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9

Nature conservation

Contents

9 Nature conservation

9.1 Chapter purpose

This chapter provides a summary of the existing marine, coastal and terrestrial environmental values of Port Curtis that have the potential to be impacted by the Project. A summary of potential impacts, risks, and key mitigation measures is also provided.

Marine, intertidal and terrestrial environmental values and potential impacts addressed in this chapter are summarised in Table 9.1.

Table 9.1 Summary of ecological value and potential impacts with section location

Ecological value	Existing environment	Potential impacts
Terrestrial and intertidal flora and wetlands	Section 9.4	Section 9.5
Intertidal and terrestrial fauna	Section 9.6	Section 9.7
Seagrass meadows and epibenthic macroalgae	Section 9.8	Section 9.9
Reef communities	Section 9.10	Section 9.11
Fish and marine reptiles (excluding marine turtles)	Section 9.12	Section 9.13
Soft sediment habitats and benthic macroinvertebrates	Section 9.14	Section 9.15
Migratory birds	Section 9.16	Section 9.17
Marine turtles	Section 9.18	Section 9.19
Marine mammals	Section 9.20	Section 9.21
Marine pests	Section 9.22	Refer to other potential impact sections related to marine values
MNES and MSES	Section 9.26	Section 9.26

A summary of water quality values is provided in Chapter 8 (water quality) and the Water Quality Technical Report (Appendix H1).

Existing marine, coastal and terrestrial ecological values are further detailed in the Ecology Technical Report (Appendix I1).

Other appendices that support this chapter include:

- Appendix I1 – Ecology Technical Report (Appendix B – Likelihood of occurrence assessment)
- Appendix I2 – Potential impacts and risk assessment methodology
- Appendix I3 – Threatening processes for conservation significant species
- Appendix I4 – Ecology potential impacts and risk assessment ratings.

9.2 Methodology

9.2.1 Overview

The nature conservation chapter provides:

- A review of the existing environment for all ecological values within the Project impact areas
- An assessment of the potential ecological impacts and risks associated with Project activities.

A summary of the methodology implemented to describe the existing environment of the ecological values of Port Curtis and potential impacts and risks from Project activities is provided in Sections 9.2.2 and 9.2.3.

Several sections and appendices support the description of the existing environment and the impact assessment for each ecological value in this chapter, as well as providing detailed reference information, including:

- Detailed information on the ecological values and existing environment within the Project impact areas provided in the Ecology Technical Report (refer Appendix I1)
- Identification of the potential impacts on ecological values and the methodology implemented for the potential impact and risk assessment provided in Appendix I2. This appendix also defines key terms used in the risk assessment process (e.g. sensitivity rating, magnitude, consequence, likelihood).
- Risk rating tables relevant to the potential impacts on ecological values provided in Appendix I4. This appendix provides the working detail supporting the risk ratings for each potential impact on an ecological value, and details the consequence and likelihood of the potential impact, and the resultant risk rating.
- Mitigation measures relevant to ecological values provided in Section 9.27. These measures are considered in the assessment of the risk ratings for potential impacts (i.e. risk ratings assume that mitigation measures have been implemented).
- Significant residual adverse impact assessments for ecological values considered to be MSES and/or MNES (provided within the relevant ecological value sections). These sections provide an assessment in accordance with the relevant Commonwealth guidelines (i.e. *Matters of National Environmental Significance Significant Impact Guidelines, Version 1.1* (DoE 2013b)) and/or the state guidelines (i.e. *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (EHP 2014a)). Each assessment is made against relevant criteria and a determination is made as to whether the Project is likely to result in a significant residual impact (assuming mitigation measures are implemented).
- Assessment of the threatening processes for species of conservation significance and migratory species provided in Appendix I3. This appendix identifies where Project impacts have the potential to constitute a threatening process for the species or community based on the threats identified in conservation advice documents, recovery plans and threat abatement plans. This information is then utilised for the assessment of significant residual adverse impact for MSES and/or MNES.

The ecological values assessed in this chapter are defined in Table 9.2 in the context of how the values were grouped for the purposes of this chapter. The definition includes the individual species groupings and habitat types included within each value, to clarify where species or habitats are assessed. It is noted that while some species groupings/habitat types may technically fit into more than one ecological value category, the potential impacts on a species grouping/habitat type is assessed only once (e.g. marine turtles are technically marine reptiles, however they are assessed in the 'marine turtles' section and not the 'fish and marine reptiles' section).

Table 9.2 Definition of ecological values assessed in this chapter

Ecological value	Species groups and/or habitat types included in this value	Species groups and/or habitat types excluded from this value
Terrestrial and intertidal flora and wetlands	■ Flora values associated with: – Terrestrial vegetation communities and species (including flora species of conservation significance) – Mangroves communities (flora values) – Coastal saltmarsh communities ■ Integrity and condition of wetlands at the ecosystem-wide scale.	■ This value does not include seagrass meadows, epibenthic macroalgae, or the individual ecological values inhabiting wetlands.
Intertidal and terrestrial fauna	■ Intertidal and terrestrial fauna values associated with: – Fauna species that utilise terrestrial and intertidal habitats, including mammals, birds, and reptiles – Fauna habitat values, including fauna corridors and landscape connectivity – Pest species relevant to terrestrial and intertidal habitats.	■ This value does not include migratory shorebirds (i.e. only resident shorebirds are included) and does not include fish, sea kraits, marine turtles. Intertidal habitat such as soft sediments and seagrass meadows are not included in this value.
Seagrass meadows and epibenthic macroalgae	■ All seagrass meadows, including coastal seagrass meadows and deep water seagrass meadows, and epibenthic macroalgae.	■ This value does not include the assessment of the potential impacts on fauna species that utilise seagrass meadows and epibenthic macroalgae.
Reef communities	■ Coral reef communities, including fringing, platform, headland and rocky/rubble reef types.	■ This value does not include the assessment of the potential impacts on fauna species that utilise these reef habitats.
Fish and marine reptiles (excluding marine turtles)	■ Fish, marine reptiles and fisheries values, including: – Fish species associated with different habitat types within Port Curtis (e.g. reef fish species, estuarine and coastal fish species) – Crustaceans such as prawns and mud crabs and other nektobenthic invertebrates such as cuttlefish – Sea snakes and kraits – Commercial and recreational fisheries – Declared FHAs.	■ This value does not include assessment of the potential impacts on the Saltwater crocodile or on marine turtles.
Soft sediment habitats and benthic macroinvertebrates	■ Soft sediment habitats in intertidal and marine habitats, and benthic macroinvertebrate communities.	■ This value does not include the assessment of the potential impacts on species that utilise soft sediment habitats other than macroinvertebrates (e.g. foraging shorebirds).
Migratory birds	■ Includes migratory birds that are shorebird or pelagic (seabird) species.	N/A
Marine turtles	■ Marine sea turtles, foraging habitat and known nesting beaches.	N/A
Marine mammals	■ Whales, dolphins and dugong, and their habitat.	N/A

Ecological value	Species groups and/or habitat types included in this value	Species groups and/or habitat types excluded from this value
Marine pests	■ Marine pests recorded within Port Curtis are discussed, however the impact assessment as a result of the introduction and/or spread of marine pests is included within the relevant ecological values above.	N/A
World Heritage values of the GBRWHA within Port Curtis	■ Summarises the World Heritage values of the GBRWHA that are expressed in the Port of Gladstone and surrounds.	N/A
MNES and MSES	■ Summarises the MSES and MNES within the Project impact areas and the results of the significant impact assessment. The information summarised is based on the information provided in earlier sections of the chapter.	N/A

9.2.2 Existing environment

To describe the existing ecological values of the Project direct impact areas and potential indirect impact areas (Project impact areas) information was obtained from the following sources:

- Database searches
- Desktop reviews of previous ecological studies undertaken in the Port Curtis region
- Ongoing ecological studies being undertaken in the Port Curtis region for purposes independent of the Project
- Field data collection tasks designed for the Project EIS to supplement existing studies.

For the purposes of database searches, the Project EIS search area was defined as 6,210 square kilometres (km^2) of land and sea, spanning approximately 30km to the north and south of the Project impact areas (including Rodds Bay), and included the waters within Port Curtis to approximately 50km offshore, as shown in Figure 9.1.

Appendix I1 (Section 2) and the relevant ecological value sections provide further detail on the specific methodology used for each ecological value.

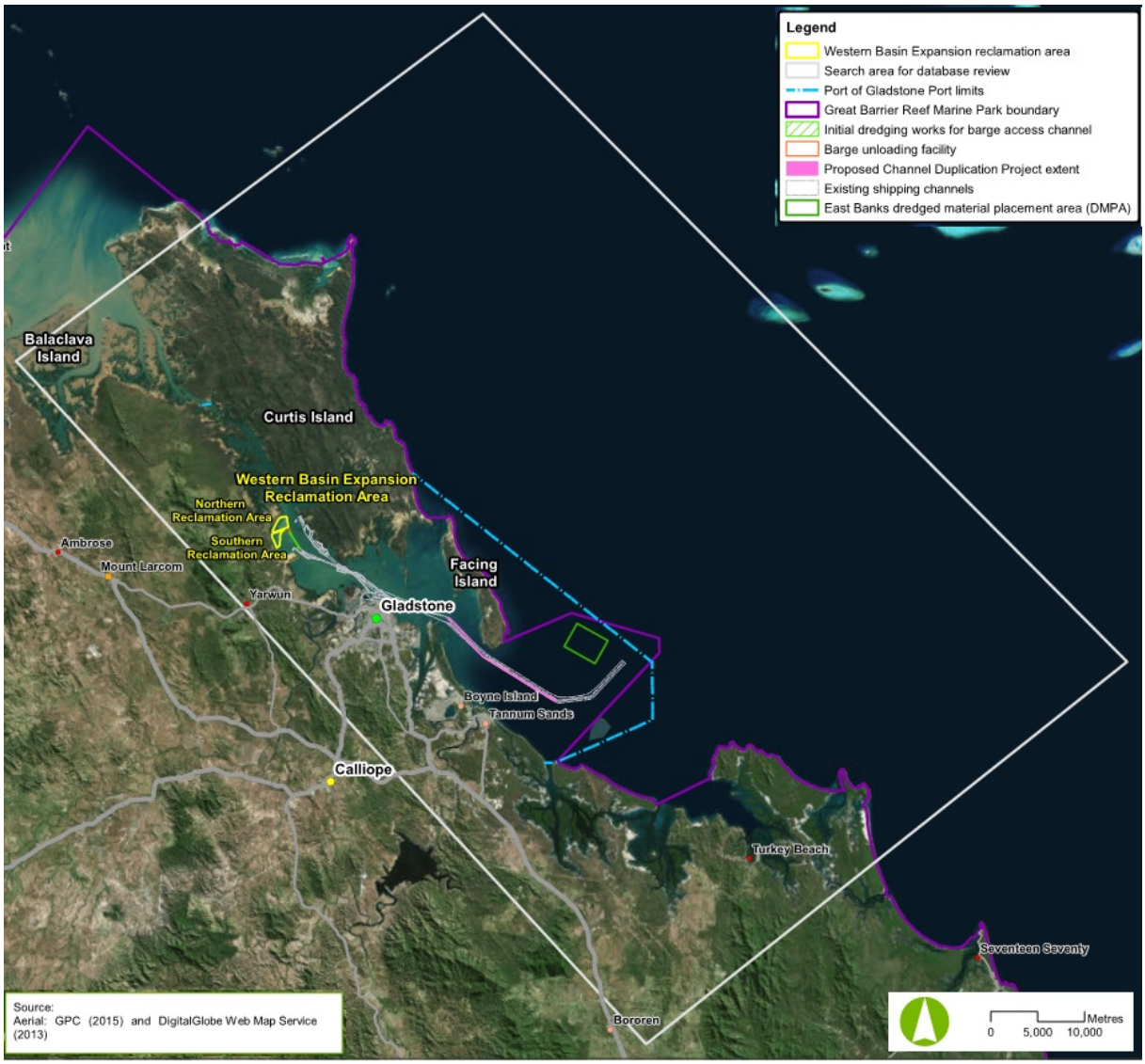

Figure 9.1 **Search area for database review**

9.2.3 Project field surveys

Marine and terrestrial ecological monitoring was undertaken for the Project EIS to provide an adequate description of the existing ecological values and MNES, to supplement existing data from previous and ongoing Port Curtis monitoring programs.

Due to the high number and diversity of marine, intertidal and terrestrial species within the Project impact areas a number of individual targeted baseline surveys were developed and undertaken by the EIS study team, comprising technical experts with local knowledge of the Port Curtis environment. Ecological baseline data has been collected and summarised over a seasonal (where relevant) scale in order to establish an appropriate baseline assessment. Marine ecological factors were investigated biannually (wet and dry seasons) or quarterly depending on the particular communities' natural rates of change.

Prior to construction marine and terrestrial ecological surveys will be undertaken to obtain additional site-specific information to supplement existing data.

Table 9.3 provides a summary of the Project EIS field surveys conducted as well as the additional surveys used.

