwater Creek presently.

3.1.3 Essential Habitat

Essential habitat mapping identifies areas where habitat suitable for CREVNT species occurs, as listed under the NC Act. The Vegetation Management Supporting Map Version 10.1 (VM Map) for the Study area identifies essential habitat for the following species:

• *Rhodamnia dumicola*– NC Act 'Endangered'

• *Cupaniopsis shirleyana* – NC Act 'Vulnerable'.

As discussed further in Section 3.1.5, neither of these species were encountered during the field assessment. Due to the extensive areas of disturbance and modification to the vegetation communities within the Site, it is considered unlikely that either species occurs in the Site or immediate locality.

3.1.4 Protected Plant Trigger Area

There are high risk protected plant areas mapped within the Project site, as identified on the protected plants flora survey trigger map illustrated in Figure 9.

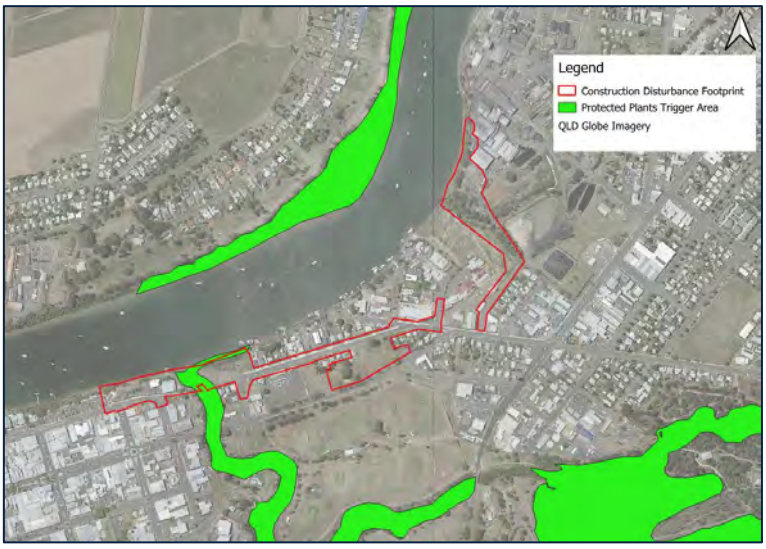

Figure 9: Protected plant trigger area

3.1.5 Conservation Significant Flora

The 2024 WildNet and PMST desktop assessment identified six threatened flora species listed as CREVNT with the potential to occur within 5 km of the study area. Of the identified species, five were considered to be known, likely, or possible to occur in the site, detailed in Table 4. The full likelihood of occurrence assessment has been provided as Appendix C.

Table 4: Desktop results for conservation significant flora

Scientific Name	Common Name	NC Act	EPBC Act
Rhodamnia dumicola	rib-fruited malletwood	Endangered	-
Cupaniopsis shirleyana	wedge-leaf tuckero	Vulnerable	Vulnerable
Dichanthium setosum	bluegrass	Least Concern	Vulnerable
Acacia attenuata	-	Vulnerable	Vulnerable
Samadera bidwillii	Quassia	Vulnerable	Vulnerable

3.1.6 Flora Field Assessment

No threatened flora species were encountered during the field assessment. Based on the results of the surveys, no threatened flora species are considered likely to occur within the disturbance footprint of the currently proposed works. A total of 74 species were recorded during the field assessment with 54 of these being introduced species and the remaining being Least Concern under the provisions of the NC Act. A full list of flora species encountered during the field assessment has been provided as Appendix D.

3.2 Fauna

3.2.1 Essential Habitat

3.2.1.1 Desktop Search

Essential habitat mapping identifies areas where habitat suitable for CREVNT species occurs, as listed under the NC Act. The VM Map for the Study area identifies essential habitat for the following species:

• Western Alaskan bar-tailed godwit– NC Act 'Vulnerable'

• Eastern Curlew– NC Act 'Endangered'

Neither of these species were encountered during the field assessment and the Site does not provide any habitat for either species. Marginal and temporary habitat for both species may occur within the Baldwin Swamp Environmental Park located approximately 2 km south east of the Site.

3.2.1.2 Fauna Habitat

Three vegetation communities were recorded within the Project site, including

- Cleared and disturbed grassland.
- Regrowth riparian eucalypt forest.
- Grey mangrove forest.

A summary of these communities is provided below in Table 5. The location of the recognised breeding features (e.g. hollow bearing trees and burrows) encountered during the field assessment have been illustrated on Figure 10.

Table 5: Habitat types and key habitat features and values within the Site

Habitat Type	Analogous RE	Key Habitat Features and Values
Cleared and disturbed grassland	Non-remnant	Limited overall value to most fauna groups. May be used by disturbance tolerant terrestrial and arboreal mammals and birds. A small number of hollows are present within the larger trees in parklands. Foraging for birds may be provided within some of the isolated larger eucalypts and figs.
Regrowth riparian eucalypt forest	Regrowth 12.3.3	This community is likely to provide roosting and foraging habitat for birds and arboreal mammals, particularly within the larger hollow bearing eucalypts and figs that are located along the banks of the river near the sugar mill. While highly disturbed and narrow, this habitat type is still likely to support a range of common and disturbance tolerant ground dwelling reptiles and mammals.
Grey mangrove forest	Remnant 12.1.3	The grey mangrove forest habitat provides resources to both terrestrial and intertidal/aquatic fauna species. The area is used by a range of common and disturbance tolerant bird species for foraging and roosting while small ground dwelling mammals and reptiles are likely to forage through the community during low-tide. There were no notable fauna breeding features (e.g. hollows or nests) with the community, however a number of burrows were noted at the margin of the community within a vertical creek bank west of the rowing club.

3.2.2 Conservation Significant Fauna

3.2.2.1 Desktop findings

The desktop assessment identified 22 conservation significant fauna with the potential to occur within the Project site. Of the identified species, nine were considered to be known, likely, or possible to occur in the site, detailed in Table 6. The full likelihood of occurrence assessment has been provided as Appendix C.

Table 6: Desktop results for conservation significant fauna

Scientific Name	Common Name	NC Act	EPBC Act
Birds			
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Endangered	Critically Endangered
Calidris ferruginea	Curlew Sandpiper	Critically Endangered	Critically Endangered
Limosa lapponica baueri	Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	Vulnerable	Endangered
Tringa nebularia	Common Greenshank, Greenshank	special least concern	Endangered
Calidris acuminata	Sharp-tailed Sandpiper	Special least concern	Vulnerable
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	Vulnerable	Vulnerable
Mammal			
Xeromys myoides	Water Mouse, False Water Rat, Yirrkoo	Vulnerable	Vulnerable
Reptile			
Hemiaspis damelii	Grey Snake	Endangered	Endangered
Egernia rugosa	Yakka Skink	Vulnerable	Vulnerable

3.2.2.2 Field confirmed fauna observations

The field surveys recorded 62 fauna species, comprising 59 bird, two reptile and a single introduced amphibian species. All observed fauna are typical for the region and habitat types recorded on site.

No conservation significant fauna species were identified during the field surveys, and based on the results of the assessments it is considered unlikely that any occur on a permanent basis.

Findings in relation to fish and fish habitat have been provided in the Fish community and passage assessment (ABS 2024), Appendix A.

The full fauna list has been provided as Appendix D.

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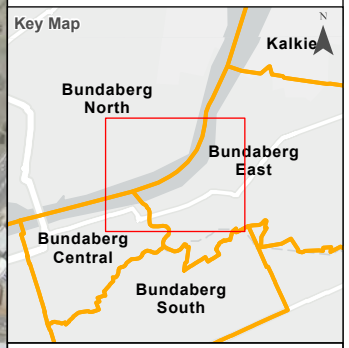
0 40 80 120 160

Metres

Scale: 1:6,000 @A4
GDA2020 MGA Zone 56, ESPG: 7856

LEGEND

- Construction Disturbance Footprint
- Burrows
- Hollow Bearing Tree



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PROJECT:	Bundaberg East Levee
PROJECT NO:	30034151
FIGURE NO:	3
FIGURE TITLE:	Habitat Features
CREATED BY:	LL16284
DATE:	9/05/2024
VERSION:	VERSION 1
PAGE SIZE:	A4

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4. Impacts and Avoidance

Potential impacts to ecological 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 are outlined below, as well as mitigation measures to minimise the potential impacts on flora and fauna values.

4.1 Construction Phase

Table 7: Impact and avoidance assessment – Construction

Impact	Description	Mitigation Measure
Vegetation clearing including: • Marine plant clearing • General native vegetation clearing	The proposed works will result in the removal of mature and regrowth marine vegetation, including mangroves and salt couch/samphire. Based on the current footprint of works the expected permanent impact to marine plants will be 0.6 hectares (ha). At this stage it is expected that there will be no temporary impacts to marine plants as activities that will result in temporary disturbance (e.g. access tracks and laydowns) can be contained within the permanent disturbance footprint. While the terrestrial vegetation is highly disturbed there will be direct loss of native vegetation that can provide foraging and roosting habitat for native fauna. Based on the current footprint the expected permanent disturbance footprint will be: • Regrowth eucalypt riparian community: 0.8 ha. • Cleared and disturbed grassland: 1.1 ha. Figure 11 presents the permanent disturbance areas to the vegetation communities within the site.	There are a range of measures that can be implemented to minimise the level of impact from clearing vegetation. These include: • Vegetation clearing will be minimised within the intertidal zone where practicable. • Auxiliary construction activities (e.g. laydowns and access points to the river and creek) to be located within the permanent disturbance footprint. • Minimise the use of instream scour as far as practicable and use of light machinery to place scour protection to avoid unnecessary disturbance. • A Vegetation Management Plan should form part of the Project Environmental Management Plans. This document should identify specific vegetation management measures to be followed during construction. • Clear guidance should be provided within the VMP on areas to be cleared and retained, methods for clearing and other relevant environmental protection measures. • A rehabilitation management plan should be prepared for the project. This plan should focus on restoration and rehabilitation of the marine plant and riparian communities with a goal of improving overall river bank resilience and connectivity.
Loss of fauna habitat and habitat fragmentation	The clearance of native vegetation can adversely affect native fauna species. Potential impacts can include: • Direct loss of habitat resulting in loss/changes to local populations.	Complete avoidance of vegetation clearing for the Project is unavoidable, however there are a range of measures that may be taken to minimise the level of impact, including:

Impact	Description	Mitigation Measure
	• Fragmentation of populations, which can reduce movement for migration and foraging and gene flow between small isolated populations. • Works can result in the establishment and spread of exotic species or diseases that may displace native species or otherwise impact a population through disease. • Loss of leaf litter and coarse woody debris, resulting in a reduction in micro-habitat for smaller reptiles and mammals • Loss of food resources such as foliage, flowers, nectar, fruit and seeds. While there will be limited clearing occurring within the Site, there is the potential for some of these impacts to result or be exacerbated by the proposed works – particularly within close proximity to Saltwater Creek, Distillery Creek and the Burnett River.	• 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. • A Fauna Management Plan should be prepared to provide clear guidance on areas to be cleared and retained, methods for clearing, role of the spotter-catcher and other relevant environmental protection matters. • Identify and clearly delineate no-go zones to avoid unauthorised disturbance of areas of sensitive vegetation and habitat. • Retention of felled trees and hollows where practicable for reuse within the Site.
Fauna mortality or injury	Clearing of vegetation can result in injury or mortality of fauna, particularly ground dwelling fauna while Arboreal mammals and reptiles may be trapped in trees as they are felled. However, given the relatively small amount of vegetation clearing expected and the aforementioned controls, the direct mortality impacts to local and regional fauna is expected to be low.	Mitigation measures to reduce the likelihood of injury or mortality to fauna include the following. • Pre-clearance surveys to identify shelters and breeding places potentially utilised by fauna. • Fauna spotter-catchers to be present during clearing. • Limits on driving speeds and locations to be planned and enforced. • Any injured, sick and dead vertebrate fauna will be recorded before (by fauna spotter-catchers), during and after construction and operation.
Noise and vibration	During the construction phase, there will be an increase in noise, vibration and activity in the Project site, particularly during activities such as clearing and piling works. It is relevant to note the Site is in a built-up environment with moderate levels of existing background noise, as such fauna are likely to be more tolerant to high, temporary noise levels. Nonetheless potential impacts may include the following: • Temporary avoidance of foraging habitat due to increased noise. • Increased potential for collisions with vehicles.	Noise and vibration measures should be included within a project specific Construction Environment Management Plan. This may include measures such as: • Ensuring all machinery used is maintained and in good running order • Machinery is fitted with noise dampening devices where possible • Avoiding operating any machinery between dusk and dawn.