Table 9.3 Summary of the Project surveys

Ecological value	Summary of Project surveys
Terrestrial and intertidal flora and wetlands	An ecological assessment of the terrestrial vegetation communities, mangrove and saltmarsh communities was undertaken by two suitably qualified and experienced Aurecon ecologists between 4 and 11 March 2015. The ecological field assessments were conducted to identify the following ecological values: ■ Flora species and vegetation communities and their conservation status under the EPBC Act, NC Act and VM Act ■ Likely occurrence of conservation significant flora species based on habitat characteristics. Further, the Project indirect impact areas associated with the WB and WBE reclamation areas were traversed during ecological field assessments by two suitably qualified and experienced Aurecon ecologists between 10 February and 12 February 2015. One of the objectives of these ecological field assessments was to describe the values of any wetland areas present. Surveys conducted for WBDDP EIS, RE mapping and database searches were used as a baseline.
Intertidal and terrestrial fauna	To supplement the existing information, an ecological field assessment was conducted within the Project impact areas by two suitably qualified and experienced Aurecon ecologists between 10 and 12 February 2015. The ecological field assessment was conducted to identify the likely occurrence of any conservation significant fauna species present within the Project impact areas, provide a description of the key habitat values of the areas, and to provide a list of incidental fauna observations which would provide an indication of the key local fauna assemblages in the areas.
Seagrass meadows and epibenthic macroalgae	Numerous seagrass surveys have been conducted between 2002 and 2017 on quarterly, biannual and annual basis were referenced
Reef communities	■ Numerous surveys of the coral reefs within Port Curtis have been undertaken between 2002 and 2018 ■ Wet (January to March 2015) and dry (June to August 2015) season surveys have been captured in investigations undertaken as part of the Project EIS baseline surveys
Fish and marine reptiles (excluding marine turtles)	■ Numerous surveys conducted between 2002 and 2017 on quarterly, biannual and annual basis ■ QFish datasets for the period from 2005 to 2018 was analysed for trend in species diversity, abundance and yields ■ Infofish Australia commercial and recreational fish catch data from 2014 to 2018 ■ Historical surveys undertaken between 2004 and 2015 were supplemented with seasonal (wet and dry season monitoring) EIS field surveys undertaken in 2014 and 2015 ■ Annual GHHP report cards between 2014 and 2017 include fish and crab indicators.
Soft sediment habitats and benthic macroinvertebrates	Detailed investigations of soft sediment benthic macroinvertebrate communities were undertaken by Vision Environment as part of the Project EIS. These investigations focussed on intensive sampling at locations likely/potentially affected by Project activities, including direct and potential indirect impact areas, nearby sensitive receptors and reference sites. Macroinvertebrate assemblages were investigated twice over 12 months during the Project EIS baseline assessment (i.e. pre wet season (June to August 2014 and May to June 2015) and post wet season (January to March 2015)).
Migratory birds	■ Numerous surveys have been undertaken between 1993 and 2017 (refer Appendix I1, Section 12.2) ■ EIS field surveys included a summer survey of migratory species habitat in 2015 to supplement the existing information. These field surveys complement existing survey information within close proximity to survey sites used for the Annual Port Curtis and Curtis Coast migratory shorebird monitoring program (Wildlife Unlimited 2015).

Ecological value	Summary of Project surveys
Marine turtles	■ There were no Project specific surveys carried out for marine turtles ■ Numerous annual nesting season surveys have been undertaken in the Port Curtis region during turtle breeding/nesting season (refer Appendix I1, Section 14.2) ■ Numerous turtle tracking and health assessments (refer Appendix I1, Section 14.3) ■ The information within these survey reports was reviewed and summarised in conjunction with database records.
Marine mammals	■ Seasonal surveys of marine megafauna within Port Curtis have been undertaken between 2011 and 2018 (including autumn and summer surveys), for the ERMP established under the WBDDP ■ The information within these survey reports was reviewed and summarised in conjunction with database records
Marine pests	■ Historical surveys have been undertaken in 2001 and 2009 and the survey reports were reviewed in conjunction with database records to account for seasonal and temporal variations ■ Introduced marine pest survey undertaken in May and June 2015 as part of the *Port of Gladstone Biosecurity Monitoring Program 2015*
World Heritage values of the GBRWHA within Port Curtis	■ No specific Project surveys undertaken, however, all marine values surveyed are relevant to this section where they are considered to contribute to the OUV of the GBRWHA
MNES and MSES	■ No specific Project surveys undertaken for this section, however, values monitored.

9.2.4 Potential impacts and risk assessment

To assess and appropriately manage the potential impacts and risks to ecological values as a result of Project activities, a risk assessment process has been implemented (herein referred to as the 'risk assessment'). The risk assessment methodology adopted is based on principles outlined in the:

- AS/NZS ISO 31000:2009 Risk management – Principles and guidelines
- HB 203:2012 Handbook: Managing environment-related risks.

Figure 9.2 outlines the general risk assessment process methodology, relating to each of the key steps to the processes outlined in the Standard and Handbook listed above.

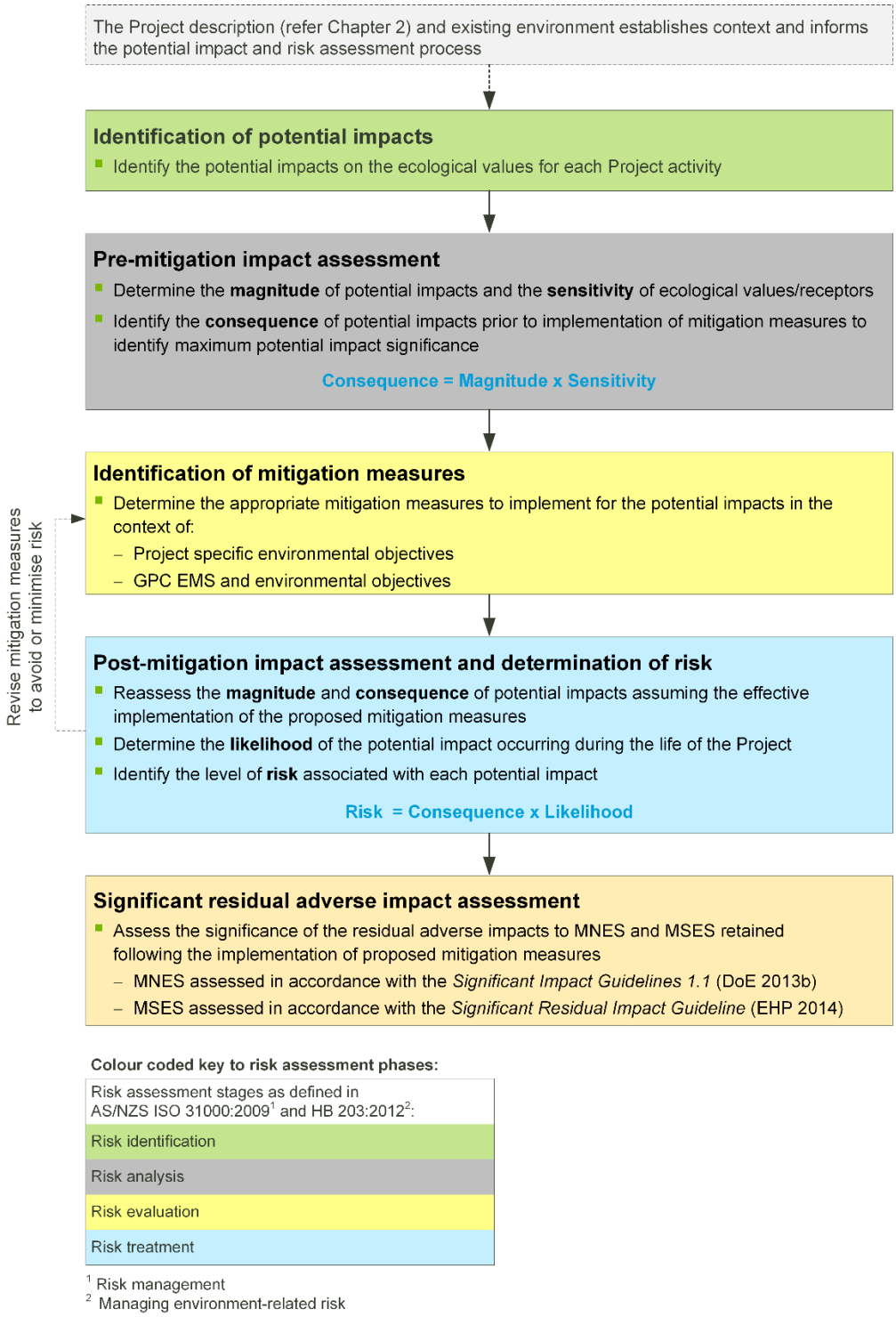

Figure 9.2 Potential impact and risk assessment overview

The EIS Project description (refer Chapter 2) has been used to list all relevant proposed Project activities/actions that have the potential to impact (directly or indirectly) on ecological values and these include:

- Establishment of the WBE reclamation area and BUF, including:
  - Site preparation
  - Establishment of the site compound, offices and temporary areas
  - Source and transport of reclamation area and BUF bund wall material
  - Placement of core and armour material, and geotextile fabric

  - Construction of BUF, including sheet piling or similar earth retaining structure and fill placement
- Dredging activities, including:
  - Initial dredging works for the barge access channel
  - Dredging to duplicate the Gatcombe and Golding Cutting shipping channels
  - Dredged material shipping by barge to BUF, barge unloading and dredged material placement within the WB and WBE reclamation areas
  - Dredging vessel movements (including TSHD, CSD, barges, pushbusters, tugs and other support vessels)
- Removal and installation of navigational aids
- Stabilisation and maintenance activities on the WB and WBE reclamation areas
- Operation of the duplicated shipping channel
- Maintenance dredging.

Appendix I2 provides an overview of the Project activities and the key potential impacts on ecological values that are addressed within the risk assessment.

Table 9.4 identifies the risk matrix used for determining the potential impacts on ecological values. The risk level of potential impacts is a product of the consequence of the potential impacts and the likelihood of their occurrence assuming the effective implementation of the proposed mitigation measures. Appendix I2 provides details on how sensitivity, magnitude, likelihood and consequence are determined for the ecological values.

Table 9.4 Risk matrix

Likelihood	Consequence				
	Negligible	Low	Moderate	High	Very high
Rare	Negligible	Negligible	Low	Medium	Medium
Unlikely	Negligible	Low	Low	Medium	High
Possible	Negligible	Low	Medium	High	High
Likely	Negligible	Medium	Medium	High	Very high
Almost certain	Low	Medium	High	Very high	Very high

9.3 Legislative and policy context

An overview of the Commonwealth and State legislation that is relevant to this chapter is outlined below.

9.3.1 Environment Protection and Biodiversity Conservation Act 1999

On 23 October 2012, the Project was declared to be a ‘controlled action’ for which an EIS is required under the EPBC Act. The controlling provisions for the Project are:

- World Heritage properties (Sections 12 and 15A)
- National Heritage places (Sections 15B and 15C)
- Listed threatened species and communities (Sections 18 and 18A)
- Listed migratory species (Sections 20 and 20A)
- Commonwealth marine areas (Sections 23 and 24A)
- Great Barrier Reef Marine Park (Sections 24B and 24C).

Approval is required from the Commonwealth Environment Minister prior to any action in relation to the Project being undertaken. Assessment of the Project under the provisions of the EPBC Act is being undertaken at the same time as the Queensland State Government EIS assessment under the SDPWO Act, with one EIS covering the requirements of both assessments.

Environmental offsets may be required either under the Commonwealth conditions of the decision notice or in accordance with the *Environmental Offsets Act 2014* (Qld) (Offsets Act). The Offsets Act identifies each of the controlling provisions above as 'prescribed environmental matters', for which offsets may be required. The Offsets Act cannot, however impose the provision of an offset for a matter which related to an area which there is an existing Commonwealth condition.

The Project is not being undertaken through the Bilateral Agreement between the Commonwealth and Queensland Government.

9.3.2 Nature Conservation Act 1994

The NC Act hold provisions to conserve, protect or manage wildlife, habitat or areas to ensure the survival of viable populations, particularly EVNT species, and to identify and reduce or remove the effects of threatening processes.

Approvals are required under the NC Act for the clearing of native vegetation (exempt clearing permit), in addition to tampering with an animal breeding place (species management plan), interfering with a cultural or natural resource in a protected area or erecting a structure in a protected area.

The Project surveys indicate the presence of Water mouse (*Xeromys myoides*) within the potential Project indirect impact areas. It is unlikely that the Project will trigger an approval of a species management plan, however this is to be confirmed during the detailed design phase of the Project.

9.3.3 Fisheries Act 1994

The Fisheries Act provides for the management, use, development and protection of fish habitats and resources, together with the management of aquaculture activities. The Fisheries Act holds provision for the following:

- Taking, causing damage to or disturbance to marine plants
- Works in a declared FHA
- Waterway barrier works
- Tidal water, fresh and marine aquaculture operations.

The Project will result in the temporary and permanent disturbance of marine plants, and will therefore trigger the requirement to obtain a development permit for operational work for the removal, destruction or damage of a marine plant. The application will trigger assessment by the State (DAF) which will require consideration of the relevant DAF operational policies.

9.3.4 Environmental Offsets Act 2014

'Prescribed environmental matters' for which offsets may be imposed are outlined in Section 5 and Schedule 2 of the Offset Regulation, and include the following triggers applicable to the Project:

- MNES:
  - A declared World Heritage property within the meaning of the EPBC Act
  - A threatened species within the meaning of the EPBC Act
  - A migratory species within the meaning of the EPBC Act
  - A National Heritage place within the meaning of the EPBC Act

- MSES
  - A wetland of high ecological significance shown on the map of referable wetlands
  - A marine plant within the meaning of the Fisheries Act.

A summary of the MNES and MSES relevant to the Project is provided in Section 9.26.