Impact	Description	Mitigation Measure
	• Human visitation increasing disturbance to foraging or breeding behaviours	

4.2 Operation and Maintenance Phase

Table 8: Impact and avoidance assessment – operation and maintenance

Impact	Description	Mitigation Measures
Hydrological change	Once constructed, the levee is designed to prevent flood waters from the Burnett River impacting populated areas of Bundaberg, up to and including the design flood event. During the 'operational phase' of the levee (i.e. during the design flood events) there is the potential for: • Altered surface hydrological regimes. • Reduction in fish passage within Saltwater and Distillery Creek • Modified accretion and erosion regimes. Based on a review of the current operational expectations it is unlikely these modifications would significantly impact the upstream marine plant and TEC communities. Specifically it is noted that the inundation duration upstream of the gates under the modelled 1 in 100 AEP Burnett River Flood Event with 90th Percentile Local Rainfall will not change as a result of the flood gates as a result of the proposed pumping regime. Fish passage through the creeks will be interrupted while the flood gates are closed, however, the frequency and duration of operation is expected to be relatively short and infrequent – thus minimising overall impacts to fish movement. The Fish Community and passage assessment (ABS 2024) indicates that there is the potential for impacts to fish passage while the flood gates are open, as there is the potential for head loss, velocities and turbulence levels that exceed accepted levels for fish passage under a range of high flow conditions.	• While a detailed operating strategy is under development, the existing modelling and gate operating procedure has been designed to ensure that there will be no change to the inundation duration upstream of the levee. This will be achieved through the pumps being engaged at the point of gate closure to maintained catchment inflow levels in Saltwater Creek at design levels with pumping ceasing once water levels in the river and the creek at the same. Further detail on this is provided within the Surface Water Technical Report (SMEC 2024) and the Fish Community and passage assessment (ABS 2024) provided as Appendix A. • Gate sills have been designed so the invert more closely aligns within the bathymetry of Saltwater Creek, with two lowered gates providing for fish passage during MLWS tide events and lower. • The intake screens on the pumps proposed for the BEL should initially be designed with a maximum aperture of 2mm and a maximum approach velocity of 0.1m/s • It is understood that CFD modelling will be undertaken at detailed design stage and this will be used to inform design refinement to avoid and mitigate impacts to fish passage. This may include provision of dedicated fish movement infrastructure

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LEGEND

- Highest Astronomical Tide
- Construction Disturbance Footprint

Vegetation Communities

- Regrowth eucalypt riparian community
- Grey mangrove forest
- Cleared and disturbed grassland

SOURCES:
1. Roads, Watercourse and Locality © State of Queensland (Department of Resources) 2023
2. Basemap:Light Gray Base: Department of Resources, Dept.of Environment and Science, Esri, TomTom, Garmin, Foursquare, METI/ NASA, USGS
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PROJECT:	Bundaberg East Levee
PROJECT NO:	30034151
FIGURE NO:	4a
FIGURE TITLE:	Marine Plant Impacts
CREATED BY:	ZD17041
DATE:	17/05/2024
VERSION:	VERSION 1
PAGE SIZE:	A4

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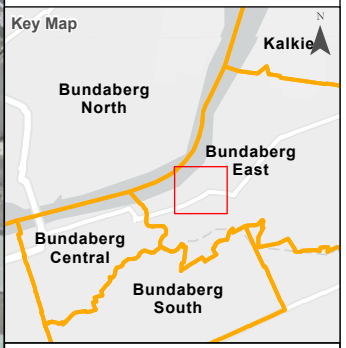
LEGEND

- Highest Astronomical Tide
- Construction Disturbance Footprint

Vegetation Communities

- Regrowth eucalypt riparian community
- Cleared and disturbed grassland



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PROJECT:	Bundaberg East Levee
PROJECT NO:	30034151
FIGURE NO:	4b
FIGURE TITLE:	Marine Plant Impacts
CREATED BY:	ZD17041
DATE:	17/05/2024
VERSION:	VERSION 1
PAGE SIZE:	A4

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ABN 47 065 475 149

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Metres

Scale: 1:2,500 @A4
GDA2020 MGA Zone 56, ESPG: 7856

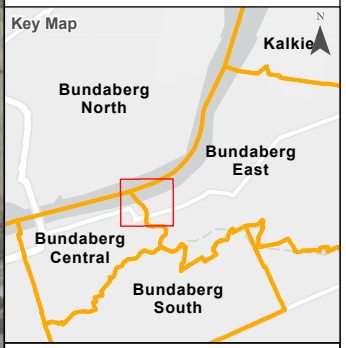
LEGEND

- Highest Astronomical Tide
- Construction Disturbance Footprint

Vegetation Communities

- Regrowth eucalypt riparian community
- Grey mangrove forest
- Cleared and disturbed grassland

Key Map



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PROJECT:	Bundaberg East Levee
PROJECT NO:	30034151
FIGURE NO:	4c
FIGURE TITLE:	Marine Plant Impacts
CREATED BY:	ZD17041
DATE:	17/05/2024
VERSION:	VERSION 1
PAGE SIZE:	A4

5. Conclusion and Recommendations

Based on the desktop and field surveys, the Project Site supports the following ecological values:

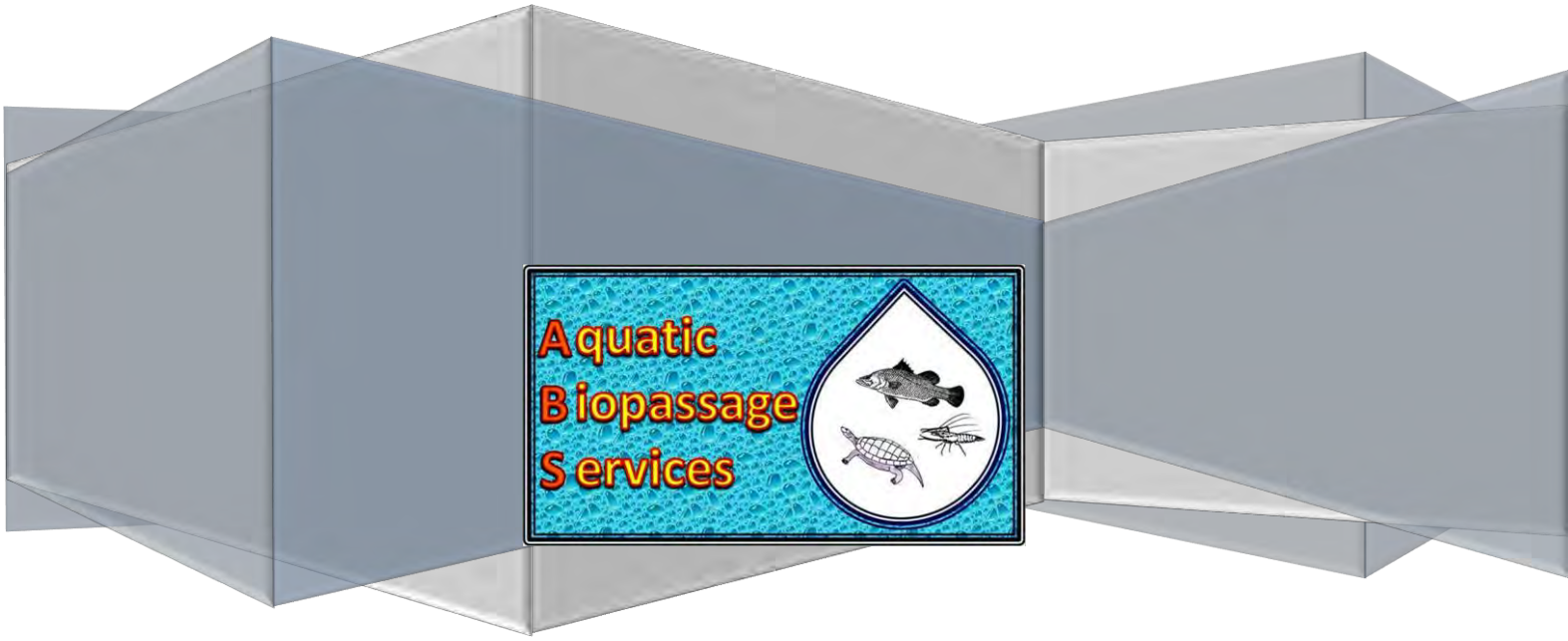
- Large areas of cleared and disturbed grassland with scattered native and introduced plant species that provide some limited foraging and roosting opportunities for native fauna.
- A narrow and highly disturbed regrowth riparian forest that supports a number of larger eucalypts and figs that would supports habitat features such as hollows and useful foraging resources such as nectar and fruit.
- A narrow but reasonably well-developed grey mangrove forest lining all the tidal estuaries and creeks within the Site. The marine plant community is expected to provide value to both terrestrial and intertidal species for both foraging and roosting purposes.
- No threatened flora and fauna species were identified and none are expected to occur on a permanent basis within the Site.
- The Site is not expected to provided habitat that is critical to the survival of any threatened species, nor does it provide habitat or floristic values that are unique or rare within the broader landscape·
- The project will result in direct and indirect impacts to the vegetation communities that occur within the Site. Including:
  - Grey mangrove forest (marine plants) 0.6 ha
  - Regrowth eucalypt riparian community: 0.8 ha
  - and Cleared and disturbed grassland: 1.1 ha
- A range of mitigation measures have been proposed to avoid, minimise and mitigate these impacts to terrestrial and intertidal vegetation and fauna including:
  - Minimise vegetation clearing – particularly within the intertidal zone.
  - Contain disturbance to existing disturbed areas as far as practicable.
  - Minimise the use of instream scour as far as practicable.
  - Preparation of a Fauna Management Plan and a Vegetation Management Plan.
  - Preparation of a Rehabilitation Management Plan with a focus on restoration and rehabilitation of the marine plant and riparian communities.
  - Ensure a suitably qualified fauna spotter catcher conducts pre-clearance habitat searches and is present during vegetation clearing activities. to minimise fauna harm.
  - Identify and clearly delineate no-go zones to avoid unauthorised disturbance of areas of sensitive vegetation and habitat.
  - Retention of felled trees and hollows where practicable for reuse within the Site.
- There is the potential for impacts to fish passage during period when the flood gates are open but there are high flows within Saltwater Creek and Distillery Creek as a result of increased velocity, turbulence and head loss. Gate sills have been designed so the inverts more closely align with the bathymetry of Saltwater Creek, this will help maintain fish passage across MLWS tide events and lower. Further detailed CFD modelling will be undertaken as part of later design stages to refine the design and help to further avoid, minimise and mitigate fish passage.
- Based on the current designs and the results of the desktop and field assessments, a significant impact to any MNES is considered unlikely and consequently it is not considered necessary to submit a referral to the Commonwealth for a decision on whether the project is a Controlled Action under the EPBC Act. However to ensure significant impacts are avoided it will be necessary to ensure best practice measures are implemented during construction and operation to ensure impacts water quality and hydrology are avoided so that impacts to the Great Barrier Reef Marine Park and the TEC located upstream of the Site are avoided.

- The Project will result in impacts to marine plants which are a MSES at this location. The current expected disturbance is 0.6 ha. However, further design refinement is likely to alter this figure. As such, once the final disturbance area is understood, it will be necessary to conduct a Significant Residual Impact assessment to determine if an offset for impacts to marine plants would be necessary.

Appendix A – Fish community and Passage Assessment

Bundaberg East Levee
Fish community and passage assessment

A. P. Berghuis
Aquatic Biopassage Services
May 2024
for SMEC



Contents

1. Site Details

The following description of site and the proposed levee arrangement is taken from CDM Smith (2019). The proposed Bundaberg East Levee (BEL) site is located in an urban, residential, and mixed-use area adjacent to the southern bank of the Burnett River in Bundaberg, Queensland. The project site is bounded by Walla Street to the west, Bourbong and Cran Streets to the South, the Millaquin Sugar Mill to the east, and the Burnett River to the north. The ground surface elevation generally ranges from between approximately 2 m Australia Height Datum (AHD) to 11 m AHD across the project site with the low-lying areas located near Saltwater Creek and Distillery Creek.

The BEL is proposed to run parallel to the southern bank of the Burnett River and across Saltwater Creek and Distillery Creek. The structure will consist of a concrete floodwall with an indicative top of wall elevation of 9.5 m AHD. The top of floodwall elevation is approximately 300 mm above the 100-year ARI design flood elevation at this location. The floodwall alignment will consist of two main segments, the City Alignment and the Sugar Mill Alignment.

The City Alignment is approximately 1000 m long and generally extends along the northern edge of Quay Street from the intersection of Toonburra Street across Saltwater Creek to the intersection of Scotland Street. The alignment then follows Scotland Street to the intersection of Cran Street.

The Sugar Mill Alignment is approximately 570 m long and crosses Distillery Creek. The Sugar Mill Alignment extends from the intersection of Cran Street and Scotland Street and runs east along Cran Street, and parallels the river bank until it terminates north of the sugar mill.

Pump station and flood gate structures are to be constructed at the Saltwater Creek crossing with a flood gate at the Distillery Creek crossing. The pump station and flood gate structures will be significantly larger at Saltwater Creek due to the larger creek width and larger contributing upstream catchment. An equipment building will be constructed adjacent to the Saltwater Creek pump station and flood gate structure.

The flood control levee at Saltwater Creek and Distillery Creek will require flood closure structures, which will allow passage of normal flows in each creek, and provide closure during flood events. The recommended flood closure structures for both facilities are vertical lift gates.

One permanent pump station is planned for the Project at Saltwater Creek, and a temporary skid / trailer mounted mobile engine-driven pump is planned for service at Distillery Creek. These pumps will operate to pump water from Saltwater Creek and Distillery Creek into the Burnett River during flood conditions.

1.1. Burnett River estuary

The Burnett River estuary is predominantly tidally driven with the tidal range being 4.04 m between Lowest Astronomical Tide (LAT) Highest Astronomical Tide (HAT) (MSQ , 2024). The construction of the Ben Anderson barrage in 1976 and alterations to the river mouth since 1958 have altered the hydrology of the estuary (Heidenreich and Lupton 1999). Construction of the Ben Anderson barrage greatly reduced freshwater flow into the Burnett estuary and effectively reduced the tidal prism by 40% (Heidenreich and Lupton 1999) Accumulations of deposited silt in the upstream sections of the estuary are extensive, which in turn reduces tidal flow into adjacent creeks and channels.

The Burnett River estuary consists of numerous unnamed creeks and inlets, predominantly in the lower estuary. Named creeks from the coast upstream to the Ben Anderon Barrage consist of :

- Fairymead Ck
- Rubyanna Ck
- Tantitha Ck
- Paddy Ck
- Distillery Ck
- Bundaberg/Saltwater Ck
- O'Connell Ck
- Palmer Ck
- McCoys Ck
- Splitters Ck

The creek systems directly impacted by the proposed BEL are Saltwater Creek and Distillery Creek. Saltwater Creek and Washpool Creek are three branches of the same system that historically drained into an ephemeral coastal wetland and then into the Burnett River estuary. The development of Saltwater Creek commenced early in the settlement of the city of Bundaberg. In 1901, a rock weir to provide water for the city's first reticulated water supply was constructed under where the Princess Street bridge is now located (Engineers Australia, 2010). The construction of the weir would have reduced the available marine habitat of the creek for at least several hundred metres upstream and prevented fish passage into the upstream wetland and creeks in all but very high flow events.