'Prescribed activities' for which offsets may be imposed are outlined in Schedule 1 of the Offsets Regulation, and include the following triggers applicable to the Project:

- A prescribed ERA under the EP Act
- Taking a protected plant within the meaning of the NC Act under a protected plant clearing permit approved under the NC Regulation in an area outside a protected area
- Development for which an offset may be required under the SDAP provisions.

It is noted that whilst the Offsets Act identifies provisions for offsetting protected matters of MNES under the EPBC Act, Section 15 of the Offsets Act also restricts the State from imposing an offset condition for a matter which relates to an area for which there is an existing Commonwealth condition. The proposed Project offset framework is included in Section 9.28.

9.4 Terrestrial and intertidal flora and wetlands – existing environment

9.4.1 Background

9.4.1.1 Terrestrial flora

Due to the unique and complex geological and geomorphological processes that have shaped the coastline, there are a diverse range of marine, intertidal and terrestrial habitats along the Curtis Coast. The WB and WBE reclamation areas are situated directly adjacent to the coastline within Port Curtis and the potential Project indirect impact areas encompass habitats within the marine, intertidal and terrestrial environments. This section relates to the terrestrial flora values located within the potential Project indirect impact areas, within 500m of the WB and WBE reclamation areas.

In general, the terrestrial flora communities provide a range of resources for fauna that are not provided within intertidal and coastal areas (e.g. dense ground cover, hollow-bearing trees, freshwater sources, important flowering resources, including Myrtaceous plant species). The variation in the structural complexity of the terrestrial flora communities is also important in providing a range of different habitat values and fauna resources.

Terrestrial habitats in the vicinity of Project activities are comprised of Eucalyptus woodlands on alluvial plains, rehabilitated and revegetated areas, and cleared or highly disturbed areas.

For the purposes of this section, the potential indirect impact areas are defined as the terrestrial environments within a 500m buffer surrounding the direct impact areas (WB and WBE reclamation areas, barge access channel and BUF), to ensure that impacts associated with edge effects on adjacent communities can be adequately addressed.

Edge effects associated with vegetation clearing and fragmentation have been reported as one of the most significant patterns influencing both the flora and environmental conditions within an edge-affected ecosystem (Ewers and Didham 2006). For example, the increase in light penetration and radiation can have broad-ranging impacts on ecosystems, including detrimental impacts on the growth of shade-adapted plants (Watling et al. 1997); changes to air temperature, soil temperature and relative humidity (Chen et al. 1995; Matlack 1993); and changes to the understorey composition and structure (Klinka et al. 1996).

Dignan and Bren (2003) undertook a study to determine the impacts and extent of light penetration from a cleared edge into a retained area of Mountain ash (*Eucalyptus regnans*) in southeastern Australia. This study indicated that changes in light attenuate rapidly over the initial 10m to 30m from the edge, and that at approximately 100m from the edge in the retained vegetation, changes in light penetration were still evident, however the difference was in most cases less than 10%. Subsequently, assessment of potential indirect impacts within a buffer of 500m for terrestrial environments is considered to adequate for the purposes of the Project EIS.

Project EIS flora field survey locations are shown in Figure 9.3 (including mangrove, intertidal and terrestrial vegetation sites).

The methodology implemented to describe the terrestrial flora values is provided in Appendix I1 (Section 3.2).

9.4.1.2 Intertidal flora

The diversity and complexity of intertidal environments in Port Curtis provides habitat suitable for a range of different flora communities, including estuarine wetlands, mangrove forests and woodlands, mudflats and saltmarshes. The coastal saltmarsh community is listed as a Threatened Ecological Community (TEC) under the provisions of the EPBC Act, predominantly as a result of threats associated with human settlement and coastal developments (Threatened Species Scientific Committee (TSSC) 2013). Furthermore, mangroves and other intertidal marine plants are protected plants under the Fisheries Act and permits are required for their disturbance or removal.

Mangroves and saltmarshes are also important productive habitats for a range of fauna species, and are important habitats for conservation as they provide foraging resources and shelter for a range of invertebrates, birds, fish, mammals, and some marine reptiles (refer Sections 9.12, 9.16 and 9.6, and Appendix I1).

Project EIS flora field survey locations are shown in Figure 9.3 (including mangrove, intertidal and terrestrial vegetation sites).

The methodology implemented to describe the intertidal flora values is provided in Appendix I1 (Section 4.2).

While coastal seagrass meadows are defined as intertidal flora, these ecological values are included in Section 9.8 due to the significant amount of existing studies and information on this value within the Port of Gladstone.

9.4.1.3 Wetlands

There are 15,000km^2 of wetlands within the catchments of the Great Barrier Reef, which serve to capture and filter nutrients, contaminants and sediment load, and regulate the water quality of the Great Barrier Reef (WetlandCare Australia 2008). The five types of wetlands within the Great Barrier Reef include:

- Palustrine (marsh or swamp)
- Lacustrine (lakes and dams)
- Riverine (rivers or deepwater habitats in a channel)
- Estuarine (brackish waters at the marine-freshwater interface)
- Marine (saltwater up to 6m in depth) (WetlandCare Australia 2008).

Port Curtis contains large areas of marine wetlands, with estuarine wetlands mapped at the interface between the key rivers and the marine environment (e.g. at the mouth of both the Boyne and Calliope Rivers) (refer Figure 9.4).

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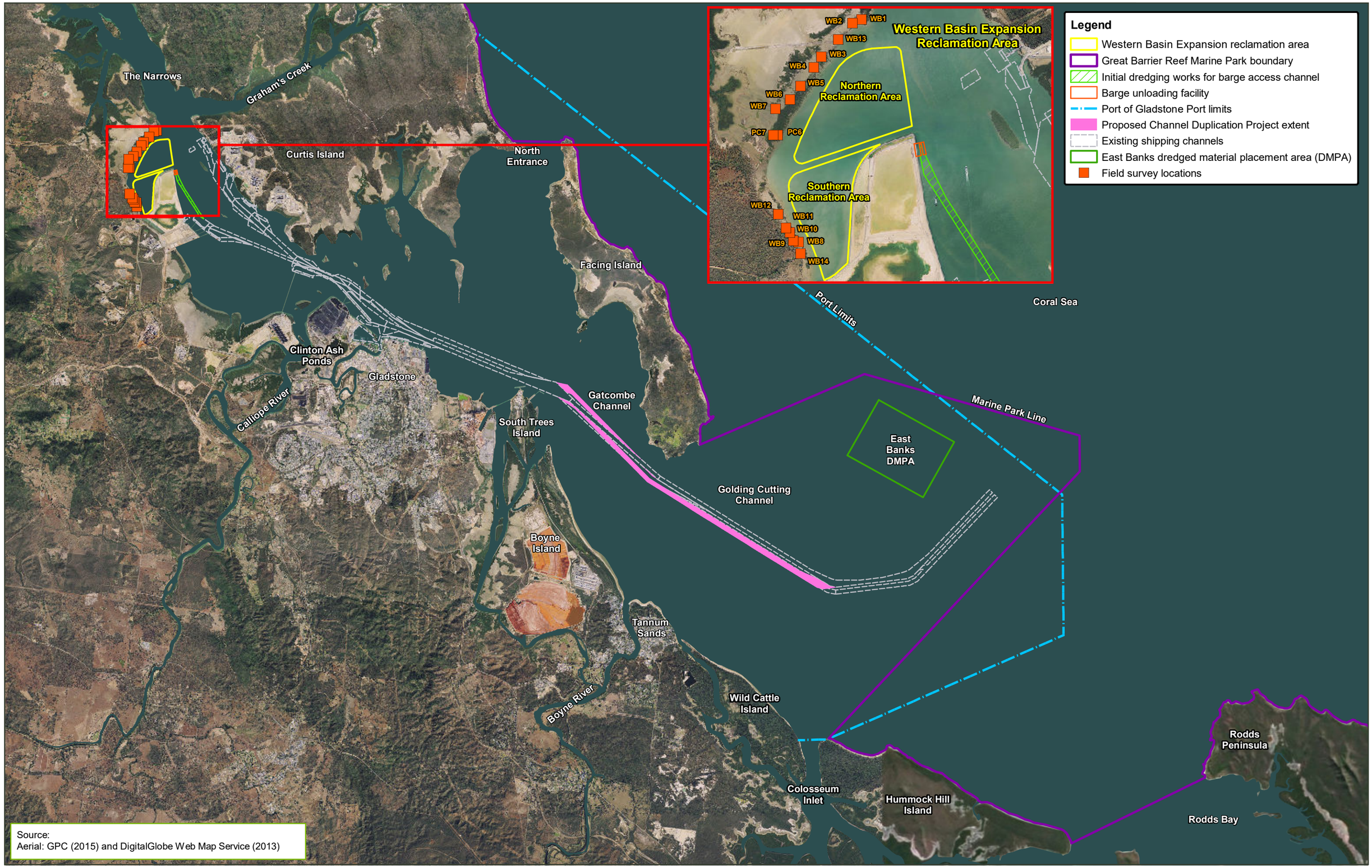

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0 1,900 3,800 Metres

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Coordinate system: GDA_1994_MGA_Zone_56

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Figure 9.3: Mangrove, intertidal and terrestrial flora survey locations

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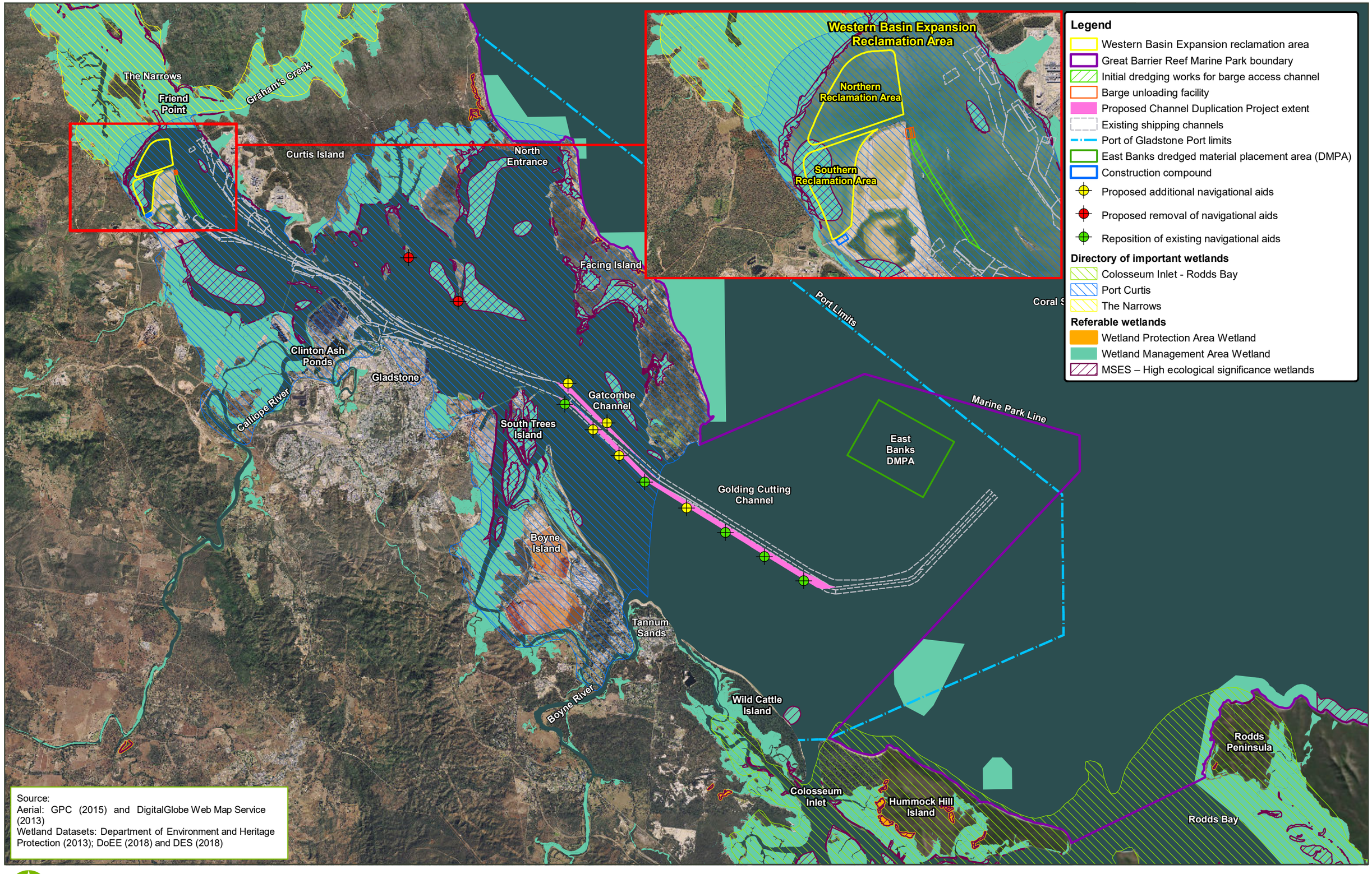

Source:
Aerial: GPC (2015) and DigitalGlobe Web Map Service (2013)
Wetland Datasets: Department of Environment and Heritage Protection (2013); DoEE (2018) and DES (2018)

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Gatcombe and Golding Cutting Channel Duplication Project

Figure 9.4: Wetland mapping

The Ramsar Convention is an international agreement which is implemented to improve the conservation and management of wetlands at a global scale, particularly those wetlands with ecological values of international importance. A diverse range of wetland environments are protected under the Ramsar Convention, such as swamps, marshes, billabongs, lakes, salt marshes, mudflats, mangroves, and coastal or marine areas. There are 65 Ramsar wetlands in Australia, which are also recognised as MNES and are therefore afforded protection under the provisions of the EPBC Act (Commonwealth of Australia 2018).

Wetlands of national importance (i.e. not included on the Ramsar Convention) are identified on the Directory of Important Wetlands of Australia (DIWA). Wetlands are typically considered nationally important if they meet one or more of the following criteria:

- They are a good example of a wetland type occurring within a biogeographic region in Australia
- The wetland plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- The wetland is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports 1% or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance.

There are wetlands within Port Curtis that have been identified and mapped as either:

- Wetlands of national importance included on the DIWA
- Referable wetlands containing values of high ecological significance (HES), protected under the provisions of the Planning Act (refer Figure 9.4).

The methodology implemented to describe the wetland values is provided in Appendix I1 (Section 5.2).

9.4.2 Terrestrial flora values

9.4.2.1 Regional Ecosystems

The Project direct impact areas do not contain any mapped remnant terrestrial vegetation communities (refer Figure 9.5). Potential indirect impact areas encompass 23.68ha of mapped remnant vegetation analogous with terrestrial communities. This total is comprised of 21.69ha of Least Concern RE and 1.99ha of Endangered RE (under the provisions of the VM Act) (i.e. calculated using the percentage splits for each community as provided in the RE mapping and in Table 9.5).

Project EIS field investigations confirmed the RE mapping for the Project direct and potential indirect impact areas. Description of the terrestrial REs within the potential indirect impact areas are described in Table 9.5.

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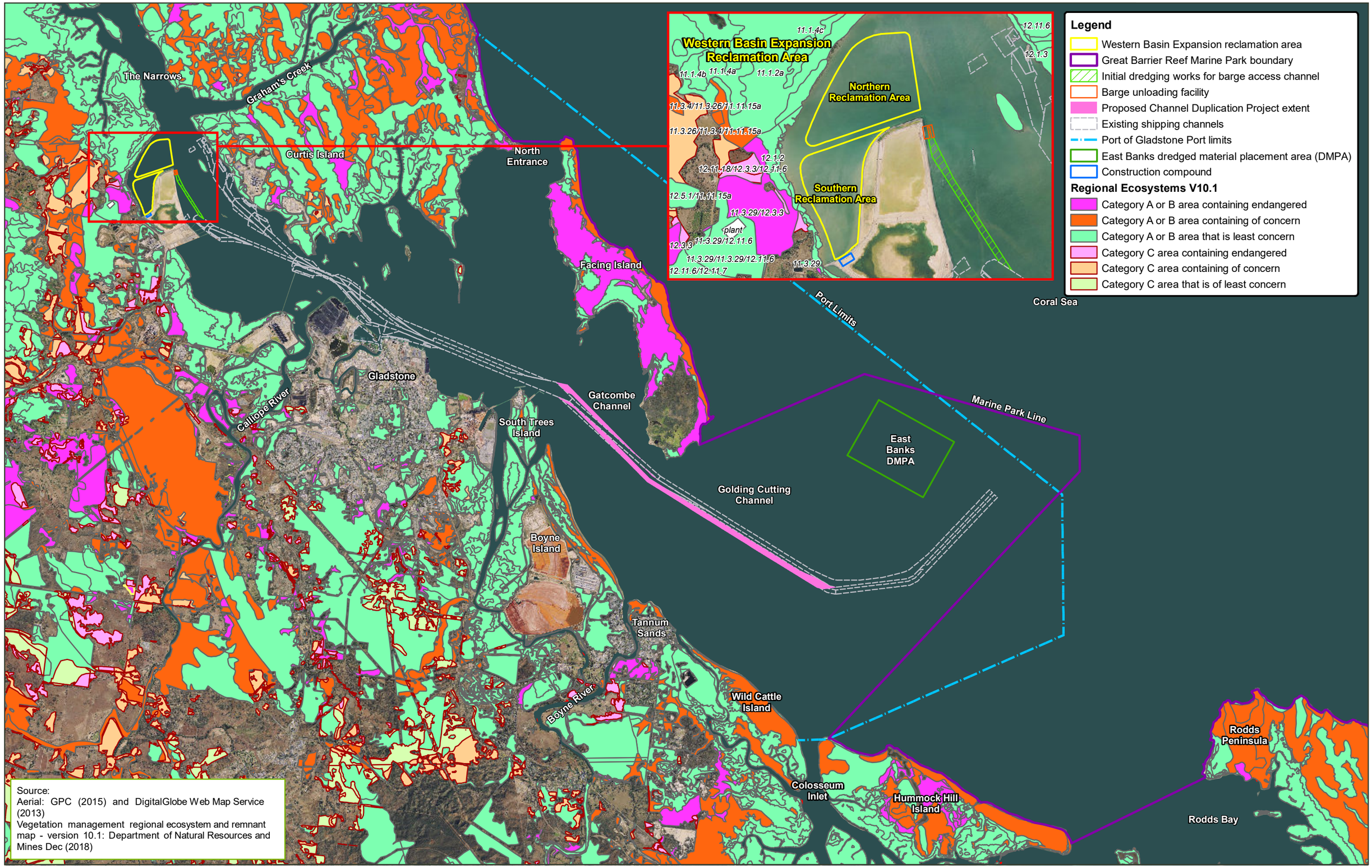

Source:
Aerial: GPC (2015) and DigitalGlobe Web Map Service (2013)
Vegetation management regional ecosystem and remnant map - version 10.1: Department of Natural Resources and Mines Dec (2018)

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0 1,900 3,800 Metres

Date: 31/01/2019 Version: 2 Job No: 237374
Coordinate system: GDA_1994_MGA_Zone_56

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Figure 9.5: Regional Ecosystems and High Value Regrowth mapping

Table 9.5 Remnant terrestrial Regional Ecosystems mapped within the potential indirect impact areas

RE code (percentage splits for each community where a heterogenous polygon)	VM Act status	Biodiversity status	Extent preserved in reserves	Short description of community	Area within the Project potential indirect impact areas (ha)
11.3.29	Least Concern	No concern at present	Low	*Eucalyptus crebra*, *E. exserta*, *Corymbia dallachiana*, *C. intermedia* woodland usually with a low tree understorey of *Melaleuca viridiflora* and *M. nervosa*. Occurs on broad plains and fans formed from Quaternary alluvium. Usually associated with bleached sodic duplex soils	**4.02**
11.3.29/ 12.3.3 (90/10)	Least Concern/ **Endangered**	No concern at present/ **Endangered**	Low/ Medium	*Eucalyptus crebra*, *E. exserta*, *Corymbia dallachiana*, *C. intermedia* woodland usually with a low tree understorey of *Melaleuca viridiflora* and *M. nervosa*. Occurs on broad plains and fans formed from Quaternary alluvium. Usually associated with bleached sodic duplex soils. / *Eucalyptus tereticornis* woodland. *Eucalyptus crebra* and *E. moluccana* are sometimes present and may be relatively abundant in places, especially on edges of plains and higher level alluvium. Other species that may be present as scattered individuals or clumps include *Angophora subvelutina* or *A. floribunda*, *Corymbia clarksoniana*, *C. intermedia*, *C. tessellaris*, *Lophostemon suaveolens* and *E. melanophloia*. Occurs on Quaternary alluvial plains, terraces and fans where rainfall is usually less than 1,000mm/year	**19.38**

RE code (percentage splits for each community where a heterogenous polygon)	VM Act status	Biodiversity status	Extent preserved in reserves	Short description of community	Area within the Project potential indirect impact areas (ha)
12.11.18/ 12.3.3/ 12.11.6 (70/20/10)	Least Concern/ **Endangered**/ Least Concern	No concern at present/ **Endangered**/ No concern at present	Medium/ Medium/ High	*Eucalyptus moluccana woodland +/- Corymbia citriodora subsp. variegata, E. tereticornis, E. siderophloia* or *E. crebra, E. longirostrata, C. intermedia, E. carnea.* Occurs on Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics. Occurs as scattered occurrences in a range of topographic positions from ridgetops to lower slopes / *Eucalyptus tereticornis* woodland. *Eucalyptus crebra* and *E. moluccana* are sometimes present and may be relatively abundant in places, especially on edges of plains and higher level alluvium. Other species that may be present as scattered individuals or clumps include *Angophora subvelutina* or *A. floribunda*, *Corymbia clarksoniana*, *C. intermedia*, *C. tessellaris*, *Lophostemon suaveolens* and *E. melanophloia*. Occurs on Quaternary alluvial plains, terraces and fans where rainfall is usually less than 1000mm/y / Open forest to woodland of *Corymbia citriodora subsp. variegata* generally with *Eucalyptus crebra.* Other species such as *Eucalyptus exserta, E. tereticornis, E. moluccana, E. melanophloia, E. acmenoides, Angophora leiocarpa* may be present in scattered patches or in low densities. Understorey grassy or shrubby. Occurs on Palaeozoic and older moderately to strongly deformed and metamorphosed sediments and interbedded volcanics	**0.28**
Total area					**23.68**

Table note:

Potential indirect impact areas have been defined as the area within 500m of the Project direct impact areas.

Source: Queensland Herbarium (2018)

9.4.2.2 Vegetation communities

The vegetation communities within the Project impact areas have been described and mapped using information collected during EIS field investigations in combination with the findings from the WBDDP EIS *Terrestrial Ecology Report* (GHD 2009b).

A flora species list in Appendix I1 (Appendix C) provides a list of the dominant flora species present within the Project impact areas. The flora species list is not intended as a comprehensive list of all flora species present but rather a list of the dominant species present in the vegetation communities.

Due to the offshore location of the areas to be dredged, there are no terrestrial vegetation communities present within these areas.

The main vegetation community observed within the potential indirect impact area is dry Eucalypt woodland which is dominated by *Eucalyptus crebra* (Narrow-leaved ironbark) and *Eucalyptus exserta* (Queensland peppermint) in the canopy stratum at an approximate average height of 18m and canopy cover of 20% (refer Photograph 9.1). *Corymbia tessellaris* (Moreton Bay ash) was also recorded in the canopy stratum. *Melaleuca viridiflora* (Broad leaved tea-tree) and *Lophostemon suaveolens* (Swamp mahogany) were present in the sub-canopy stratum with an approximate height of 14m and 10% canopy cover.

The shrub stratum in these areas is dominated by juvenile canopy species and *Acacia disparrima* (Hickory wattle) at an average height of approximately 2m and vegetative cover of approximately 5%.

The ground stratum is defined by approximately 60% vegetative cover, 20% large woody debris, 10% leaf litter and 10% bare ground and was dominated by *Chloris gayana* (Rhodes grass).

This vegetation community is analogous to the Least Concern RE 11.3.29 with the RE mapping confirmed as correct for the area.

Photograph 9.1 *Eucalyptus crebra* woodland in the potential indirect impact area associated with Western Basin and Western Basin Expansion reclamation area

The Project EIS ecological field assessments confirmed areas of disturbance associated with access tracks and easements within the Project potential indirect impact areas. Previously cleared landscapes adjacent to the WB and WBE reclamation areas are characterised by a variety of native and non-native grass and other ground stratum species, including *Heteropogon contortus* (Black speargrass), *Megathyrsus maximus* (Guinea grass) and *Hyptis suaveolens* (Hyptis), with a vegetative cover of approximately 95%. The canopy stratum was absent and the shrub stratum in these landscapes is sparse, with an approximate vegetative cover of 10% and average height of 1m. The shrub stratum is defined by regrowth vegetation dominated by *A. disparrima*.

Photograph 9.2 shows the vegetation typical of the previously cleared landscapes present adjacent to the WB and WBE reclamation areas.

Photograph 9.2 Previously cleared landscapes directly adjacent to the Western Basin and Western Basin Expansion reclamation areas

9.4.2.3 Threatened ecological communities

The EPBC Act protected matters search tool (PMST) identified the following TECs as potentially occurring within the search area (shown in Figure 9.1):

- Brigalow (*Acacia harpophylla* dominant and co-dominant) which is listed as Endangered under the EPBC Act
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community which is listed as Endangered under the EPBC Act
- Coolibah – Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions which is listed as Endangered under the EPBC Act
- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia which is listed as Critically Endangered under the EPBC Act
- Lowland Rainforest of Subtropical Australia which is listed as Critically Endangered under the EPBC Act
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions which is listed as Endangered under the EPBC Act
- Subtropical and Temperate Coastal Saltmarsh which is listed as Vulnerable under the EPBC Act
- Weeping Myall Woodlands which is listed as Endangered under the EPBC Act.

There are no TECs within the Project direct impact areas; however a TEC has been confirmed within the Project indirect impact areas, being the Subtropical and Temperate Coastal Saltmarsh community (i.e. 'Coastal Saltmarsh'), which is an intertidal vegetation community (Ecosure 2017) (refer Figure 9.6).

9.4.2.4 High value regrowth

The VM Act regulates the removal of regulated regrowth vegetation and is mapped on the DNRME certified regulated vegetation management map.

There are no areas of regulated regrowth vegetation present within the Project impact areas.