Over the subsequent 50 years the estuarine habitat of Saltwater Creek was further reduced by the filling of a section to form the Kendall Flat sportsground. The original rock weir was partially removed and replaced with a concrete weir upstream of the Princess Street bridge that is approximately 1.8 m high. The ephemeral coastal wetlands were originally used as a rubbish dump and then excavated to form permanent pools in what is now the Baldwin Swamp environmental park.

Fish passage connectivity in lower Saltwater Creek was re-established in 2011 when a bypass fishway commencing from immediately downstream of the concrete weir up into the most downstream pool of the Baldwin Swamp wetland was constructed. The other wetland pools are interconnected by various crossings consisting of pipe culverts, foot bridges and concrete channels.

Due to the presence of local springs and urban run-off, the pools stay at full capacity and are usually connected. However, connectivity from a fish passage perspective varies and under some conditions

these structures represent physical or hydraulic barriers to fish movement. Lower Washpool Creek has been channelised to bypass the wetland under most flow conditions and was connected directly to Saltwater Creek downstream of the weir, the remainder of the Washpool Creek and tributaries have been channelised and concreted. Upper Saltwater Creek has been channelised and concreted upstream of Tantitha Street. Upper Saltwater Creek passes under numerous road crossing and drains the suburbs of Ashfield and Kepnock.

Distillery Creek is a minor tributary of a catchment that occupies the area where the Millaquin sugar mill has been located since 1881 (NLA, 2024). Processing water from the sugar mill is released into the creek and then into the Burnett River approximately 350m from confluence of the two. The remainder of Distillery Creek has been channelised and concreted, passing through the East Bundaberg industrial area for approximately 1500 m and draining the adjacent residential area south of Bargara Road.

1.2. Evaluation of Saltwater Creek and Distillery Creek

The proposed locations of the BEL over both Saltwater Creek and Distillery Creek were inspected on the 16th of April 2024 around 3 hours before low tide for the day.

The high bank of Saltwater Creek is approximately 70 m wide and commences approximately 60 m upstream of the confluence with the Burnett River in line with the existing pedestrian bridge. Due to the permanent tidal influence of the Burnett River there is no defined low flow channel, tidal marks on the bank indicate that the channel is up to 40 m wide at high tide.

The vegetation at the proposed BEL site for Saltwater Creek consists of a narrow strip of grey mangrove (*Avicennia marina*) and river mangrove (*Aegiceras corniculatum*) along the creek edge with a range of native and introduced grasses and shrubs. The vegetation upstream of the site was not inspected but appeared to be consistent throughout, the only exception being an area immediately upstream of the Kennedy Bridge.

Figure 1. Confluence of Saltwater Creek and the Burnett River on 16th April 2024.

The high bank of Distillery Creek is approximately 30 m wide and commences approximately 20 m upstream of the confluence with the Burnett River. At the time of inspection there was minimal tidal ingress in the creek, processing water from the Millaquin Mill was being released into the Burnett River (Figure 2). Tidal marks on the bank indicate that the channel is up to 20 m wide at high tide.

Figure 2. Distillery Creek downstream of the proposed floodgate on 16th April 2024.

The vegetation at the proposed BEL site for Distillery Creek consists of a narrow strip of grey mangrove (*Avicennia marina*) with some river mangrove (*Aegiceras corniculatum*) along the creek edge and a range of native and introduced grasses and shrubs up to the high bank. The vegetation upstream of the site was consistent with the above description for 150 m upstream from the Burnett River to a bridge crossing. Beyond the bridge the creek channel has been rock lined with no riparian vegetation other than terrestrial grasses.

1.3. Fish habitat values of Saltwater Creek and Distillery Creek

Saltwater Creek is part of a system that once supported a small but high value marine and freshwater wetland complex. Over the years, the development of Bundaberg has reduced the extent of the system and negatively impacted on the function of the creek system and wetlands as fish habitat. However more recent improvements such as the protection of freshwater reaches with Baldwin Swamp Environmental Park and the re-establishment of fish passage beyond the tidal weir have improved the function of the Saltwater Creek system as fish habitat. Future projects such as the proposed Washpool Creek naturalisation project and the current regulations for waterway crossings and stormwater treatment at new works will continue to assist in improving fish habitat in the system.

It is vital that any works associated with the construction of the BEL minimises any further impact to the fish habitats of the Saltwater Creek system and that the operation of the levee has no negative impact on habitat quality or connectivity, including extended freshwater inundation.

Due to its proximity to the Saltwater Creek system, Distillery Creek was likely to have been part of the same wetland system. The development of the Millaquin Mill and of the industrial and residential areas have resulted in the channelisation and degradation of the freshwater habitats of the creek. The lower tidally influenced section of Distillery Creek continues to provide a marine

habitat with connectivity to the Burnett River, however it is likely that its value as marine habitat is reduced by the regular release of processing water from the Millaquin Mill.

It is important that any works associated with the construction and operation of the proposed BEL minimises the impact to the marine habitat of Distillery Creek. Despite the very poor condition of the upper reach it is likely that it does provide some freshwater habitat with potential for rehabilitation in the future. Accordingly it is necessary that the operation of the levee has no further negative impact on habitat quality or connectivity.

2. Fish species of the upper Burnett River estuary

The marine and estuarine fish fauna of the Burnett Mary River region is extraordinarily diverse, with over 1,500 species having been recorded in the area (Kirkwood & Hooper, 2004). A search of the WildNet database provided by the Qld Department of Environment and Science (DES) was performed for fish species within 50km of Saltwater Creek. The original list has been edited to only include species considered to predominantly utilise freshwater habitats and those that migrate between marine and freshwaters (Tables 1 and 2). Migration of freshwater fish is described by two broad classifications:

- *Potamodromy*, which is wholly within freshwater, and
- *Diadromy*, which is between freshwater and the sea.

Diadromous fishes are further classified into:

- *Catadromy,* which are species that must migrate to marine waters for breeding and back to freshwater to feed and grow.
- *Amphidromy*, where the adults remain in either freshwater (freshwater amphidromy) or saltwater (marine amphidromy); juveniles migrate between the two habitats, with early growth in the sea (freshwater amphidromy) or freshwater (marine amphidromy); followed by migration into the adult habitat. For some species this strategy is obligatory and others facultative.
- *Anadromy,* which are species that migrate into freshwater to spawn, with adults resident in marine waters.

While some migration classes are more susceptible to the impacts of waterway barriers, once the waterway is interrupted by a barrier effect, any separation of the links between juvenile and adult habitats by the barrier will result in some level of population impact, and in extreme cases some species can become locally extinct upstream of barriers.

Many estuarine species are considered as euryhaline, which means they are a marine species that can tolerate a wide range of salinities including freshwater. This is not a migration strategy but represents a group of fish that moves freely between freshwater and the estuary. With a few exceptions, movements into freshwater generally occur in the lower reaches of streams and so these species are relevant to the proposed BEL project.

Table 1 provides 32 species of marine associated fish that are known from the upper Burnett River estuary, of these 30 species are either diadromous or euryhaline and have an association with marine and freshwater habitats. The other two species are known from marine habitats only and would move with the salinity gradient to select the most suitable conditions.

Table 1. Fish species from the WildNet Database present in the upper Burnett River estuary with a marine & freshwater habitat association. * = exotic species, # = marine only.

Family	Scientific Name	Common Name
Ambassidae	*Ambassis marianus*	estuary glassfish
Anguillidae	*Anguilla reinhardtii*	longfin eel
Ariidae	*Neoarius graeffei*	blue catfish
Belonidae	*Strongylura krefftii*	freshwater longtom
Carcharhinidae	*Carcharhinus leucas*	bull shark
Centropomidae	*Lates calcarifer*	barramundi
Cichlidae	*Oreochromis mossambica**	Mozambique mouthbrooder
Clupeidae	*Herklotsichthys castelnaui*	southern herring
Eleotridae	*Gobiomorphus australis*	striped gudgeon
Eleotridae	*Hypseleotris compressa*	empire gudgeon
Elopidae	*Elops hawaiensis*	Hawaiian giant herring
Gerreidae	*Gerres filamentosus*	threadfin silverbiddy
Hemirhamphidae	*Arrhamphus sclerolepis*	snubnose garfish
Kuhliidae	*Kuhlia rupestris*	jungle perch
Leiognathidae	*Leiognathus equulus*	common ponyfish
Lutjanidae	*Lutjanus argentimaculatus*	mangrove jack
Megalopidae	*Megalops cyprinoides*	oxeye herring
Monodactylidae	*Monodactylus argenteus*	diamondfish
Mugilidae	*Liza subviridis*	greenback mullet
Mugilidae	*Mugil cephalus*	sea mullet
Mugilidae	*Trachystoma petardi*	pinkeye mullet
Percichthyidae	*Macquaria novemaculeata*	Australian bass
Plotosidae	*Porochilus rendahli*	Rendahl's catfish
Pseudomugilidae	*Pseudomugil signifer*	Pacific blue eye
Retropinnidae	*Retropinna semoni*	Australian smelt
Scatophagidae	*Scatophagus argus*	spotted scat
Scatophagidae	*Selenotoca multifasciata*	striped scat
Scorpaenidae	*Notesthes robusta*	bullrout
Sparidae	*Acanthopagrus australis*	yellowfin bream
Synbranchidae	*Ophisternon bengalense*	one gill eel
Synbranchidae	*Ophisternon gutturale*	swamp eel
Sillaginidae	*Sillago sihama*#	northern whiting
Tetraodontidae	*Chelonodon patoca*#	milkspot toadfish

Table 2 provides a list of the fish species known from the lower freshwater reaches of the Burnett River. All of these species are potamodromous and have varying tolerance to saline conditions. The bony herring for example can be very abundant in upper Burnett River estuary and tolerate high salinities (Stuart & Berghuis, 2022). Conversely, the Qld lungfish is regularly washed into the Burnett River estuary during floods and is commonly found deceased if it is unable to return to freshwater following a return to marine conditions (author pers obs.). It is considered unlikely the Qld lungfish would occur in Saltwater or Distillery Creek, during extreme events they may be washed into the Burnett River and creeks. The proposed works are not considered likely to have any significant impact on the Lungfish or their ability to return to freshwater sections of the Burnett River under the proposed gate operating strategy. A high level of connectivity between marine and freshwater

habitats and particularly at floodgates and tidal barrages is vital in ensuring the negative impact on these species is minimised.

Table 2. Fish species from the WildNet Database with a freshwater habitat association present in the upper Burnett River estuary. * = exotic species.

Family	Scientific Name	Common Name
Ambassidae	*Ambassis agassizii*	Agassiz's glassfish
Apogonidae	*Glossamia aprion*	mouth almighty
Atherinidae	*Craterocephalus stercusmuscarum*	flyspecked hardyhead
Ceratodontidae	*Neoceratodus forsteri*	Australian lungfish
Clupeidae	*Nematalosa erebi*	bony bream
Cyprinidae	*Carassius auratus**	goldfish
Eleotridae	*Hypseleotris galii*	firetail gudgeon
Eleotridae	*Hypseleotris klunzingeri*	western carp gudgeon
Eleotridae	*Hypseleotris species 1*	Midgley's carp gudgeon
Eleotridae	*Mogurnda adspersa*	southern purple spotted
Eleotridae	*Oxyeleotris lineolata*	sleepy cod
Eleotridae	*Philypnodon grandiceps*	flathead gudgeon
Eleotridae	*Philypnodon macrostomus*	dwarf flathead gudgeon
Melanotaeniidae	*Melanotaenia duboulayi*	crimson spotted rainbowfish
Percichthyidae	*Macquaria ambigua**	golden perch
Plotosidae	*Neosilurus hyrtlii*	Hyrtl's catfish
Plotosidae	*Tandanus tandanus*	freshwater catfish
Poeciliidae	*Gambusia holbrooki**	mosquitofish
Poeciliidae	*Xiphophorus maculatus**	platy
Terapontidae	*Amniataba percoides*	barred grunter
Terapontidae	*Bidyanus bidyanus**	silver perch
Terapontidae	*Leiopotherapon unicolor*	spangled perch

It is unknown whether all of the listed species are present in the Saltwater Creek and Distillery Creek systems. However a review of the biology of the listed species confirmed that they have the potential to be present in both creeks. Accordingly for the purposes of the current review and in the context of the proposed BEL project it should be assumed that all of the species in Table 1 and 2 have the potential to occur. Due to the reduced habitat quality and extent, Distillery Creek is likely to have a lower fish species mix and biomass than the Saltwater Creek system.

The presence of species in the Saltwater Creek and Distillery Creek systems will vary according to seasonal and river flow conditions. During periods of low and no freshwater flow the upper Burnett River estuary will be predominantly saline, with varying flows coming from the creeks to create a variable brackish water zone.

The assessment of the Ben Anderson tidal barrage fishway by Stuart & Berghuis (1999) provides a guide to the behaviour of fish in the tributary creeks of the upper Burnett River. Many of the species listed in Table 1 will move into and out of the lower creeks up to the tidal limit. Diadromous species such as the various gudgeon species, eel, mullets, mangrove jack and barramundi will move beyond the tidal weir on Saltwater Creek via the existing fishway.

During higher rainfall periods, freshwater flow from the Burnett River and the upper tributary creeks pushes the saltwater further downstream creating an extensive freshwater zone. Many of the fish

present in the freshwater reaches will move downstream into the estuary and in the case of diadromous species continue to migrate downstream or remain in the estuary according to their biology. Potamodromous species will move into the upper estuary with the freshwater flows and remain there while the estuary contains predominantly freshwater.

At the same time that some fish are moving downstream, other fish are moving upstream to access freshwater reaches according to their biology. Data from Stuart & Berghuis (1999) and at other tidal barrage fishways throughout Qld indicates that the flood peak and the corresponding falling hydrograph are important periods for upstream migration of diadromous fish species.

As the flood hydrograph falls, saline conditions will gradually return to upper the Burnett River estuary and potamodromous fish species will need to return to freshwater habitats. Species with poor tolerance to saltwater may become stranded downstream of tidal weirs and floodgates and die or fall prey to marine predators such as sharks.

Based on the characteristics of the expected fish community at Saltwater Creek and Distillery Creek it is important that suitable and safe upstream and downstream fish passage is provided over all tidal and freshwater flows when the floodgates are open. It will also be vital to reinstate suitable and safe fish passage immediately upon the re-opening of the floodgates.

3. Potential impacts of the proposed BEL

The proposed works on Saltwater Creek and Distillery Creek consist of vertical lift gates that will assist in preventing inflow from the Burnett River during high flood conditions. The proposed gates are to have the following arrangements:

- Saltwater Creek: 4 gates, each 4.5 m wide by 4.5 m high, invert level -1.0 m AHD.
- Distillery Creek: 2 gates, each 2 m wide by 3 m high, invert level 0.5 m AHD

Both the Saltwater Creek Distillery Creek systems are part of a low-lying floodplain that when enclosed by a gated levee will function like dam storages, attenuating any inflows in accordance with their respective storage curves as presented in CDM Smith (2019) and reproduced in Figure 3.

According to the hydrology studies by CDM Smith (2019), local runoff water for Saltwater Creek could be impounded up to a level of about 5 m AHD without having a significant impact, providing up to 2200 ML of storage; similarly, local runoff for Distillery Creek could be stored up to a level of about 6 m AHD, providing about 200 ML of storage. It's possible that some small mitigation projects (such local bunding, etc.) will need to be completed.

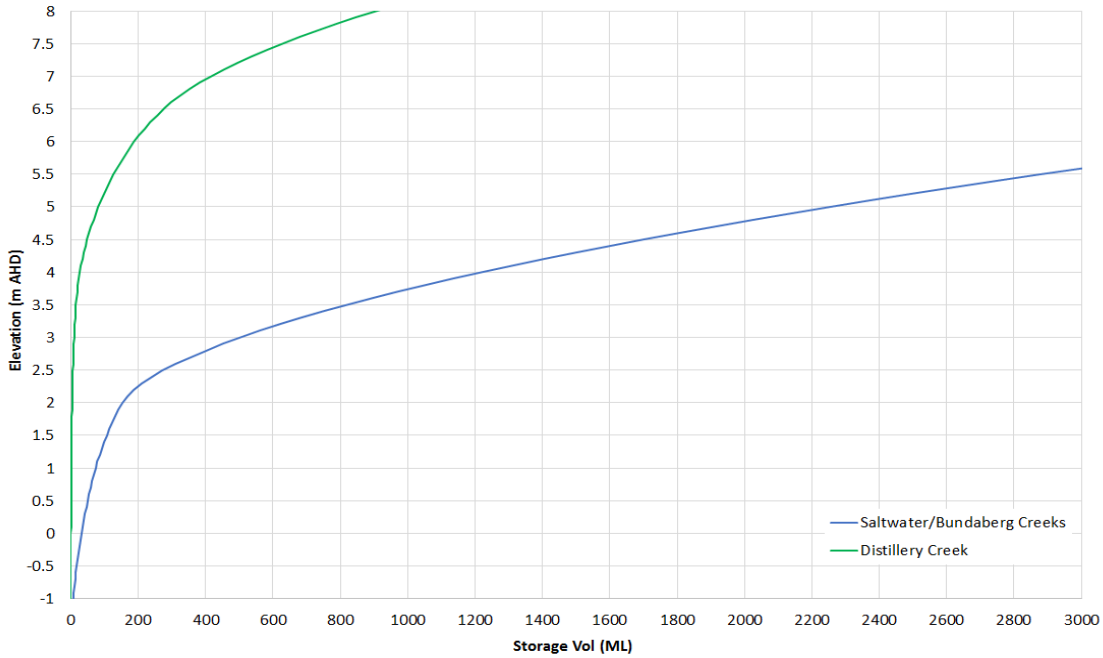


Figure 3. Storage elevation curves for Saltwater Creek and Distillery Creek from CDM Smith (2019).

When the gates are closed it will be necessary to control the local inflow via the use of pumps. The study by CDM Smith (2019) determined that the following design pump rates (duty capacity) should be implemented:

- Saltwater Creek: 7 m3/s
- Distillery Creek: 1 m3/s

In both cases, CDM Smith (2019) determined that the design pump rate alongside the potential floodplain storage would be sufficient to accommodate a storm with a total rainfall depth of approximately 100 mm.

The choice of whether to open or close the gates in the face of an approaching flood is complicated by a number of variables, such as the extent of the flood, the probability of future local rainfall, and the state of the river levels and stream flow at the time. A detailed operating strategy taking these considerations into account should be developed as part of the detailed design phase. The operating strategy will also need to consider the potential impacts to fish passage and access to fish habitat, including the potential for extended inundation following gate closure and the impact of other infrastructure such as one way flaps and minor bunds.

The hydraulic impact of the proposed floodgates was modelled by CDM Smith (2019) using a steady-state HEC-RAS model comparing the current conditions in the creek channel against those following floodgate installation. At Saltwater Creek the differential upstream and downstream with the gates installed ranged from 0.03m at a 50% AEP to 0.94 at a 1% AEP event. The predicted peak flood level of 3.31 m is less than the top-of-gate level of 3.4 m AHD.

At Distillery Creek the relatively steep longitudinal grade where the floodwall crosses the creek creates more complex hydraulic conditions. The differential upstream and downstream with the gates installed ranged from 1.43m at a 50% AEP to 2.10 m at a 1% AEP event (CDM Smith 2019). The hydraulic model determined that under the current situation there were super critical flows with

high velocities, low water levels and a hydraulic jump where the bed grade flattens. The installation of the proposed gated structure would force the flow to remain sub-critical and leading to comparatively higher water levels, and lower velocities that would disrupt the hydraulic jump.

Analysis of the results by CDM Smith (2019) suggested that a break in grade at around Ch 180 m would serve as the hydraulic control in both the existing and future cases. For all flood events under consideration, peak water levels in Distillery Creek are predicted to remain both contained within the channel, and below the top-of-gate level.

3.1. Fish passage requirements at the proposed floodgates

In regards to potential impacts on fish passage, the hydraulic model by CDM Smith (2019) indicates an afflux upstream and downstream of the floodgates in both Saltwater and Distillery Creeks when the gates are open and there is local runoff and levels in the Burnett River are not elevated.

A hydraulic model was developed within the current project by SMEC (2024) for the 1:2 (50%) AEP event with a peak flow of 118 m^3/s and 1:5 (20%) AEP with a peak flow of 174 m^3/s. The model considered water levels and flow velocities at these events at MHWS (1.41m AHD) and MLWS (1.14m AHD) in Saltwater Creek at points along the creek channel 10 m downstream and 15 m upstream of the proposed floodgate. The most relevant data in regards to determining the potential impact on upstream fish passage through the gates is the peak flow water level upstream of the gates and peak velocities downstream, with and without the levee and gates in place. Table 3 provides the peak water levels under the varying flow and tide conditions and the differential between the before and after levee cases. Under all conditions the water levels are from 0.637 m to 1.518 m higher with the levee and gates in place than they are in the current condition, demonstrating that the gates are creating a backwater effect upstream.

Table 3. Modelled peak water levels 50% & 20% AEP flow and MHWS and MLWS with the differential between with and without levee cases (SMEC,2024).

	Peak water level (m)		
Upstream of gate	**No Levee**	**With levee**	**Differential**
50% AEP @ MHWS	1.487	2.124	0.637
50% AEP @ MLWS	-0.010	1.508	1.518
20%AEP @ MHWS	1.588	2.387	0.799
20%AEP @ MLWS	0.589	2.264	1.675

Table 4 provides the peak flow velocities under the varying flow and tide conditions and the differential between the before and after levee cases. At the 50% AEP case at MHWS, the flow is 43.3% higher with the levee and gates in place than they are in the current condition. Conversely at MLWS the peak velocity is 25.9% lower with the levee and gates in place. Similarly for the 20% AEP case at MHWS the flow is 17.5% higher with the levee and gates in place than they are in the current condition and at MLWS the peak velocity is 62.5% lower with the levee and gates in place.

Table 4. Modelled peak velocity levels 50% & 20% AEP flow and MHWS and MLWS with the differential between with and without levee cases (SMEC,2024).

	Peak flow velocity (m/s)		
Downstream of gate	**No Levee**	**With levee**	**Differential**
50% AEP @ MHWS	1.531	2.700	1.169
50% AEP @ MLWS	3.165	2.514	-0.651
20%AEP @ MHWS	2.276	2.759	0.483
20%AEP @ MLWS	3.660	2.252	-1.408

The hydraulic model provided by SMEC was not designed to determine levee gate flow velocities or for accuracy at the lower range of flows in Saltwater Creek. Accordingly the figures in Tables 3 and 4 should be considered as low precision estimates of what may occur if the levee gates are installed in their proposed configuration.

The following points provide a guide to suitable hydraulic conditions established for fishway design:

- Maximum between pool head loss of 100mm
- Maximum velocity (small fish)
    - 0.8m/s – burst speed (distances <20mm)
    - 0.3m/s – sustained speed (distances < 100mm)
- Maximum velocity (medium –large fish) 1.8 m/s - burst speed

The data in Tables 3 and 4 do not meet the fishway design criteria above at the flow conditions listed even without the levee and gates in place. However, it should be considered that these values for the hydraulic modelling are averaged across the channel and do not reflect the impacts of variation in the creek bed and banks that would create localised small scale effects particularly for flow velocities. Furthermore these values are for high flow conditions in Saltwater Creek that are typically of short duration.

No hydraulic data has been developed for the levee gates at the lower range of flows or for no flow conditions with tidal influence. However based on observations at other tidal sites it is likely that upstream fish passage will occur under most tidal conditions with the currently proposed gate design and the gates open, due to influence of the ebb and flow of the tide. To reduce the impact of the gate frames on fish passage at the range of tides below MLWS, recent bathymetric survey has been used to refine the proposed levels of the gate sills so the invert more accurately reflects the existing bed level profile. Further modelling will be undertaken during later design stages to refine this aspect of the gates and help ensure fish passage is provided during the range of tides below MLWS.

It is likely that fish passage will occur at the lower range of freshwater outflows both due to the tidal influence and bed and bank roughness, provided the gate frame sills are not a physical barrier.

More detailed modelling of the Saltwater Creek channel as well the Distillery Creek using appropriately scaled 3D Computational Fluid Dynamics (CFD) is recommended. Where applicable the hydraulic values listed above should be replicated under the full range of flows whenever the gates remain open. Modifications to the initial gate sill design have provided a lowered set of gates within the central channel of Saltwater Creek, with the gate sill profile more accurately reflecting the

updated bathymetric survey. Further investigation into the design of the gates will be undertaken as part of later design stages to help ensure impacts to fish passage are avoided, minimised and mitigated.

3.2. Potential impacts of floodgate closure on fish passage

A trigger for closure of the proposed flood gates and the operation of the pumps is yet to be fully developed. Recent modelling within the current project by SMEC (2024) is based on a trigger where the Burnett River level exceeded 4.0 m AHD for at least 30 minutes and the river level was 0.01 m above the Saltwater Creek level (backwater effect taking place). Once these criteria were met, the gate would gradually close at a rate of 0.3 m/minute (15 minutes to closure). It would then open once the creek level was 0.01 m above the river level. Whilst closed, the pumps would become operational with capacity of 7 m^3/s at Saltwater Creek and 1 m^3/s at Distillery Creek.

The operation is demonstrated in SMEC (2024) with a time-series analysis of water levels and flows for the 1 in 100 AEP regional design flood event in a backwater from the Burnett River that fills Saltwater Creek to just below 4.0m AHD to trigger gate closure and the pumps become operational, the backwater begins to drawdown until the local rainfall occurs. Then, runoff in excess of the pump capacity fills the Saltwater Creek basin to 5.5 m AHD, once the local rainfall has ceased the gate opens on the receding flow limb to drain Saltwater Creek.

The requirements to close the floodgates is likely to be very infrequent and in most situations for a short duration. Accordingly it may not be necessary to provide fish passage at the peak of extreme floods. However it will be necessary to detail the expected frequency of flows that will trigger gate closure and to determine the period that the gates will be closed and ensure the immediate recommencement of fish passage once flood levels subside. The expected gate operation data can then be compared to fish migration needs and gate operational requirements can be assessed to minimise impacts on fish passage and habitat.

No specific detail is provided on the pumps or the configuration of intake screens expected o be installed on the pumps. High volume pumps have the potential to injure or kill fish that are entrained on the intake screens by high velocities or drawn into pumps that have insufficient screening. The tendency for a fish to escape entrainment or impingement typically relates to both its swimming ability and velocities generated at the screen face, particularly the velocity vector perpendicular to the screen (approach velocity) relative to that along the screen face (sweeping velocity) (Boys *et. al*. 2013).

Best practice screen design guidance for pump intakes is based on research in NSW by Boys *et. al*. (2013) A summary of the relevant points from the research and guidelines are:

- Smaller fish (< 150 mm) were most vulnerable to screen contact as approach velocity increased from 0.1 to 0.5 m/sec.
- Fish smaller than 50 mm, had a 40 to 75 % chance of contacting the screen when approach velocities were 0.5 m/s, compared to 15 to 30 % at 0.1 m/sec.
- The ability of a fish to avoid contact with a screen is associated with its size and swimming ability, as well as behavioural response when exposed to an approach velocity.
- Intakes screens should be a maximum aperture of 2 mm for wedge wire and 3 mm for woven mesh and perforated plate.