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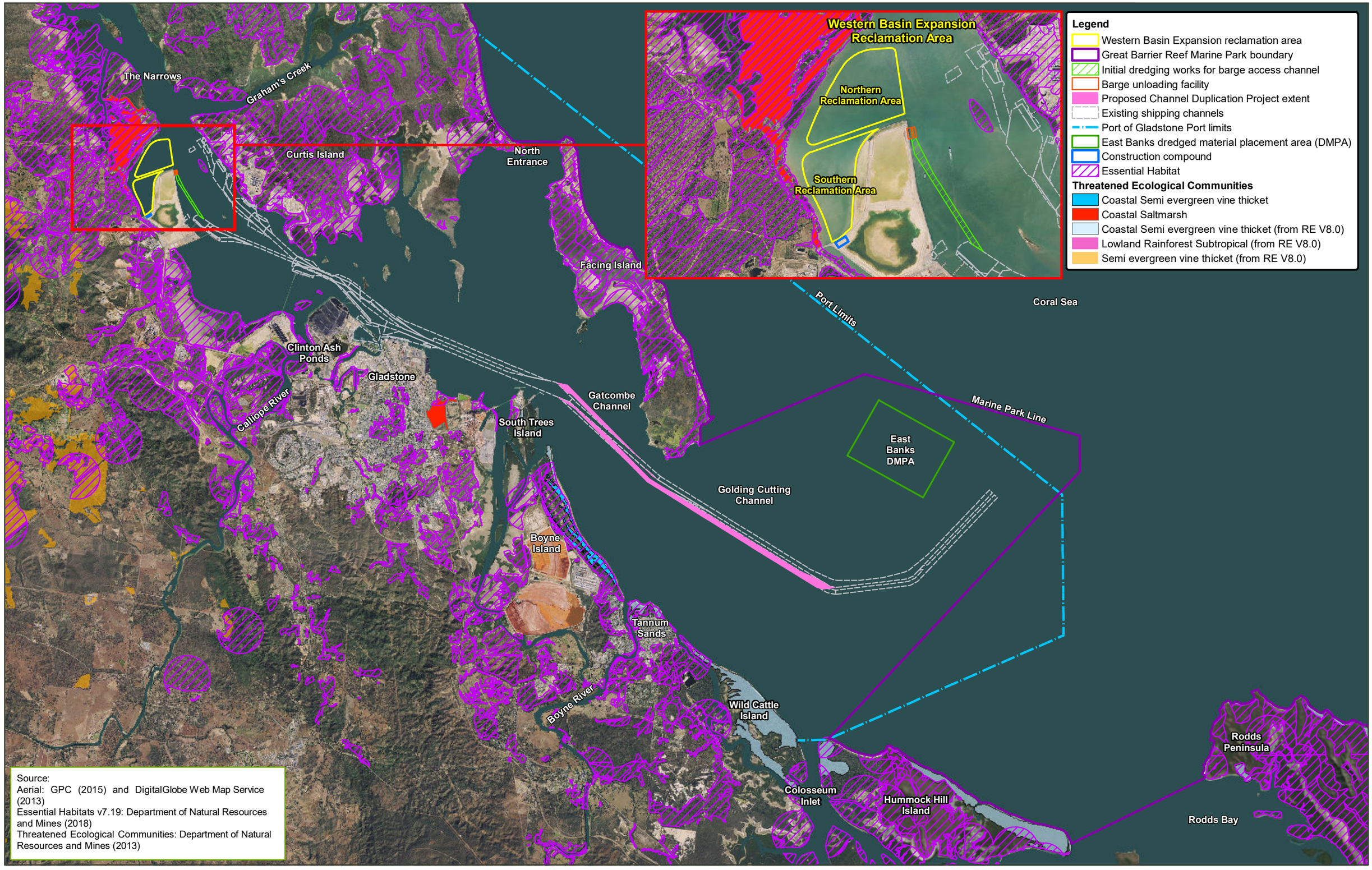

Source:
Aerial: GPC (2015) and DigitalGlobe Web Map Service (2013)
Essential Habitats v7.19: Department of Natural Resources and Mines (2018)
Threatened Ecological Communities: Department of Natural Resources and Mines (2013)

Map by: NKM P:\GIS\Projects\237374_GPC_Channel_Duplication_EIS\237374_EIS_246.mxd 31/01/2019 13:43

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Date: 31/01/2019 Version: 2 Job No: 237374

Coordinate system: GDA_1994_MGA_Zone_56

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Figure 9.6: Threatened Ecological Communities and Essential Habitat

9.4.2.5 Regulated vegetation

The VM Act provides for the provision of regulated vegetation via the 'Regulated Vegetation Management Map'. The Regulated Vegetation Management Map categorises vegetation into one of the following categories:

- Category A – Areas subject to compliance notices, offsets and voluntary declarations
- Category B – Areas of remnant vegetation
- Category C – Areas of high-value regrowth vegetation on leasehold land for agriculture and grazing purposes
- Category R – Regrowth watercourse areas on freehold land, Indigenous land and leasehold land for agriculture and grazing purposes within the priority reef catchment area of the Wet Tropics, Burdekin and Mackay Whitsunday areas
- Category X – Areas which are non-remnant, not regulated regrowth and not subject to compliance notices, offsets or voluntary declarations.

The VM Act provides for a declaration process that protects areas of high nature conservation value and areas vulnerable to land degradation. When an area is declared as an area of high nature conservation value or vulnerable to land degradation, the area is declared a 'Category A' area under the Regulated Vegetation Management Map.

Within the Project impact areas, there are no Category A areas mapped on the VM Act Regulated Vegetation Management Map (refer Figure 9.7). Subsequently, there are no declared areas of high nature conservation value or areas vulnerable to land degradation present within the Project impact areas.

9.4.2.6 Essential Habitat

Figure 9.6 shows Essential Habitat mapped within the potential indirect impact areas associated with WBE reclamation area, however this is associated with Koala (*Phascolarctos cinereus*) and is discussed in Section 9.6.

9.4.2.7 Threatened species

A total of 33 threatened flora species protected under the provisions of the EPBC Act and/or the NC Act were identified from database searches as potentially occurring within the search area (as shown in Figure 9.1) (refer Appendix I1 (Appendix B)). The threatened species that have been identified as potentially occurring within the search area, the species habitat association and the likelihood of the species and its habitat occurring within the Project impact areas has been detailed in Appendix I1 (Appendix B).

The likelihood of occurrence assessment detailed in Appendix I1 (Appendix B) identified no threatened flora species as known to occur within the Project impact areas. Seven species were considered to have a moderate likelihood of occurrence within the Project impact areas (i.e. indirect impact areas) based on the presence of potentially suitable habitat occurring within the Project impact areas, as identified in Table 9.6.

Table 9.6 Threatened flora species for which potential habitat occurs within the Project impact areas

Scientific name	Common name	Status		Likelihood of occurrence within the Project impact areas
		EPBC Act	NC Act	
Bertya opponens	No common name	Vulnerable	Least concern	Moderate – suitable habitat present in the Project impact areas
Cycas megacarpa	No common name	Endangered	Endangered	Moderate – suitable habitat present in the Project impact areas

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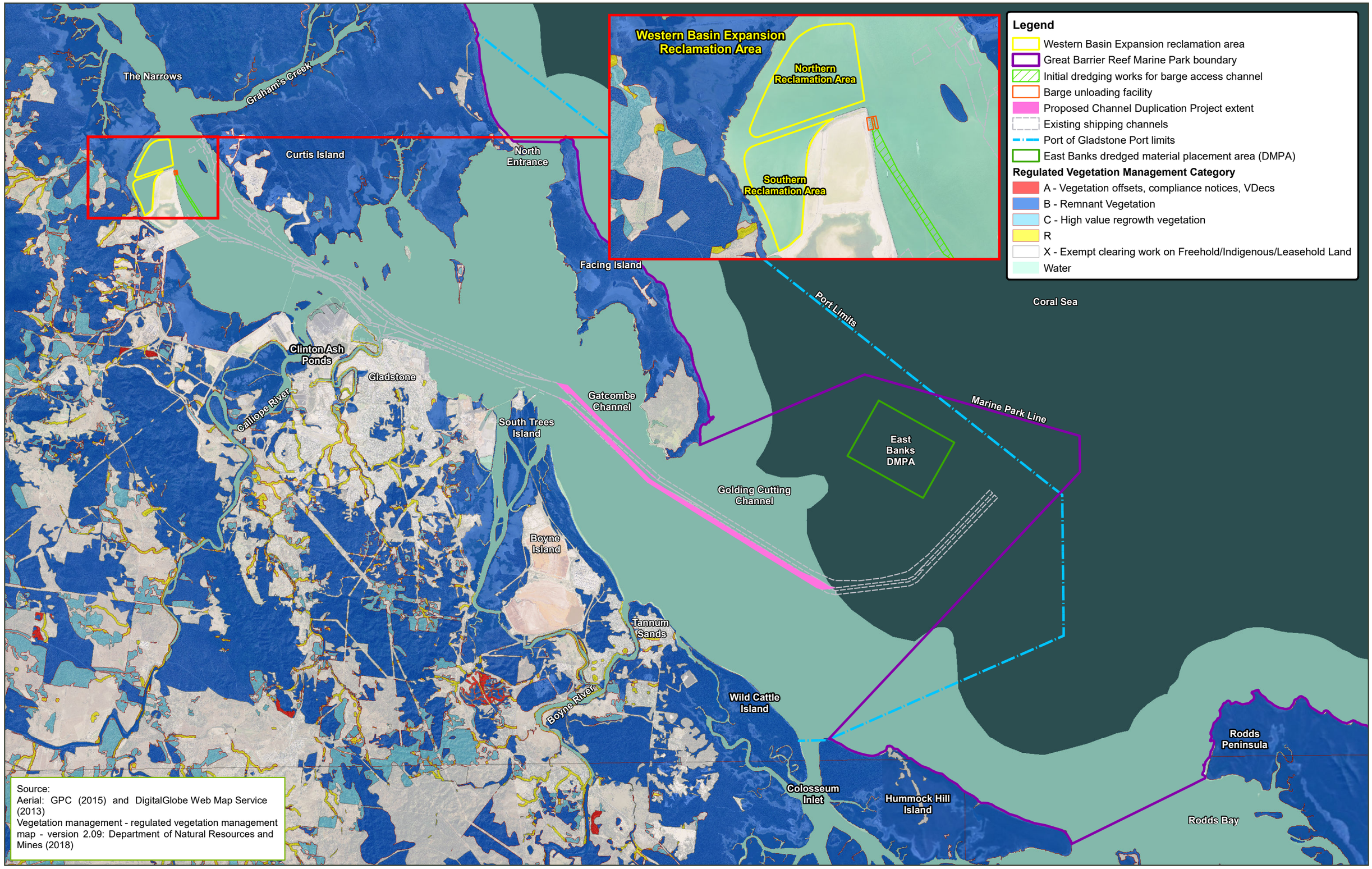

Source:
Aerial: GPC (2015) and DigitalGlobe Web Map Service (2013)
Vegetation management - regulated vegetation management map - version 2.09: Department of Natural Resources and Mines (2018)

Map by: RB P:\GIS\Projects\237374_GPC_Channel_Duplication_EIS\237374_EIS_247.mxd 31/01/2019 13:49

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Date: 31/01/2019 Version: 2 Job No: 237374

Coordinate system: GDA_1994_MGA_Zone_56

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Figure 9.7: Vegetation Management Act Regulated Vegetation

Scientific name	Common name	Status		Likelihood of occurrence within the Project impact areas
		EPBC Act	NC Act	
Cycas ophiolitica	Marlborough blue	Endangered	Endangered	Moderate – suitable habitat present in the Project impact areas
Dichanthium setosum	Bluegrass	Vulnerable	Least concern	Moderate – suitable habitat present in the Project impact areas
Germainia capitata	No common name	Vulnerable	Vulnerable	Moderate – suitable habitat present in the Project impact areas
Myrsine serpenticola	No common name	-	Endangered	Moderate – suitable habitat present in the Project impact areas
Xylosma ovata	No common name	-	Near threatened	Moderate – suitable habitat present in the Project impact areas

9.4.2.8 Special least concern plants

Cheilanthes distans (Bristly cloak fern) is listed as a special least concern flora species under the provisions of the NC Act belonging to the Adiantaceae family.

Habitat for *C.distans* is present within the WBE reclamation area indirect impact area in areas of dry Eucalypt forest. Habitat for the species is associated with RE polygons 11.3.29/12.3.3 and 12.11.18/12.3.3/12.11.6.

9.4.2.9 Priority Back on Track flora species

The 'Back on Track species prioritisation framework' (Back on Track (BoT)) identifies priority threatened species for conservation and recovery management. The priority species identified by BoT are those which are in decline on a whole-of-Queensland scale but also have a high likelihood for recovery.

BoT is based on the method of Marsh et al. (2007) which ranks species as 'critical', 'high', 'medium' or 'low' priority for the State and for the relevant natural resource management (NRM) region. A 'data deficient' category is also included which identifies species considered to be too poorly known to receive a BoT criterion ranking, though recognising that these species are priorities for research and/or taxonomic work.

An assessment of the BoT priority species for the Fitzroy NRM was undertaken (refer Appendix I1) to determine the likelihood of occurrence of these species within the Project impact areas.

Seven BoT priority flora taxa were identified as part of the database review and Project EIS field assessments as having a moderate likelihood of occurring within the Project impact areas. No BoT priority flora taxa were identified within the Project impact areas during the EIS field investigations. The priority flora taxa identified as potentially occurring within the Project impact areas are identified in Table 9.7.

Table 9.7 Back on Track priority flora species for the Fitzroy natural resource management region

Species name	Back on Track status (Fitzroy NRM)	Habitat association
Bowenia serrulata	Critical priority	Associated with dry sclerophyll Eucalypt forests.
Comesperma oblongatum	High	Grows on exposed coastal headlands, often in more open, bare areas.
Cycas megacarpa	Critical priority	Found in the grassy understorey of *Corymbia citriodora* and *Eucalyptus crebra* woodland to open forest and in rainforest margins.
Cycas ophiolitica	Critical priority	Inhabits eucalypt open forest and woodland communities with a grassy understorey.

Species name	Back on Track status (Fitzroy NRM)	Habitat association
Hemisteptia lyrata	Critical priority	Found in disturbed areas.
Melaleuca irbyana	High	Grows in flat areas that are periodically waterlogged, in eucalypt forest, mixed forest and *Melaleuca* woodland with a sparse and grassy understorey.
Rhaponticum australe	High	Grows in eucalypt open forest with a grassy understory and in grasslands on black clay soil. Often found on roadsides and on road or rail reserves.

9.4.2.10 Restricted matter invasive plants

Three invasive plants listed under the provisions of the Biosecurity Act as a restricted matter were recorded within the Project indirect impact areas during Project EIS field investigations. These species and their declared status are detailed in Table 9.8.

Table 9.8 Restricted matter (invasive plant) identified within the Project direct or potential indirect impact areas

Family name	Species name	Common name	Biosecurity Act restricted matter	WBE reclamation area (indirect impact area)
Apocynaceae	*Cryptostegia grandiflora*	Rubber vine	Category 3*	✓
Cactaceae	*Opuntia stricta*	Prickly pear	Category 3*	✓
Verbenaceae	*Lantana camara*	Lantana	Category 3*	✓

Table notes:

* Category 3 restricted matter = A category 3 restricted matter must not be disturbed. That is, the matter must not be given as a gift, sold, traded or released into the environment unless the distribution or disposal is authorised in a regulation or under a permit. Deliberate human distribution or disposal contrary to the legislation is a key source of spread into other areas of the state.

Two species are identified as weeds of national significance. These are Lantana and Rubber vine. Weeds of national significance are identified by the Commonwealth government based on their invasiveness, potential for spread and environmental, social and economic impacts (Ecosure 2017). All three species in Table 9.8 are listed in the *Gladstone Regional Council Biosecurity Plan 2016-2019* (GRC 2016).

There were no aquatic weed species recorded within the Project impact areas during the EIS field investigations, as outlined in Appendix I1 (Appendix C).

9.4.2.11 Biodiversity Planning Assessment

Priority flora species

The Biodiversity Planning Assessment: Southeast Queensland Bioregion Flora Expert Panel Report (EHP 2016) identifies 14 priority flora species which are considered to be of regional or State significance within the Southeast Queensland (North) bioregion. These 14 priority species are not listed as having conservation significance under the provisions of the EPBC Act and/or the NC Act.

Six priority flora species were identified during the database review as potentially occurring within the Project impact areas. Note that no priority flora species were identified within the potential Project direct or indirect impact areas during the Project EIS field investigations. It is considered unlikely that any of these six priority flora species occur within the Project impact areas, as is further discussed in Appendix I1 (Section 3.4).

Biodiversity Planning Assessment mapping

Figure 9.8 provides the Biodiversity Planning Assessment (BPA) mapping for areas within the Project impact areas. As the mapping is focused on terrestrial biodiversity values, the Project direct impact areas will not directly affect BPA mapping values.

The potential indirect impact areas associated with the WBE reclamation area are mapped as having State biodiversity significance and are mapped as forming part of a State fauna corridor (refer Figure 9.8). These areas are situated at least 100m from the existing WB reclamation area bund wall on the coastline of Kangaroo Island. The BPA mapping identifies these areas as having State biodiversity significance due to the presence of:

- Port Curtis wetland (DIWA) and associated habitat for fauna species
- Poorly conserved REs
- Large contiguous patch of remnant vegetation
- Fauna movement corridor value (i.e. connectivity to vegetation to the north and south).

9.4.3 Intertidal flora values

9.4.3.1 Overview

More than 9,600ha of mangrove habitat and 5,500ha of saltpan/saltmarsh communities have been estimated to occur within Port Curtis and Colosseum Inlet. As part of the PCIMP, broad-scale mapping of mangroves and intertidal vegetation communities was undertaken in 2009, and showed a high diversity of mangrove and saltmarsh species present within Port Curtis (VE 2011).

Fourteen different mangrove species have been recorded to occur along the Port Curtis coastline (refer Table 9.9). Within Port Curtis, the distribution of mangroves is determined by several factors, including topography, salinity, substrate type and exposure to wave action. Port Curtis represents the southern limit of the distribution of two mangrove species; *B. exaristata* and *X. moluccensis* (GPC 2012a; VE 2011).

Table 9.9 Mangrove species recorded as occurring along the Port Curtis Coast

Mangrove species recorded along Port Curtis Coast	
Acanthus ilicifolius (Holly leaf mangrove)	*Ceriops tagal* (Yellow mangrove)
Acrostichum speciosum (Mangrove fern)	*Excoecaria agallocha* (Milky mangrove)
Aegialitis annulata (Club mangrove)	*Lumnitzera racemosa* (Black mangrove)
Aegiceras corniculatum (River mangrove)	*Osbornia octodonta* (Myrtle mangrove)
Avicennia marina (Grey mangrove)	*Rhizophora stylosa* (Red mangrove)
Bruguiera exaristata (Orange mangrove)	*Xylocarpus granatum* (Cannonball mangrove)
Bruguiera gymnorrhiza (Large-leaved orange mangrove)	*Xylocarpus maoluccensis* (Cedar mangrove)

Source: GPC (2012a)

Agricultural, industrial and urban development have contributed to the loss of a large proportion of intertidal wetlands in the Port Alma region. However, long term declines in rainfall over a 130 year period have also been linked to mangrove dieback and the increase of saltmarsh areas (SKM 2013). The Port Alma region has experienced an expansion of mangrove habitat in many areas (i.e. the formation of new mangrove islands in the Fitzroy River estuary). Overall, the intertidal wetlands of the Port Alma region intertidal wetlands have remained relatively stable, although gradual decreases in vegetation cover were observed in the early 2000s (SKM 2013).

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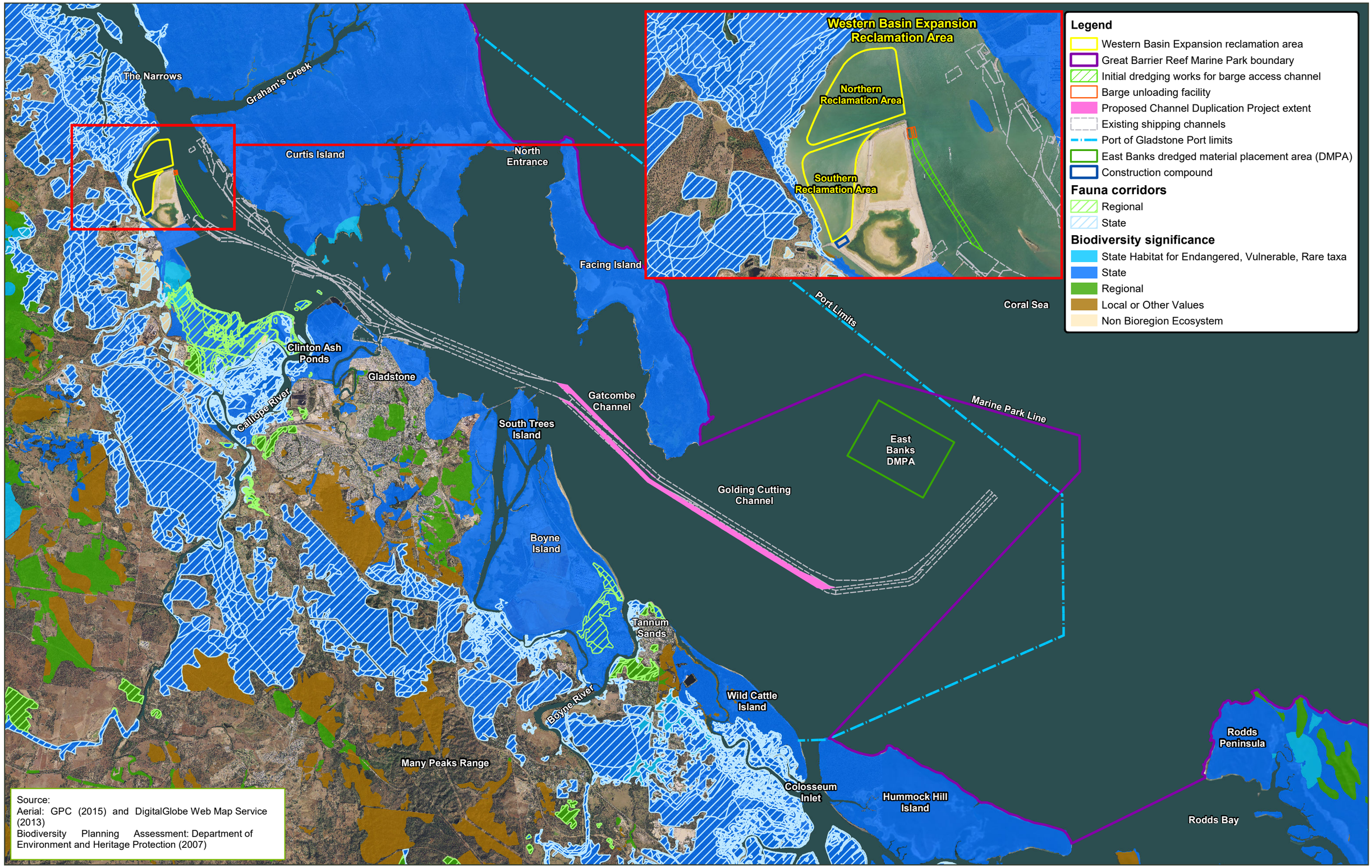

Source:
Aerial: GPC (2015) and DigitalGlobe Web Map Service (2013)
Biodiversity Planning Assessment: Department of Environment and Heritage Protection (2007)

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Figure 9.8: Biodiversity Planning Assessment mapping areas within and adjoining the Project impact areas

Saltmarsh communities are intertidal environments that are dominated by salt tolerant plants, including samphires and salt couches. There are approximately 690,000ha of saltmarsh communities in Queensland, which represents more than a third of the total area of saltmarsh in Australia. Saltmarsh flora species that have been identified within Port Curtis (on Facing Island), include: *Enchylaena tomentosa* (Ruby saltbush), *E. agallocha, Sarcocornia quinqueflora* (Bead weed)*, Sarcocornia viminale, Sesuvium portulacastrum, Sporobolus virginicus* (Marine couch), *Suaeda australis* (Austral seablite)*, Tecticornia halocnemoides* (Glasswort), *Tecticornia indica* and *Tecticornia pergranulata* (Ecosure 2017).

9.4.3.2 Regional Ecosystems

Areas that have potential to be impacted by WBE reclamation area and BUF construction activities include mapped intertidal RE communities (refer Figure 9.5). These mapped RE communities are dominated by mangrove and saltmarsh flora species. All marine plants are protected under the Fisheries Act, regardless of their status under the VM Act. Impacts on marine plants are discussed in this chapter, and are further discussed in Section 9.26.2, which relates to MSES.

The Project direct impact areas do not encroach on any mapped remnant vegetation analogous with intertidal communities. However, the Project potential indirect impact area includes approximately 94.50ha of mapped remnant vegetation analogous with intertidal communities.

There are no intertidal communities mapped within the Project potential indirect impact areas that are classified as Endangered or Of Concern REs (refer Figure 9.5). However, there are communities listed as TECs under the provisions of the EPBC Act (refer Section 9.4.3.4), and all marine plants are protected under the provisions of the Fisheries Act.

Table 9.10 describes the intertidal RE communities within the Project potential indirect impact areas (i.e. within 500m of the direct impact areas). Project EIS field investigations confirmed the DES RE mapping for the Project potential indirect impact areas, with the vegetation field survey sites are shown in Figure 9.9.

The RE communities within the Project potential indirect impact areas are not categorised under the RE framework as being:

- Threshold REs at risk of falling below 30% of their pre-clearing extent
- Critically limited REs, that are:
  - REs that have a remnant extent below 5% of their pre-clearing extent and an area less than 500ha in total extent
  - Or that have a remnant extent less than 200ha, or that are at risk of the remnant extent falling below 200ha.