Accordingly based on the above and the predominance of small bodied fish species in Saltwater Creek, the intake screens on the pumps proposed for the BEL should initially be designed with a maximum aperture of 2mm and a maximum approach velocity of 0.1m/s. Further detail on best practice fish screening requirements and implementation is provided in Boys *et. al*. (2021) and Boys, (2021). All relevant aspects of the guidelines should be applied to the proposed pump and intake screen as the designs develop.

The potential for fish injury at the BEL floodgates when they are opened to release flow must also be considered. Research by Baumgartner *et al.* (2013) found that undershot gates had a substantial influence on larval fish mortality. Higher gate openings appeared to contribute to increased mortality, this was amplified in magnitude if the weir was discharging into a shallow tailwater. These trends were quite consistent among larvae and small-bodied natives, but effects were lower in juveniles and adults of large-bodied species. Larger-scale impacts are therefore likely to be species and size specific. However, the evidence exists that undershot gates cause substantial fish mortality and injury and that EPBC listed species such as Qld lungfish may be impacted by undershot gates. Accordingly, at the BEL project, the design and operation of any undershot gates should seek to be minimise impact to fish moving downstream at the site. Gates that are opened and lifted entirely out of the water do not impact on safe downstream fish passage.

3.3. Potential construction impacts

No detail on the construction methodologies for the BEL floodgates has been developed to date, however the report by CDM Smith (2019) and SMEC (2024) as well recent design updates for the floodgates by SMEC inform the general procedures. From a fish habitat perspective the main aspects are the destruction of marine plants and excavation of waterways that will require sediment protection and may have potential acid sulphate soils, these aspects can be dealt with using best practice construction techniques and the relevant permits.

The maintenance of fish passage during construction is also important, not just to maintain the movement of fish according to tide and flow conditions but also to allow fish to move away from construction impacts. The updated floodgate designs indicate that the gate frames in both creeks will be installed from one bank to the centre with the other bank open, the gate frame will then be installed from the opposite bank to join with the other gate frame.

Based on the currently understood construction methodology it is likely that the proposed works will maintain fish passage under most tidal and low flow conditions. Later design stages will consider and address the expected hydraulic and flow conditions at the gate frames during the construction works.

3.4. Fish stranding

The closure of the flood levee gates during high river flow events increases the potential for fish stranding compared to the current situation without gates. The operational plan for the gates should consider a staged opening of the gates to permit fish to move downstream to permanent habitat with the receding water levels in the creeks.

4. State approvals for Waterway Barrier Works

In October 2023 QBuild received a pre-lodgement advice on numerous matters relating to the BEL from the Department of State Department, Infrastructure, Local Government and Planning (DSDILGP). In regards to Waterway Barrier Works (WBW) the requirements consist of satisfying the State Development Assessment Provisions Code18 (SC18). At this stage of design development there is insufficient information to satisfactorily address many aspects of the SC18. Future design development and reporting must address each of the relevant Performance Outcomes (PO)

4.1. Potential mitigation or offset projects

At the current early stage of the design development of the BEL, it is impossible to determine the specific impacts on MSES and whether there will be any requirements for project mitigations or offsets. Some of risks identified to date include:

- the reduction of fish passage at the lower tidal range due to the height of gate frame both in Saltwater Creek and Distillery Creek.
- the design of the gate frame may cause high velocities that preclude fish passage under some flow conditions even when the gates are open.
- fish may be injured by the undershot gates when they are reopened following a flood event.
- the flood pumps may injure or kill fish when operational.
- the increased risk of fish stranding upstream of the floodgates following a flood event.

Many of the above risks are likely to be addressed and eliminated in detailed design and this should be a priority over accepting the impacts to MSES and identifying mitigation works or offsets. Accordingly it is impossible to provide the extent of an impact or a value for any offsets. However if mitigations or offsets are required there are numerous opportunities to provide on site mitigation works for fish passage and habitat within the local catchment.

5. Conclusion & recommendations

The proposed BEL project is still in the early phases of design and development and there is currently little detailed information of specific impacts to fish passage and fish habitat. Accordingly the current report has provided detail on the expected fish community at the site and the potential negative impacts of the general concept and opportunities to address these impacts. The fish community at the proposed site is diverse with varying requirements according to their biology. Substantial consideration must be given to the design and operational program of the proposed floodgates and any other instream structures such as pumps to minimise harm and maximise fish passage under all flow conditions where the gates are open.

Specifically the following matters must be addressed in future design development of the BEL:

- The current modelling indicates there will be limited potential for extended freshwater inundation in the flood plain following closure of the floodgates. However, this should be further investigated during later design stages and assessment of potential impacts made.
- Develop designs for the floodgates that maximise the opportunities for safe and effective upstream and downstream passage of fish using 3D CFD or physical modelling and suitable hydrological data.
- Develop the pump designs to minimise fish injury by incorporating suitable screening.
- Identify the requirements for gate closure and develop an operational strategy for the floodgates and pumps that maximises fish passage opportunity and minimises harm to fish and fish habitats.
- Develop a construction program that minimises harm to fish and maximises fish passage opportunity.

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Appendix B – Desktop Results

Queensland Government

WildNet species list

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Queensland status: Rare and threatened species
Records: All
Date: All
Latitude: -24.8613
Longitude: 152.3646
Distance: 5
Email: Oliver.RobertsSimmonds@smec.com
Date submitted: Friday 05 Apr 2024 10:15:41
Date extracted: Friday 05 Apr 2024 10:20:06

The number of records retrieved = 5

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Scolopacidae	*Limosa lapponica baueri*	Western Alaskan bar-tailed godwit		V	E	1
animals	birds	Scolopacidae	*Numenius madagascariensis*	eastern curlew		E	CE	8
animals	mammals	Delphinidae	*Orcaella heinsohni*	Australian snubfin dolphin		V		1/1
plants	land plants	Myrtaceae	*Rhodamnia dumicola*	rib-fruited malletwood		E		3/3
plants	land plants	Sapindaceae	*Cupaniopsis shirleyana*	wedge-leaf tuckeroo		V	V	2/2

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

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

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

Records - The first number indicates the total number of records of the taxon (wildlife records and species listings for selected areas).
This number is output as 99999 if it equals or exceeds this value. A second number located after a / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Protected Plants Flora Survey Trigger Map

High risk area
Other land parcel boundaries
Freeways / motorways / highways
Secondary roads / streets
Coordinates

LOCALITY DIAGRAM

N

0 480 960 1,440 1,920 2,400 m

This product is displayed in: GDA2020

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

Land parcel boundaries are provided as locational aid only.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of Environment, Science and Innovation at palm@des.qld.gov.au

Disclaimer: While every care is taken to ensure the accuracy of the data used to generate this product, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaim all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damages) and costs which might be incurred as a consequence of reliance on the data, or as a result of the data being inaccurate or incomplete in any way and for any reason.

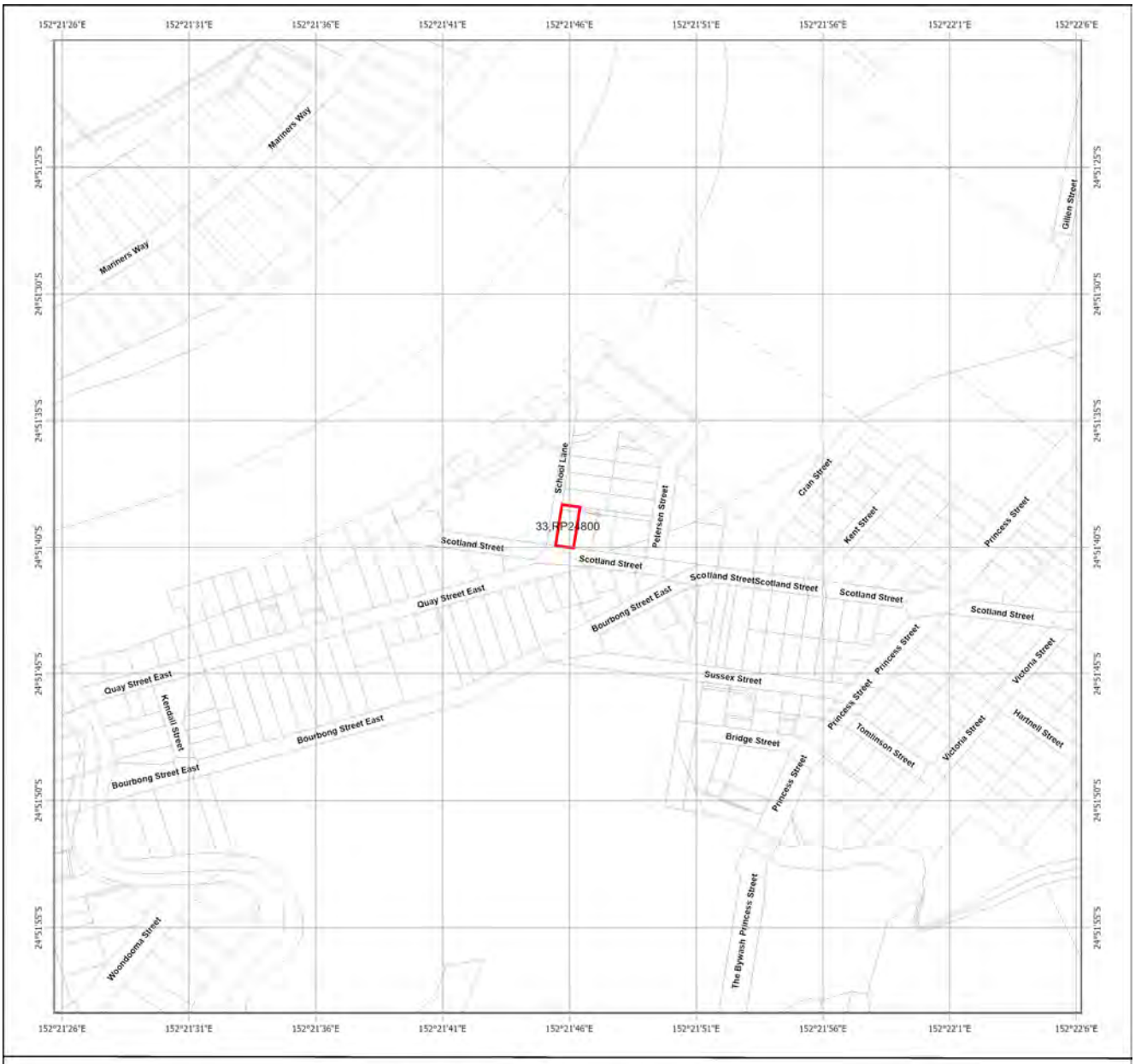
Protected plants flora survey trigger map

The protected plants flora survey trigger map identifies 'high risk areas' where endangered, vulnerable or near threatened plants are known to exist or are likely to exist. Under the *Nature Conservation Act 1992* (the Act) it is an offence to clear protected plants that are 'in the wild' unless you are authorised or the clearing is exempt, for more information see section 89 of the Act.

Please see the Department of Environment and Science webpage on the clearing of protected plants for information on what exemptions may apply in your circumstances, whether you may need to undertake a flora survey, and whether you may need a protected plants clearing permit.

Updates to the data informing the flora survey trigger map
The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information
Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the Queensland Spatial Catalogue, the Department of Environment and Science does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of Environment and Science webpage on the clearing of protected plants for more information.



Map of Great Barrier Reef Wetland Protection Areas

Cadastral Boundary
Wetland in a wetland protection area
Great Barrier Reef wetland protection area
Selected Lot and Plan

LOCALITY DIAGRAM

N

0 69 138 207 276 345 m

This product is displayed in GDA2020

Note:
This map shows the location of wetland protection areas which are defined under the Environmental Protection Regulation 2008. Within wetland protection areas, certain types of development involving high impact earthworks are made assessable under Schedule 3 of the Sustainable Planning Regulation 2009.

The Department of State Development, Manufacturing, Infrastructure and Planning is the State Assessment Referral Agency (SARA) under Schedule 7 of the Sustainable Planning Regulation 2009 for assessable development involving high impact earthworks within wetland protection areas. The Department of Environment, Science and Innovation is a technical agency.

The policy outcome and assessment criteria for assessing these applications are described in the State Development Assessment Provisions (SDAP) State Code 9 : Great Barrier Reef Wetland Protection Areas.

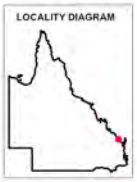
This map is produced at a scale relevant to the size of the lot on plan identified and should be printed at A4 size in portrait orientation. Consideration of the effects of mapped scale is necessary when interpreting data at a large scale.

For further information or assistance with interpretation of this product, please contact the Department of Environment, Science and Innovation, email planning.support@des.qld.gov.au.

Map of Queensland Wetland Environmental Values

Cadastral Boundary
High ecological values waters management intent
Wetlands assessed under section 7
GBR wetland of high ecological significance
Wetland of high ecological significance
Wetland of general ecological significance
Selected Lot and Plan

LOCALITY DIAGRAM



N

Note:
This map shows the location of wetlands on the Map of Queensland Wetland Environmental Values under the Environmental Protection (Wetland and Water Biodiversity) Policy 2019. The map also shows high ecological value waters management intent under Schedule 2 of the Environmental Protection (Water and Wetland Biodiversity) Policy 2019.

Wetlands are assessed for ecological significance using the environmental values for wetlands in section 7 of the Environmental Protection (Wetland and Water Biodiversity) Policy 2019. Wetlands are considered either High Ecological Significance (HES) or of General Ecological Significance (GES) for the purposes of the environmental values.

This map is produced at a scale relevant to the size of the lot on plan identified and should be printed at A4 size in portrait orientation. Consideration of the effects of mapped scale is necessary when interpreting data at a large scale.

For further information or assistance with interpretation of this product, please contact the Department of Environment, Science and Innovation, email planning.support@des.qld.gov.au.