Table 9.10 Regional Ecosystems analogous to intertidal vegetation mapped within the Project potential indirect impact areas

RE code	VM Act status[1]	Biodiversity status	Extent preserved	Short description of community	Area within the Project potential indirect impact areas (ha)
11.1.2a	Least concern	No concern at present	Low	Samphire forbland on marine clay plains	33.52
11.1.4a	Least concern	No concern at present	Low	Mangrove low open forest and/or woodland on marine clay plains	23.51
11.1.4c	Least concern	No concern at present	Low		

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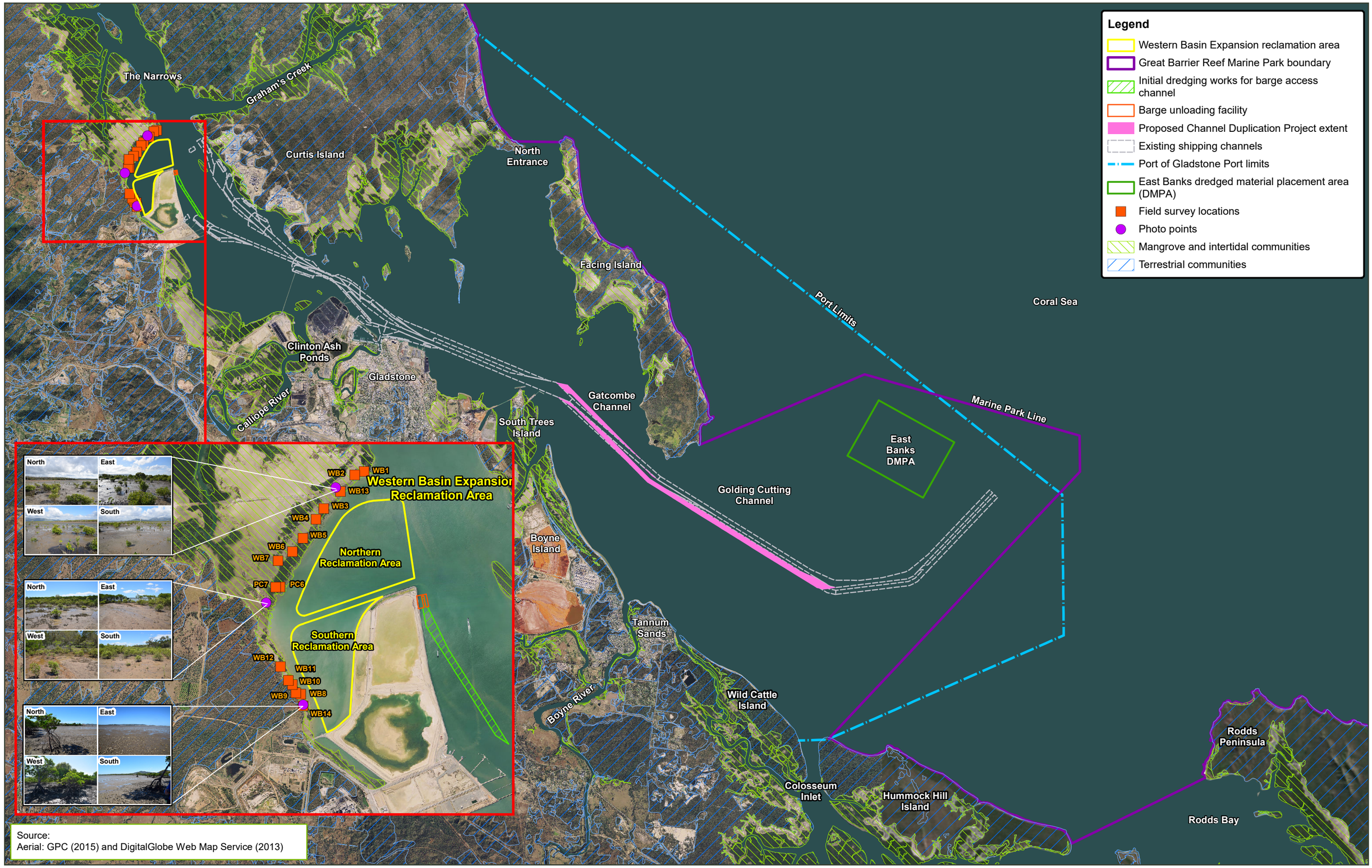

Source:
Aerial: GPC (2015) and DigitalGlobe Web Map Service (2013)

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Coordinate system: GDA_1994_MGA_Zone_56

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Figure 9.9: Vegetation field survey sites and general vegetation communities

RE code	VM Act status[1]	Biodiversity status	Extent preserved	Short description of community	Area within the Project potential indirect impact areas (ha)
12.1.2	Least concern	No concern at present	Low	Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	19.70
12.1.3	Least concern	No concern at present	Low	Mangrove shrubland to low closed forest on marine clay plains and estuaries	17.77
Total area					**94.50**

Table note:

1 All marine plants are protected under the Fisheries Act, and some saltmarsh communities are protected under the provisions of the EPBC Act (i.e. if the community meets the listing criteria for the Coastal saltmarsh TEC). These listings apply, irrespective of the VM Act status.

Source: Queensland Herbarium (2018)

9.4.3.3 Vegetation communities

This section provides a description of the key vegetation communities present within the intertidal zone of the Project impact areas (refer Figure 9.9). Further detail is provided in Appendix I1 (Section 4), including a flora species list provided in Appendix I1 (Appendix C) (i.e. this list represents dominant flora species present).

Due to the offshore location of the areas to be dredged, there are no intertidal vegetation communities present within or directly adjacent to these areas (i.e. no intertidal vegetation within 500m of the direct impact areas).

Mangroves

The shoreline directly adjacent to the WB and WBE reclamation areas is characterised by remnant mangrove vegetation. *R. stylosa* dominates the mangrove communities on the seaward side at an approximate height of 4m and canopy cover of approximately 60%. The mangrove communities on the landward side of the WB and WBE reclamation areas are defined by *C. tagal* in the canopy stratum, with *A. marina* subsp. *australasica* present as an associated species. The canopy stratum of the *C. tagal* dominated communities is approximately 3m in height with a canopy cover of approximately 50%.

Photograph 9.3 shows the vegetation typical of the mangrove communities present directly adjacent to the WB and WBE reclamation areas.

Mangrove regeneration was evident in the communities and the mangroves appeared to be of good health with minimal signs of insect or disease damage notable. A small proportion of *R. stylosa* individuals were displaying black spots, possibly attributable to disease. Some areas of minor disturbance were noted during field survey and were associated with areas that had been previously cleared (i.e. not directly related to port activities or infrastructure). Evidence of fishing and crabbing activities was noted throughout the area. The creation of raised access tracks has resulted in the creation of bunds which have altered the hydrology in areas and is likely attributed to mangrove dieback (unspecified causes).

This vegetation community is analogous with RE 12.1.3, with the RE mapping also identifying this area as RE 12.1.3 (refer Figure 9.5).

Photograph 9.3 Mangrove vegetation directly adjacent to the Western Basin and Western Basin Expansion reclamation areas; *Rhizophora stylosa* dominated community and *Ceriops tagal* dominated community

Saltmarsh

Areas below the daily high tide level directly adjacent to the WB and WBE reclamation areas contain mangrove communities defined by large expanses of exposed mudflats supporting scattered saltmarsh communities. The areas of saltmarsh vegetation were dominated by *T. halocnemoides* with *S. quinqueflora* (present as an associated species. Other species present include *S. virginicus*, *Portulaca bicolor* (Pigweed*), E. tomentosa*, *Limonium solanderi* (Sea lavender), *Ipomoea pes-caprae* (Beach morning glory), *Myoporum acuminatum* (Boobialla) and *Fimbristylis ferruginea* (Rusty sedge).

Photograph 9.4 shows the vegetation typical of the saltmarsh and mudflat areas present directly adjacent to the WB and WBE reclamation areas.

Mangrove regeneration was associated with the saltmarsh vegetation, with an approximate cover of 2% and an average height of 1m. The dominant species observed were *C. tagal* in the canopy stratum with *A. marina* subsp. *australasica* and *L. racemosa*.

Intertidal areas above the average daily high tide mark were defined by *S. virginicus*, with a vegetative cover in the ground stratum of approximately 75%.

The saltmarsh vegetation communities present directly adjacent to the WB and WBE reclamation areas are analogous with RE 12.1.3 and RE 11.1.2, which is consistent with the RE mapping for the area (refer Figure 9.5).

Photograph 9.4 Saltmarsh vegetation and mudflats at Western Basin and Western Basin Expansion reclamation area

9.4.3.4 Threatened ecological communities

The EPBC Act PMST identified the following intertidal TEC as potentially occurring within the search area (as defined in Figure 9.6):

- Subtropical and Temperate Coastal Saltmarsh – Listed as Vulnerable under the EPBC Act.

It is noted that six other TECs (i.e. other than the coastal saltmarsh TEC) were identified as potentially occurring within the search area. These TECs are analogous with terrestrial vegetation and as such are discussed in Section 9.4.3.3.

The TEC 'Subtropical and Temperate Coastal Saltmarsh' is analogous with RE 12.1.2 (TSSC 2013), and was confirmed during field surveys within areas mapped as RE 11.1.4. Figure 9.6 shows the location of the TEC with respect to the Project impact areas.

There are no TECs present within the Project direct impact areas. The Subtropical and Temperate Coastal Saltmarsh TEC is mapped within the Project potential indirect impact areas, and is situated approximately 200 to 300m from the WB and WBE reclamation areas (refer Figure 9.6).

9.4.3.5 High value regrowth vegetation and reef regrowth watercourse vegetation

The VM Act regulates the removal of regulated regrowth vegetation, which includes high-value regrowth vegetation and regrowth watercourse vegetation mapped on the DNRME certified regulated vegetation management map.

As shown in Figure 9.5, there are no areas of regulated regrowth vegetation associated with the intertidal environments present within the Project impact areas.

9.4.3.6 Essential Habitat

There are no areas of mapped Essential Habitat for flora species of conservation significance, associated with intertidal environments within the Project impact areas (refer Figure 9.6). Section 9.6 provides further detail on the Essential Habitat mapped in Figure 9.6, which relates to habitat for terrestrial and intertidal fauna species of conservation significance.

9.4.4 Wetland values

No Ramsar wetlands are located within close proximity to the Project impact areas, with the Shoalwater and Corio Bay wetlands being the nearest Ramsar sites. These wetlands are located approximately 98km to the north of the WB and WBE reclamation areas (Commonwealth of Australia 2018).

Within the Project impact areas, there are four wetlands included on the DIWA (refer Figure 9.4). A summary of these wetlands is provided in Appendix I1 (Section 5.3), and their location in relation to the Project impact areas is provided in Table 9.11.

Table 9.11 Nationally important wetlands within the Project impact areas as listed on the Directory of Important Wetlands

DIWA name	Location in relation to the Project impact areas	Summary of ecological values from the Directory of Important Wetlands (DoEE 2018a)
Great Barrier Reef Marine Park	Approximately 4km from the area to be dredged at the southern end of Facing Island Approximately 5.5km from the closest new navigational aid at the southern end of Facing Island	■ Approximately 34,108,876ha of marine wetland ■ Contains a diverse range of habitats, including seagrass meadows, estuarine wetlands, mangrove woodlands, island cays and coral atolls ■ High diversity of corals species ■ High level of species diversity (e.g. more than 1,500 species of fish, 400 species of coral, 242 bird species and marine megafauna)
Port Curtis	WBE reclamation area, barge access channel, BUF and new navigational aids are situated within this wetland	■ Approximately 31,232ha of marine wetland ■ Partially enclosed embayment and shallow estuary which includes rocky islands, intertidal flat and estuarine islands and coral reefs ■ Contains extensive mangrove forests, seagrass meadows and saltflats/claypans ■ Contains preferred foraging and roosting sites for threatened migratory birds, including the Eastern curlew
The Narrows	Located approximately 600m to the north of the WBE reclamation area	■ Approximately 20,903ha of marine wetland ■ One of only four tidal passages in Australia ■ Includes coastal saltflats, mangrove forests, intertidal mudflats, seagrass meadows and open marine and estuarine waters ■ Supports a range of threatened marine and/or migratory fauna species
Colosseum Inlet/ Rodds Bay	Situated approximately 5.5km to the south of the closest area to be dredged	■ Approximately 24,314ha of wetlands ■ Contains three large estuaries/embayments with extensive mangrove forests, saltflats and seagrass beds ■ Extensive foraging and roosting habitat for migratory shorebirds, including the Eastern curlew which is critically endangered under the EPBC Act ■ A significant flying-fox roosting site occurs on Wild Cattle Creek

Table note:
Summary of ecological values is from DoEE (2018a)

The Referable Wetlands shown in Figure 9.4 are wetlands assessed as having ‘high’ or ‘very high’ ecological value scores as assessed in accordance with the Aqua Biodiversity Assessment Mapping Method (BAMM) (Rollason et al. 2012).

There are wetlands of high ecological significance (HES) mapped within the Project impact areas (refer Figure 9.4), including 48.62ha mapped within the WBE reclamation area.

There are DIWA wetland areas mapped within the Project impact areas (refer Figure 9.4), including:

- 278ha mapped within the BUF and WBE reclamation area
- 21.48ha mapped within the barge access channel (of which 19.03ha is within the areas to be dredged for the barge access channel)
- 50.04ha within the areas to be dredged for the channel duplication
- Small area associated with the installation of navigational aids.

9.5 Terrestrial and intertidal flora and wetlands – potential impacts and risk assessment

9.5.1 Background

9.5.1.1 Section content

This section identifies the potential impacts on flora and wetland values as a result of the Project activities. This includes both direct and indirect impacts on flora and wetland values, and for the purposes of this section, the term 'edge effects' includes potential impacts on adjoining areas associated with an increase in noise, dust, vibration, lighting during construction, and/or an increase in the potential introduction and/or spread of pest and weeds species.

For the purposes of this assessment, the term 'flora values' incorporates all native flora species and vegetation communities, including species or communities that are listed as having conservation significance under the provisions of the EPBC Act and/or NC Act, and are:

- Coastal Saltmarsh TEC
- Mangrove communities (refer Section 9.9 for discussion of potential impacts on seagrass meadows and epibenthic macroalgae)
- Terrestrial vegetation communities and species (including flora species of conservation significance).

There are a broad range of ecological values associated with wetlands in the Project area for which the potential impacts and risk assessment has been undertaken in other sections (e.g. Section 9.11 (reef communities), Section 9.13 (fish and marine reptiles (excluding marine turtles)), Section 9.7 (intertidal and terrestrial fauna values), and Section 9.21 (seagrass meadows and epibenthic macroalgae)). This section assesses the potential Project impacts on the integrity and condition of wetland values at the ecosystem-wide scale for the Port Curtis DIWA wetland and other mapped wetlands within the Port Curtis region.