0 69 138 207 276 345 m

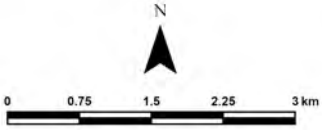
This product is displayed in: GDA2020

Pre-clearing Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

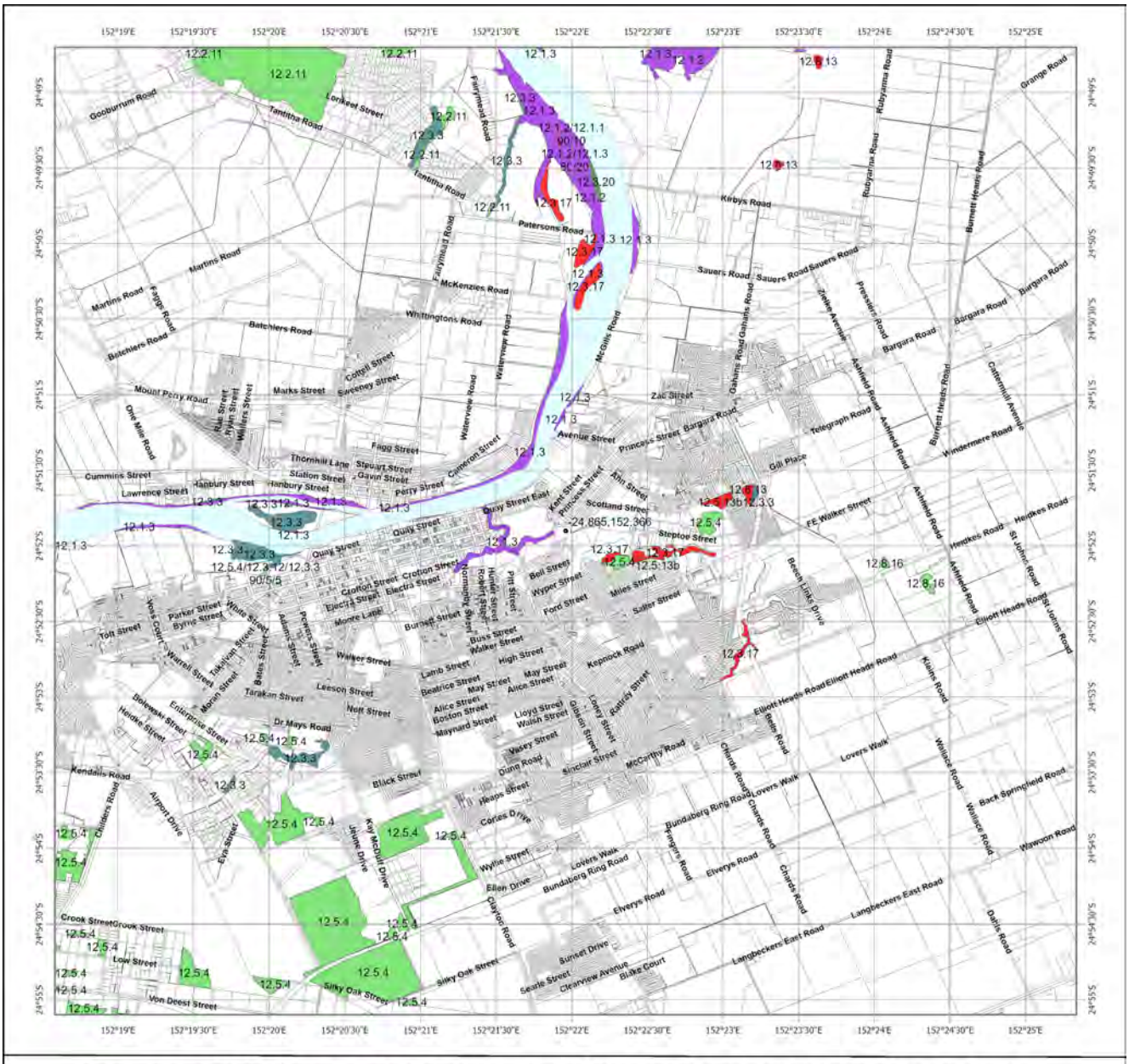
1. Rainforests and scrubs (1-7b)
2. Wet eucalypt open forests (8-8b)
3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
4. Eucalypt open forests to woodlands on floodplains (16-16d)
5. Eucalypt dry woodlands on inland depositional plains (17-18d)
6. Eucalypt low open woodlands usually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

Water
Cadastral Boundaries
Coordinates



This product is displayed in GDA2020

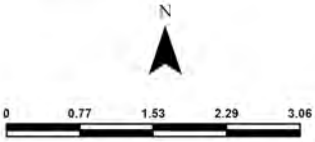
Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.



Remnant 2021 Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

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



This product is displayed in GDA2020

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled. Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.

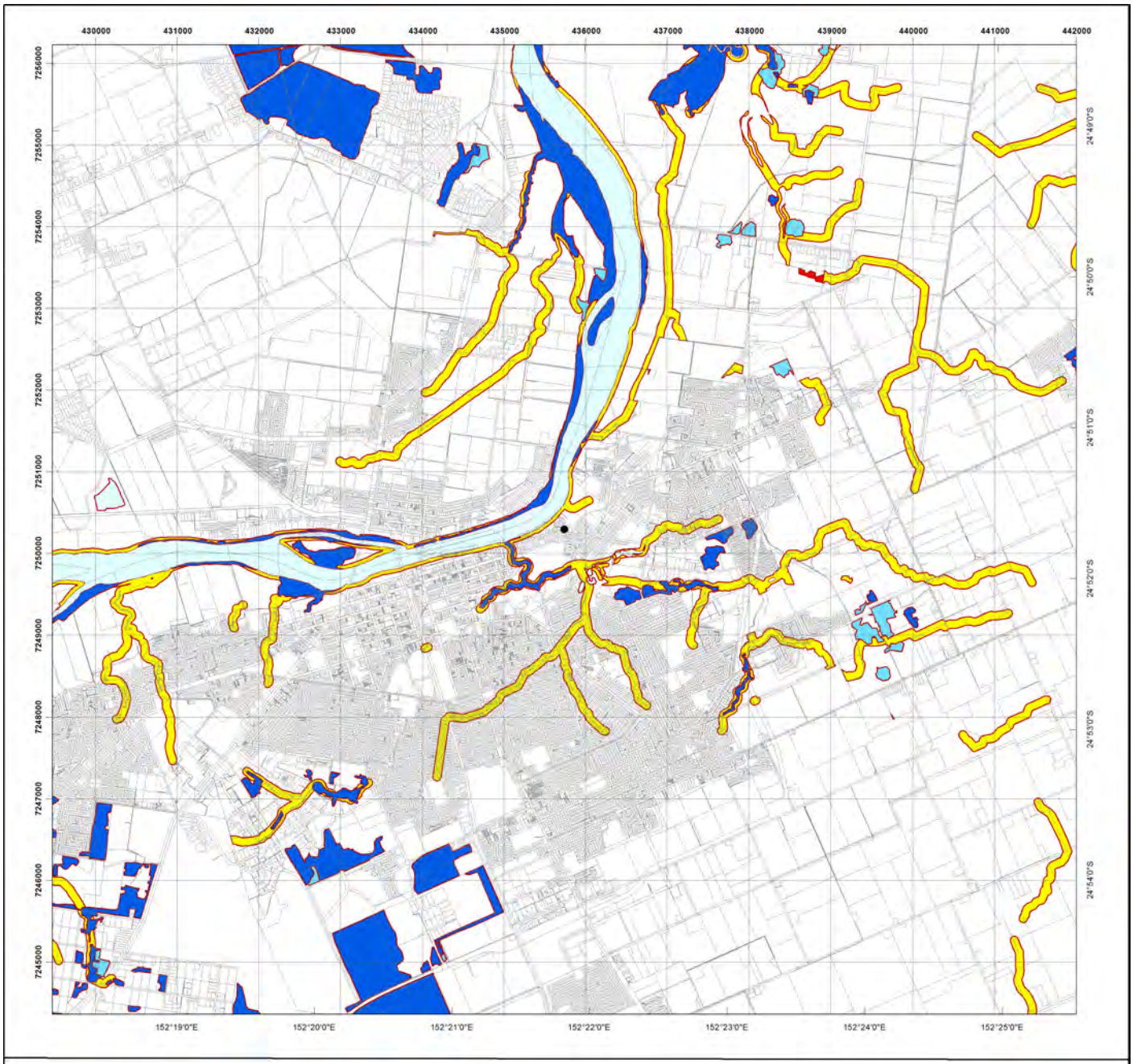
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.

The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".

Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.

Non-remnant vegetation includes regrowth and disturbed native vegetation.



Regulated Vegetation Management Map

Legend

- Coordinates
- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Other land parcel boundaries

N

0 675 1,350 2,025 2,700 3,375 m

This product is projected into:
GDA 1994 MGA Zone 56

Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Resources makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.

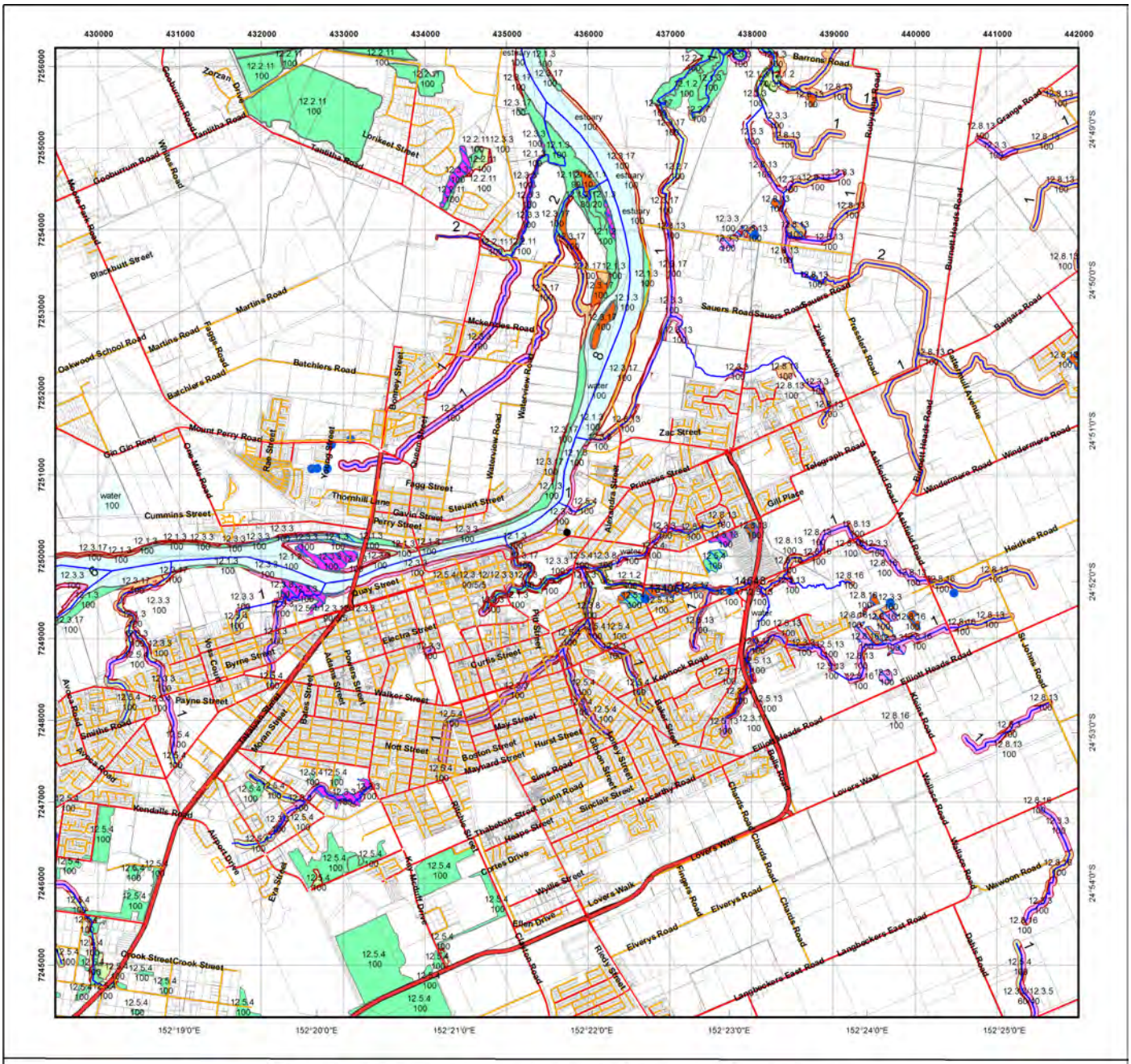
Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.resources.qld.gov.au or contact the Department of Resources.

Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.

Queensland Government



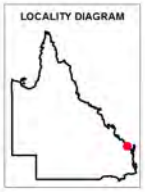
Vegetation Management Supporting Map

Legend

- Coordinates
- Category A or B area containing endangered regional ecosystems
- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystem
- Category C or R area containing endangered regional ecosystems
- Category C or R area containing of concern regional ecosystems
- Category C or R area that is a least concern regional ecosystem
- Category X area
- Water
- Wetland on the vegetation management wetlands map
- Essential habitat on the essential habitat map
- Essential habitat species record
- Watercourses and drainage features on the vegetation management watercourse and drainage features map
  (Stream order shown as black number against stream where available)
- Highway
- Connector
- Street/Local Road
- National Parks, State Forest and other reserves
- Other land parcel boundaries

Queensland Government

LOCALITY DIAGRAM



N

0 480 960 1,440 1,920 2,400 m

This product is projected into:
GDA 1994 MGA Zone 56

Labels for Essential Habitat are centred on the area of enquiry.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/- 100 metres.

Disclaimer:
While every care is taken to ensure the accuracy of this product, the Department of Resources makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the product being inaccurate or incomplete in any way and for any reason.

Additional information may be required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.resources.qld.gov.au or contact the Department of Resources.

Digital data for the vegetation management watercourse and drainage feature map, vegetation management wetlands map, essential habitat map and the vegetation management remnant and regional ecosystem map are available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

Vegetation Management Act 1999 - Extract from the essential habitat database

Essential habitat is required for assessment under the:

- State Development Assessment Provisions - State Code 16: Native vegetation clearing which sets out the matters of interest to the state for development assessment under the *Planning Act 2016*; and
- Accepted development vegetation clearing codes made under the *Vegetation Management Act 1999*

Essential habitat for one or more of the following species is found on and within 1.1 km of the identified subject lot/s on the accompanying essential habitat map.

This report identifies essential habitat in Category A, B and Category C areas.

The numeric labels on the essential habitat map can be cross referenced with the database below to determine which essential habitat factors might exist for a particular species.

Essential habitat is compiled from a combination of species habitat models and buffered species records.

The Department of Resources website (http://www.resources.qld.gov.au) has more information on how the layer is applied under the State Development Assessment Provisions - State Code 16: Native vegetation clearing and the *Vegetation Management Act 1999*.

Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated.

Essential habitat, for protected wildlife, means a category A area, a category B area or category C area shown on the regulated vegetation management map-

1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or

2) in which the protected wildlife, at any stage of its life cycle, is located.

Protected wildlife includes critically endangered, endangered, vulnerable or near-threatened native wildlife prescribed under the *Nature Conservation Act 1992*.

Essential habitat in Category A and/or Category B and/or Category C

Label	Scientific Name	Common Name	NCA Status	Vegetation Community	Altitude	Soils	Position in Landscape
13406	Rhodamnia dumicola	rib-fruited malletwood	E	notophyll or microphyll vine thicket or low vine forest	0 to 700 m	sand, loam	hill slope, ridge line, alluvial flat
14648	Cupaniopsis shirleyana	wedge-leaf tuckeroo	V	microphyll vine thicket; semi-evergreen vine thicket; evergreen simple notophyll vine forest; Araucarian microphyll/notophyll vine forest	0 to 300 m	sand, clay loam or loam (Rudosols, Tenosols, Sodosols, Chromosols, Vertosols, Hydrosols, Kandosols, Kurosols, Podosols, Organosols)	gentle to steep hill slope, gully in hilly terrain, creek bank, river bank

Label	Regional Ecosystem (mandatory unless otherwise specified)
13406	11.5.15, 12.2.2, 12.3.3, 12.3.16, 12.5.13, 12.8.3, 12.8.4, 12.8.13, 12.8.21, 12.9-10.14, 12.9-10.15, 12.9-10.16, 12.11.1, 12.11.3, 12.11.10, 12.11.11, 12.11.12, 12.12.13, 12.12.15, 12.12.16, 12.12.17
14648	12.3.11, 12.3.16, 12.3.17, 12.9-10.16, 12.11.10, 12.11.11

Appendix C - Likelihood of Occurrence Results

Scientific Name	Common Name	NC Act Status	EPBC Act Status	Habitat Requirements	2024 Likelihood of Occurrence
Flora					
Rhodamnia dumicola	rib-fruited malletwood	Endangered	-	*Rhodamnia dumicola* occurs in notophyll or microphyll vine thickets or low vine forests, often in association with Araucaria cunninghmaii, and between sea level to 400 m altitude Drier rainforests north of Beenleigh ()(Guymer, G. P., Jessup, L. W, 1986).	**Possible** Potential regrowth habitat exists however aerial shows not currently suitable. Records in a 5km buffer exist.
Cupaniopsis shirleyana	wedge-leaf tuckero	Vulnerable	Vulnerable	Occurs at 20 to 550 m elevation. Recorded in a variety of rainforest types including vine thicket and dry rainforest. Occurs on hillsides, mountain tops, lower slopes of valleys, stream beds and along riverbanks. Grows in a variety of soil types (DES, 2023).	**Possible** Potential regrowth habitat exists however aerial shows not currently suitable. Records in a 5km buffer exist.
Macadamia integrifolia	Macadamia Nut, Queensland Nut Tree, Smooth-shelled Macadamia, Bush Nut, Nut Oak	Vulnerable	Vulnerable	Rainforest and rainforest edges on ridges, hill slopes, scree slopes and foot slopes, gullies, benches and terrace plains on well-drained, high nutrient soils (Costello, Gregory and Donatiu, 2009).	**Unlikely** Suitable habitat does not exist on the site.
Dichanthium setosum	bluegrass	Least Concern	Vulnerable	Dichanthium setosum occurs in heavy soils (predominantly cracking clays or alluvium, often in gilgai) in woodland or open woodland usually dominated by Acacia (brigalow) and/or Eucalyptus species. The climate is tropical to subtropical and markedly seasonal with the habitat drying out for part of the year (Ayers, 1996; Queensland Herbarium, 2012).	**Possible** Suitable remnant habitat exists on site.
Acacia attenuata	Whipstick wattle	Vulnerable	Vulnerable	Flat coastal lowland plains in seasonally waterlogged areas of wet heathland, open eucalypt forest, and open woodland, particularly specifically on sandy poorly drained soils or peat swamps which are infertile. Grows at altitudes <30 m above sea level and is tolerant of disturbance, may grow along roads (DCCEEW, 2023a).	**Likely** Suitable remnant habitat exists on site and species is tolerant of disturbance.
Samadera bidwillii	Quassia	Vulnerable	Vulnerable	Lowland rainforest or on rainforest margins occasionally open forest or woodland. Commonly found near temporary or permanent watercourses up to 510 m elevation. Soils	**Possible** Potential regrowth habitat exists however aerial shows not currently suitable.

Scientific Name	Common Name	NC Act Status	EPBC Act Status	Habitat Requirements	2024 Likelihood of Occurrence
				include lithosols, skeletal soils, loam soils, sands, silts and sands with clay subsoils (DES, 2023).	
Fauna					
Cyclopsitta diophthalma coxeni	Coxen's Fig-Parrot	Critically Endangered	Critically Endangered	Occurs in rainforest habitats, particularly stands with figs, including subtropical rainforest, dry rainforest, littoral and developing littoral rainforest, and vine forest. Have also been recorded at trees in gardens, cultivated farmlands, and along streets in country towns. Distribution extends from Gympie in south-eastern Queensland to the Richmond River in north-eastern New South Wales, and west to the Bunya Mountains, Main Range and Koreelah Range (DCCEEW, 2023a)	**Unlikely** Potential regrowth habitat exists however aerial shows not currently suitable.
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	Endangered	Critically Endangered	Estuaries, bays, coastal lagoons, with large intertidal mudflats or sandflats (DCCEEW, 2023b).	**Possible** Suitable estuary habitat exits onsite however size of mud/ sandflats is limited when looking at aerial.
Calidris ferruginea	Curlew Sandpiper	Critically Endangered	Critically Endangered	Breeds in the high artic with a portion of the population migrating to Australia in the non-breeding season. During non-breeding season feeding on mudflats on polychaete worms, molluscs and crustaceans Records in intertidal mudflats in sheltered coastal areas, non-tidal swamps, lakes and lagoons near the coast. Occasional occurrence at inland lakes and dams. (Gils et al., 2020).	**Possible** Suitable habitat exits onsite however size of intertidal mudflats are limited when looking at aerial.
Limosa lapponica baueri	Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	Vulnerable	Endangered	Occurs in a variety of habitats including large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays (DCCEEW, 2023b).	**Possible** Suitable habitat exists on site and species can inhabit a variety of habits.
Tringa nebularia	Common Greenshank, Greenshank	special least concern	Endangered	The Common Greenshank favors dry ground adjacent to marshy areas for breeding, indicative of its preference for damp environments.	**Possible** Suitable habitat exists onsite however limited inhabitable adjacent dry ground present for breeding.

Scientific Name	Common Name	NC Act Status	EPBC Act Status	Habitat Requirements	2024 Likelihood of Occurrence
Erythrotriorchis radiatus	Red Goshawk	Endangered	Endangered	Occurs in coastal and sub-coastal areas in woodland and forests, including riverine forests. Favours intermediate density forests to aid hunting of birds. Nest in tall trees, often beside permanent water sources. (DCCEEW, 2023a)	**Unlikely** Potential regrowth habitat exists however aerial shows not currently suitable. No intermediate dense forests and tall trees present.
Rostratula australis	Australian Painted Snipe	Endangered	Endangered	Inhabits shallow inland wetlands, either freshwater or brackish water bodies. Nests on the ground amongst tall reed-like vegetation near water, and feeds near the water's edge and on mudflats. (del Hoyo et al. 2020a; DCCEEW, 2023a)	**Unlikely** Potential regrowth habitat exists however aerial shows not currently suitable. Tall reed vegetation for nesting unlikely
Calidris acuminata	Sharp-tailed Sandpiper	Special least concern	Vulnerable	The Sharp-tailed Sandpiper prefers the grassy edges of shallow inland freshwater wetlands. It is also found around swage farms, flooded fields, mudflats, mangroves, rocky shores and beaches. Its breeding habitat in Siberia is the peat-hummock and lichen tundra of the high Arctic.	**Possible** Preferred habitat is not present, however some remnant mangrove habit is on site.
Pachyptila turtur subantarctica	Fairy Prion (southern)	Least concern	Vulnerable	Subspecies breeds on the subantartic Macquarie Island in Australian territory and is found in subtropical waters durign the non-breeding season (Threatened Species Scientific Committee, 2015). Currently considered monotypic with no subspecies (Backstrom et al., 2021)	**Unlikely** Suitable habitat does not exist on site.
Hirundapus caudacutus	White-throated Needletail	Vulnerable	Vulnerable	Non-breeding migrant to Australia from eastern Asia (Chantler and Kirwan, 2020). Forages on insects between 1 m and 1,800 m above ground, rarely found roosting (Chantler & Kirwan, 2020). Occur over most types of habitat, including open forest and rainforest, and may also fly below the canopy between trees or in clearings (DCCEEW, 2023b).	**Unlikely** Potential regrowth habitat exists however aerial shows not currently suitable.
Turnix melanogaster	Black-breasted Button-quail	Vulnerable	Vulnerable	Restricted to rainforests and forests, mostly in areas with 770-1200 mm rainfall per annum. Favour drier low closed forests, particularly semi-evergreen vine thicket, low microphyll vine forest, araucarian microphyll vine forest and araucarian notophyll vine forest; also in low, dense acacia thickets and, in littoral area, in vegetation behind sand dunes. (Debus et al. 2016; DCCEEW, 2023a)	**Unlikely** Suitable habitat does not exist onsite.

Scientific Name	Common Name	NC Act Status	EPBC Act Status	Habitat Requirements	2024 Likelihood of Occurrence
Calidris canutus	Red Knot, Knot	Endangered	Vulnerable	Breeds in the Artic circle before migratory to southern latitudes including Australia in the non-breeding season (Baker et al., 2020). During non-breeding season red knot are exclusively marine shorebirds feeding on worms, crustaceans and molluscs on tidal mudflats all around the Australian coastline (Baker et al., 2020).	**Unlikely** Suitable habitat does not exist onsite.
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	Special least concern	Vulnerable	Occur in permanent and ephemeral wetlands with dense but heterogeneous vegetative cover, as well as saline or brackish water and modified or artificial habitats including farmland. They feed mostly on invertebrates, but also seeds and other plant material.	**Unlikely** Suitable habitat does not exist onsite.
Falco hypoleucos	Grey Falcon	Vulnerable	Vulnerable	Found in woodland and savanna in arid and semi-arid area, rarely close to the coast. Nest in arid woodlands typically with annual rainfall less than 500 mm (Debus, Kirwan and Christie, 2020).	**Unlikely** Suitable habitat does not exist on site and is close to coast
Charadrius leschenaultii	Greater Sand Plover, Large Sand Plover	Vulnerable	Vulnerable	Breeds in western China, Mongolia, and southern Siberia before a portion of that population migrates to the eastern and northern coastline of Australia. Exclusively found on coastal beaches, estuaries and tidal mudflats feeding on crustescens and bivalves. (Wiersma, Kirwan and Boesman, 2020).	**Possible** Suitable habitat exists on site
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)	Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)	Endangered	Endangered	Inhabits a range of eucalypt forest and woodland communities. Adequate floristic diversity, feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species. (Office of Environment and Heritage, 2022c). They are able to persist in fragmented habitats, and even survive in isolated trees across a predominantly agricultural landscape. Distributed in coastal and subcoastal eastern Australia from eastern South Australia to Cairns, Queensland. The species is limited by altitude (found below 800 m a.s.l.), temperature and leaf moisture, which restricts the distribution into arid areas (DCCEEW, 2023b).	**Unlikely** Potential regrowth habitat exists however aerial shows not currently suitable.

Scientific Name	Common Name	NC Act Status	EPBC Act Status	Habitat Requirements	2024 Likelihood of Occurrence
Dasyurus hallucatus	Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu]	Least concern	Endangered	Occupies a diversity of habitats across its range, including rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert. Generally, requires rocky areas or tree hollows for denning (DCCEEW, 2023a)	**Unlikely** Potential regrowth habitat exists however aerial shows not currently suitable.
Petauroides volans	Greater Glider (southern and central)	Endangered	Endangered	Eucalypt forests and woodlands, preferring mature forest with numerous large tree hollows. Folivorous, usually selecting habitats with a diversity of Eucalypt species. Sensitive to habitat fragmentation, restricted to gliding locomotion and reluctant to disperse through non-native habitat (DCCEEW, 2023b).	**Unlikely** Potential regrowth habitat exists however aerial shows not currently suitable.
Xeromys myoides	Water Mouse, False Water Rat, Yirrkoo	Vulnerable	Vulnerable	Mangroves and the associated saltmarsh, sedgelands, heathlands, mangroves and freshwater wetlands (DCCEEW, 2023a). Most feeds within the intertidal zone at low tide. Builds nests as high tide refuges.	**Possible** Some remnant mangrove habitat exists on site.
Pteropus poliocephalus	Grey-headed Flying-fox	Least concern	Vulnerable	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are commonly found in gullies, close to water, in vegetation with a dense canopy. They travel up to 50 km to forage, on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. (DCCEEW, 2023a)	**Unlikely** Potential regrowth habitat exists however aerial shows not currently suitable.
Hemiaspis damelii	Grey Snake	Endangered	Endangered	Occurs in brigalow and belah woodlands, usually on heavy, cracking clay soils and in association with water bodies or with areas of small gullies or ditches (Rowland, 2012b)	**Possible** Potential regrowth habitat exists.
Egernia rugosa	Yakka Skink	Vulnerable	Vulnerable	Habitat requirements are poorly known, however the 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 shrub land. The yakka skink has also been recorded in lancewood forest on coarse gritty soils in the vicinity of low ranges, foothills and undulating terrain with good drainage. (Swanson 1976; Cogger et al. 1983; Ehmann 1992; Cogger 2000; QPWS 2001).	**Possible** Potential regrowth habitat exists.

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Appendix D – Flora and Fauna Species Lists

Fauna Species

Family	Scientific Name	Common Name	Exotic?	*Nature Conservation Act 1992* Status	*Environment Protection and Biodiversity Conservation Act 1999* Status	Environment Protection and Biodiversity Conservation Act 1999 Marine/Migratory (Ma/Mi)
Acanthizidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill				
Acanthizidae	*Gerygone levigaster*	mangrove gerygone				
Acanthizidae	*Gerygone mouki*	brown gerygone				
Acanthizidae	*Sericornis frontalis*	white-browed scrubwren				
Acanthizidae	*Smicrornis brevirostris*	weebill				
Accipitridae	*Elanus axillaris*	black-shouldered kite				
Accipitridae	*Haliaeetus leucogaster*	white-bellied sea-eagle				Ma
Accipitridae	*Haliastur indus*	brahminy kite				Ma
Acrocephalidae	*Acrocephalus australis*	Australian reed-warbler				
Agamidae	*Intellagama lesueurii*	eastern water dragon				
Anatidae	*Anas gracilis*	grey teal				
Anatidae	*Anas superciliosa*	Pacific black duck				
Anatidae	*Chenonetta jubata*	Australian wood duck				
Anatidae	*Dendrocygna eytoni*	plumed whistling-duck				
Anhingidae	*Anhinga novaehollandiae*	Australasian darter				
Anseranatidae	*Anseranas semipalmata*	magpie goose				Ma
Ardeidae	*Ardea intermedia*	intermediate egret				Ma
Ardeidae	*Ardea pacifica*	white-necked heron				
Ardeidae	*Bubulcus ibis*	cattle egret				
Ardeidae	*Butorides striata*	striated heron				
Ardeidae	*Egretta novaehollandiae*	white-faced heron				
Ardeidae	*Nycticorax caledonicus*	nankeen night-heron				Ma
Artamidae	*Artamus leucorynchus*	white-breasted woodswallow				
Artamidae	*Cracticus nigrogularis*	pied butcherbird				
Artamidae	*Gymnorhina tibicen*	Australian magpie				

Family	Scientific Name	Common Name	Exotic?	*Nature Conservation Act 1992* Status	*Environment Protection and Biodiversity Conservation Act 1999* Status	Environment Protection and Biodiversity Conservation Act 1999 Marine/Migratory (Ma/Mi)
Artamidae	*Strepera graculina*	pied currawong				
Bufonidae	*Rhinella marina*	cane toad	Yes			
Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo				
Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike				Ma
Charadriidae	*Vanellus miles*	masked lapwing				
Cisticolidae	*Cisticola exilis*	golden-headed cisticola				
Columbidae	*Columba livia*	rock dove	Yes			
Columbidae	*Geopelia humeralis*	bar-shouldered dove				
Columbidae	*Geopelia placida*	peaceful dove				
Columbidae	*Ocyphaps lophotes*	crested pigeon				
Columbidae	*Streptopelia chinensis*	spotted dove	Yes			
Corvidae	*Corvus orru*	Torresian crow				
Dicruridae	*Dicrurus bracteatus*	spangled drongo				Ma
Elapidae	*Pseudonaja textilis*	eastern brown snake				
Estrildidae	*Taeniopygia bichenovii*	double-barred finch				
Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra				
Halcyonidae	*Todiramphus macleayii*	forest kingfisher				Ma
Hirundinidae	*Hirundo neoxena*	welcome swallow				Ma
Laridae	*Chroicocephalus novaehollandiae*	silver gull				
Megapodiidae	*Alectura lathami*	Australian brush-turkey				
Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater				
Meliphagidae	*Manorina melanocephala*	noisy miner				
Meliphagidae	*Philemon corniculatus*	noisy friarbird				
Meropidae	*Merops ornatus*	rainbow bee-eater				Ma
Monarchidae	Grallina cyanoleuca	magpie-lark				Ma
Oriolidae	*Sphecotheres vieilloti*	Australasian figbird				

Family	Scientific Name	Common Name	Exotic?	*Nature Conservation Act 1992* Status	*Environment Protection and Biodiversity Conservation Act 1999* Status	Environment Protection and Biodiversity Conservation Act 1999 Marine/Migratory (Ma/Mi)
Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush				
Pardalotidae	*Pardalotus striatus*	striated pardalote				
Pelecanidae	*Pelecanus conspicillatus*	Australian pelican				Ma
Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant				
Psittacidae	*Trichoglossus moluccanus*	rainbow lorikeet				
Rallidae	*Gallinula tenebrosa*	dusky moorhen				
Rallidae	*Gallirallus philippensis*	buff-banded rail				
Rallidae	*Porphyrio melanotus*	purple swamphen				
Rhipiduridae	*Rhipidura albiscapa*	grey fantail				
Rhipiduridae	*Rhipidura leucophrys*	willie wagtail				
Threskiornithidae	*Threskiornis molucca*	Australian white ibis				Ma

Flora Species

Family	Scientific Name	Common Name	Exotic?	*Nature Conservation Act 1992* Status	*Environment Protection and Biodiversity Conservation Act 1999* Status	Environment Protection and Biodiversity Conservation Act 1999 Marine/Migratory (Ma/Mi)
Acanthaceae	*Ruellia simplex*		Yes			
Acanthaceae	*Thunbergia alata*	black-eyed Susan	Yes			
Acanthaceae	*Avicennia marina*					
Aizoaceae	*Sesuvium portulacastrum*	sea purslane				
Amaranthaceae	*Alternanthera denticulata*	lesser joyweed				
Amaranthaceae	*Alternanthera nana*	hairy joyweed				

Family	Scientific Name	Common Name	Exotic?	*Nature Conservation Act 1992* Status	*Environment Protection and Biodiversity Conservation Act 1999* Status	Environment Protection and Biodiversity Conservation Act 1999 Marine/Migratory (Ma/Mi)
Amaranthaceae	*Alternanthera pungens*	khaki weed	Yes			
Amaranthaceae	*Amaranthus viridis*	green amaranth	Yes			
Amaranthaceae	*Gomphrena celosioides*	gomphrena weed	Yes			
Amaranthaceae	*Guilleminea densa*	small matweed	Yes			
Amaryllidaceae	*Crinum pedunculatum*	river lily		SL		
Anacardiaceae	*Pleiogynium timorense*	Burdekin plum				
Anacardiaceae	*Schinus terebinthifolius*		Yes			
Anacardiaceae	*Schinus terebinthifolius*		Yes			
Apocynaceae	*Alstonia constricta*	bitterbark				
Apocynaceae	*Asclepias curassavica*	red-head cottonbush	Yes			
Apocynaceae	*Cascabela thevetia*	yellow oleander	Yes			
Apocynaceae	*Catharanthus roseus*	pink periwinkle	Yes			
Apocynaceae	*Cryptostegia grandiflora*	rubber vine	Yes			
Araliaceae	*Polyscias elegans*	celery wood				
Araliaceae	*Heptapleurum actinophyllum*					
Araucariaceae	*Araucaria cunninghamii*	hoop pine				
Asteraceae	*Ageratum conyzoides*	billygoat weed	Yes			
Asteraceae	*Bidens pilosa*		Yes			
Asteraceae	*Calyptocarpus vialis*	creeping cinderella weed	Yes			
Asteraceae	*Gamochaeta purpurea*		Yes			
Asteraceae	*Hypochaeris radicata*	catsear	Yes			
Asteraceae	*Sonchus oleraceus*	common sowthistle	Yes			
Asteraceae	*Sphagneticola trilobata*		Yes			
Asteraceae	*Tagetes minuta*	stinking roger	Yes			
Asteraceae	*Tithonia diversifolia*	Japanese sunflower	Yes			
Asteraceae	*Calyptocarpus vialis*	creeping cinderella weed	Yes			
Cactaceae	*Opuntia stricta*		Yes			

Family	Scientific Name	Common Name	Exotic?	*Nature Conservation Act 1992* Status	*Environment Protection and Biodiversity Conservation Act 1999* Status	Environment Protection and Biodiversity Conservation Act 1999 Marine/Migratory (Ma/Mi)
Campanulaceae	*Lobelia purpurascens*	white root		SL		
Chenopodiaceae	*Enchylaena tomentosa*					
Colchicaceae	*Gloriosa superba*	glory lily	Yes			
Convolvulaceae	*Ipomoea indica*	blue morning-glory	Yes			
Cyperaceae	*Cyperus rotundus*	nutgrass	Yes			
Cyperaceae	*Fimbristylis dichotoma*	common fringe-rush				
Cyperaceae	*Fimbristylis ferruginea*					
Euphorbiaceae	*Macaranga tanarius*	macaranga				
Euphorbiaceae	*Ricinus communis*	castor oil bush	Yes			
Euphorbiaceae	*Excoecaria agallocha*	milky mangrove				
Lauraceae	*Cinnamomum camphora*	camphor laurel	Yes			
Laxmanniaceae	*Eustrephus latifolius*	wombat berry				
Laxmanniaceae	Lomandra longifolia					
Leguminosae	*Acacia disparrima subsp. disparrima*					
Leguminosae	*Acacia leiocalyx subsp. leiocalyx*					
Leguminosae	*Gompholobium pinnatum*	poor mans gold				
Leguminosae	*Macroptilium atropurpureum*	siratro	Yes			
Leguminosae	*Mimosa pudica var. hispida*		Yes			
Leguminosae	*Senna occidentalis*	coffee senna	Yes			
Leguminosae	*Delonix regia*	poinciana	Yes			
Leguminosae	*Acacia leiocalyx*					
Leguminosae	*Acacia disparrima*					
Leguminosae	*Libidibia ferrea*	leopard tree	Yes			
Lythraceae	*Cuphea carthagenensis*		Yes			
Malvaceae	*Sida cordifolia*		Yes			

Family	Scientific Name	Common Name	Exotic?	*Nature Conservation Act 1992* Status	*Environment Protection and Biodiversity Conservation Act 1999* Status	Environment Protection and Biodiversity Conservation Act 1999 Marine/Migratory (Ma/Mi)
Malvaceae	*Urena lobata*	urena weed	Yes			
Moraceae	*Ficus opposita*					
Myrsinaceae	*Aegiceras corniculatum*	river mangrove				
Myrtaceae	*Eucalyptus tereticornis*					
Myrtaceae	*Eugenia uniflora*	Brazilian cherry tree	Yes			
Myrtaceae	*Lophostemon suaveolens*	swamp box				
Myrtaceae	*Melaleuca quinquenervia*	swamp paperbark				
Myrtaceae	*Melaleuca viridiflora var. viridiflora*					
Myrtaceae	*Corymbia tessellaris*	Moreton Bay ash				
Ochnaceae	*Ochna serrulata*	ochna	Yes			
Onagraceae	*Ludwigia octovalvis*	willow primrose				
Passifloraceae	*Passiflora foetida*		Yes			
Picrodendraceae	*Petalostigma pubescens*	quinine tree				
Pinaceae	*Pinus elliottii*	slash pine	Yes			
Plantaginaceae	*Plantago debilis*	shade plantain				
Poaceae	*Chloris gayana*	rhodes grass	Yes			
Poaceae	*Cynodon dactylon var. dactylon*		Yes			
Poaceae	*Heteropogon contortus*	black speargrass				
Poaceae	*Imperata cylindrica*	blady grass				
Poaceae	*Megathyrsus maximus var. maximus*		Yes			
Poaceae	*Melinis repens*	red natal grass	Yes			
Poaceae	*Urochloa subquadripara*		Yes			
Poaceae	*Megathyrsus maximus*		Yes			
Poaceae	*Sporobolus virginicus*	sand couch				
Poaceae	*Urochloa mutica*		Yes			

Family	Scientific Name	Common Name	Exotic?	*Nature Conservation Act 1992* Status	*Environment Protection and Biodiversity Conservation Act 1999* Status	Environment Protection and Biodiversity Conservation Act 1999 Marine/Migratory (Ma/Mi)
Polygonaceae	*Persicaria decipiens*	slender knotweed				
Polygonaceae	*Rumex brownii*	swamp dock				
Polygonaceae	*Antigonon leptopus*		Yes			
Portulacaceae	*Portulaca oleracea*	pigweed	Yes			
Proteaceae	*Grevillea robusta*					
Rhamnaceae	*Alphitonia excelsa*	soap tree				
Sapindaceae	*Jagera pseudorhus var. pseudorhus*					
Solanaceae	*Solanum seaforthianum*	Brazilian nightshade	Yes			
Solanaceae	*Solanum torvum*	devil's fig	Yes			
Verbenaceae	*Lantana camara*	lantana	Yes			
Verbenaceae	*Stachytarpheta jamaicensis*	Jamaica snakeweed	Yes			

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