This section provides a discussion of the potential impacts on flora communities and/or wetlands values associated with the Project activities. Table 9.12 summarises the Project activities and section containing the impact assessment discussion.

Table 9.12 Summary of Project activities and section addressed (terrestrial and intertidal flora and wetlands)

Project activity	Section
Establishment of the WBE reclamation area and BUF, including: ■ Site preparation ■ Establishment of the site compound, offices and temporary areas ■ Source and transport of reclamation bund wall material ■ Placement of core and armour material, and geotextile fabric ■ Sheet piling (or similar earth retaining structure) and fill placement for the BUF	Section 9.5.2
Dredging activities, including: ■ Initial dredging works for the barge access channel ■ Dredging to duplicate the Gatcombe and Golding Cutting shipping channels ■ Dredging vessel movements ■ Unloading and placement of dredged material in the WB and WBE reclamation areas	Section 9.5.3
Removal and installation of navigational aids	Section 9.5.4
Stabilisation and maintenance activities on the WBE reclamation area	Section 9.5.5

Operation of the duplicated shipping channels and maintenance dredging activities are discussed in Sections 9.23 and 9.24, respectively.

This section includes the potential impact and risk assessment, including the magnitude and consequence of the potential impacts on the terrestrial and intertidal flora and wetlands values as identified in Appendix I1 (Section 13). Terrestrial flora species confirmed to occur, or with a moderate or high likelihood of occurrence, within the Project impact areas are addressed in this section.

9.5.1.2 Sensitivity ratings

The sensitivity criteria and ratings which are used to assess the consequence of potential impacts on ecological receptors are provided in Appendix I2. The sensitivity ratings for terrestrial and intertidal flora and wetlands are summarised in Table 9.13, which are based on the sensitivity descriptions in Appendix I2 (Section 3.1 (refer Table 3.1 for the criteria used to define sensitivity ratings)). Section 9.5.7 provides details on the assessment of significant residual adverse impacts.

Table 9.13 Sensitivity ratings for terrestrial and intertidal flora and wetlands

Terrestrial and intertidal flora and wetlands values	Conservation status under the EPBC Act or NC Act	Sensitivity rating
Coastal Saltmarsh TEC	EPBC Act – Vulnerable	High
Mangrove communities	Not listed[1]	Moderate
Terrestrial vegetation adjacent to the WB and WBE reclamation areas	Not listed	Moderate
Terrestrial vegetation adjoining the proposed haul routes to be used for transporting reclamation bund wall material	Potential for habitat for species of conservation significance exists, however the majority of the terrestrial vegetation is not listed under these acts	Low to Very High
Port Curtis DIWA wetland (entire WBE reclamation area and BUF).	Not listed	High
Queensland Wetland (version 4) Estuarine Wetland (entire WBE reclamation area and BUF)	Not listed	High
MSES – HES Wetland (largely within the southern reclamation area)	Not listed	High

Table note:

1 Mangroves protected as marine plants under the Fisheries Act and are a MSES.

Coastal Saltmarsh threatened ecological community

Coastal Saltmarsh TEC is listed as Vulnerable under the provisions of the EPBC Act and generally provides extensive ecosystem services, including filtering of surface water prior to it entering the sea; carbon sequestration; coastal productivity; nursery habitat to a range of fisheries species; provision of food and nutrients for a wide range of adjacent marine and estuarine communities, including migratory shorebirds; and stabilising the coastline and providing a buffer from waves/storms (TSSC 2013). For the purposes of the potential impacts and risk assessment, Coastal Saltmarsh TEC adjacent to the WB and WBE reclamation areas is considered to have a sensitivity rating of high. The location of the adjacent Coastal Saltmarsh TEC is shown in Figure 9.10.

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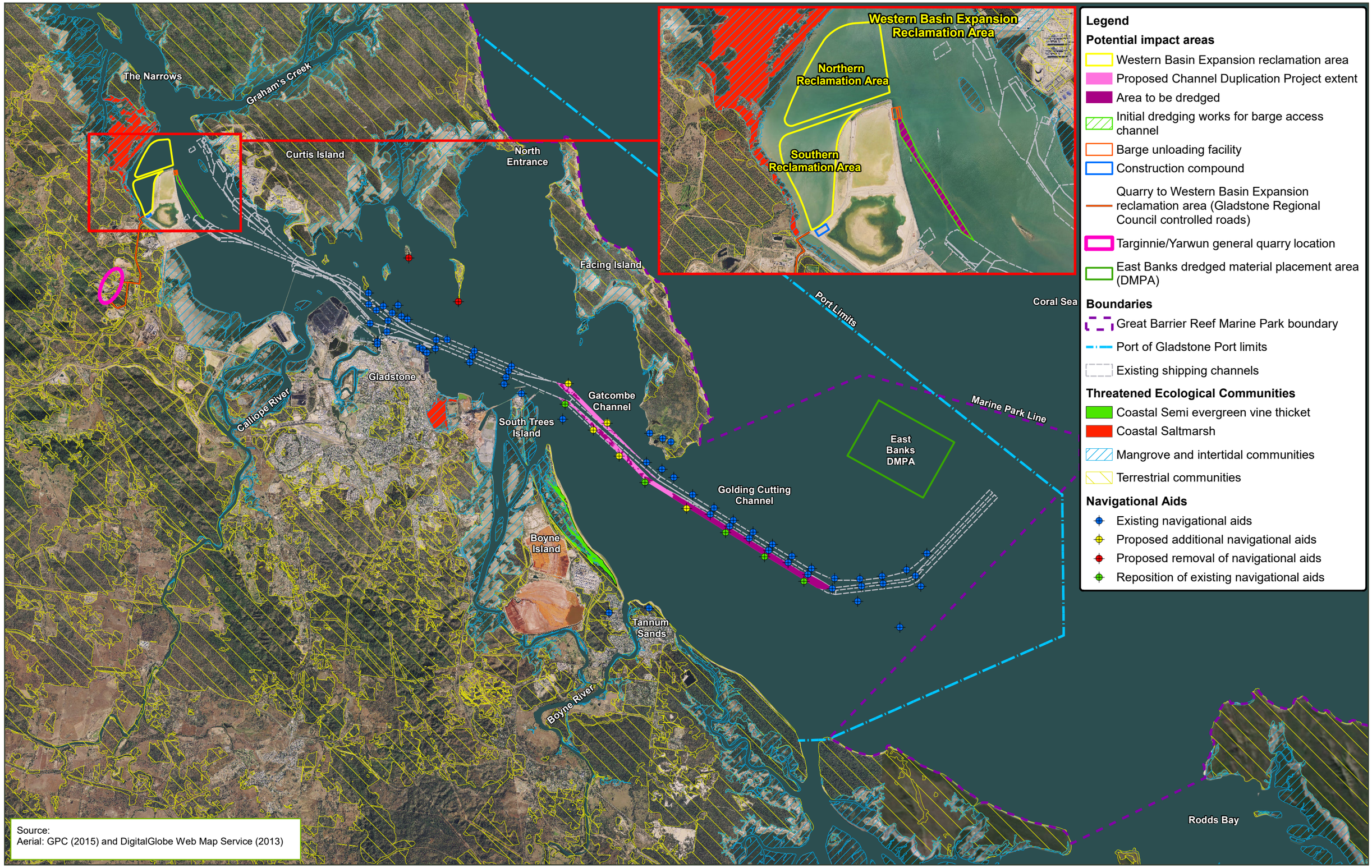

Source:
Aerial: GPC (2015) and DigitalGlobe Web Map Service (2013)

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Gatcombe and Golding Cutting Channel Duplication Project

Figure 9.10: Location of intertidal and terrestrial flora values

Mangrove communities

Mangroves are highly productive ecosystems and ecologically important in the global cycle of carbon dioxide, nitrogen, and sulfur; maintaining and building the soil; acting as a reservoir in the tertiary assimilation of waste; and providing protection against the impacts of cyclones (Australian Government 2000; Lovelock 1993). In addition, mangroves contribute to coastal stabilisation and promoting land accretion; fixation of mud banks; oxygenation of sediments; and the dissipation of wind, wave and tidal energy (Australian Government 2000; Connolly et al. 2006). Mangroves also provide important fauna habitat, including foraging resources, shelter, nursery grounds and breeding areas for birds, fish, crustaceans, shellfish, reptiles and mammals (Australian Government 2000; Lovelock 1993).

Between 2004 and 2010, the Port Curtis region experienced small declines in extent of intertidal wetlands. However, the area continues to support extensive intertidal wetlands that contain a diverse range of mangrove communities (GPC 2014). The PCPA CHAMP has identified the recent retreat of extent of mangroves within Port Curtis, with the greatest retreat observed in proximity to the existing WB reclamation area (Duke et al. 2017). This area is the location of recent port development and capital dredging which may have altered local hydrodynamics and potentially impacted mangrove shoreline stability (Duke et al. 2017).

The mangrove communities located adjacent to the WB and WBE reclamation areas are considered to have a sensitivity rating of moderate. The location of the adjoining mangrove communities is shown in Figure 9.10. The mangrove communities are considered to be in good condition, retaining many intrinsic characteristics and structural elements, though they are exposed to existing threatening processes.

Terrestrial vegetation communities

In general, terrestrial vegetation communities provide a range of resources for fauna that are not provided within intertidal and coastal areas (e.g. dense ground cover, hollow-bearing trees, freshwater sources, important flowering resources, including Myrtaceous plant species). Variation in the structural complexity of the terrestrial flora communities provides a range of different habitat values and fauna resources.

There are a range of terrestrial vegetation communities associated with the proposed Project indirect impact areas, with varying sensitivity ratings listed in Table 9.14. The location of terrestrial vegetation communities within the proposed Project indirect impact areas are shown in Figure 9.10.

Table 9.14 Sensitivity ratings of terrestrial vegetation communities located within the Project impact areas

Project impact area	Sensitivity rating	Justification
Terrestrial vegetation adjacent to the WBE reclamation area (including existing WB reclamation area)	Moderate	Remnant terrestrial vegetation mapped as Least concern and Endangered RE was observed to be in a moderate to good condition, despite being exposed to threatening processes (e.g. existing cleared/disturbed areas identified during Project field investigations)
Terrestrial vegetation adjoining the proposed haul routes to be used for transporting reclamation bund wall material	Low to very high	Terrestrial vegetation adjoining the proposed haul routes includes non-remnant vegetation, remnant vegetation and potential habitat for flora species listed as Near threatened, Vulnerable and Endangered under the provisions of the EPBC Act and/or NC Act (i.e. species of conservation significance)

Wetlands

The Port Curtis DIWA wetland includes all tidal areas in the vicinity of Gladstone, from the Boyne River Estuary in the south to Friend Point in the north, and to the seaward side of Facing Island in the east; with a total area of 31,232ha (Environment Australia 2001) (refer Figure 9.11). This wetland is listed on the DIWA as a nationally important wetland due to its important ecological and hydrological role within the Port of Gladstone. The Port Curtis wetland supports a range of flora and fauna species that are dependent on wetlands for all, or part, of their life cycle, it contains important habitat for species of conservation significance, and it is of historical and cultural significance (Environment Australia 2001). The sensitivity rating of the Port Curtis DIWA wetland is high (refer Appendix I1 (Section 5)).

In Queensland, wetlands of HES are identified as MSES and contain ecological values and important ecosystem functions. Queensland referable wetlands mapping indicates that a HES wetland occurs within the southern extent of the WBE reclamation area, and the existing WB reclamation area, with a small area of HES also extending into the northern reclamation area. The HES wetlands mapped in Figure 9.11 are predominantly associated with seagrass meadows.

Queensland Wetlands mapping (version 4) shows an Estuarine Wetland extending across the entirety of the WBE reclamation area. This Estuarine Wetland entirely overlaps the Port Curtis DIWA wetland mapping, and as such, will be combined with the DIWA wetland area for the purposes of this impact assessment.

The location of the Project impact areas in relation to the Queensland wetlands data mapping is shown in Figure 9.11.

9.5.2 Establishment of the dredged material placement area and barge unloading facility

9.5.2.1 Permanent loss of values within the Western Basin Expansion reclamation area and barge unloading facility

Context of impact

The Project potential impact areas encompass mapped wetlands within the WBE reclamation area and BUF, as discussed in Section 9.4.4. No terrestrial and intertidal flora are known to occur within the WBE reclamation area and BUF, as discussed in Sections 9.4.2 and 9.4.3. Therefore, this impact and risk assessment addresses the permanent loss of wetland values, as a consequence of the establishment of the WBE reclamation area and BUF. The estimated permanent loss of wetland areas is provided in Table 9.15.

Table 9.15 Estimated permanent loss of terrestrial and intertidal flora and wetland areas associated with the establishment of the Western Basin Expansion reclamation area and barge unloading facility

Terrestrial and intertidal flora and wetlands values	Area within the mapped Port Curtis DIWA wetland[1] (proportion of the total Project direct impact area as a percentage)	Area within mapped 'wetland areas' (HES) on the Queensland wetlands data map[2] (proportion of the total Project direct impact area as a percentage)
Coastal Saltmarsh TEC	0ha	0ha
Mangrove communities	0ha	0ha
Terrestrial vegetation communities	0ha	0ha
Wetlands	278.20ha (100%)[3]	48.63ha (17.49%)

Table notes:

1 Source: Environment Australia (2001)
2 Source: DES (2019b)
3 This value also represents the area within the mapped Estuarine Wetlands (Queensland Wetlands, version 4)

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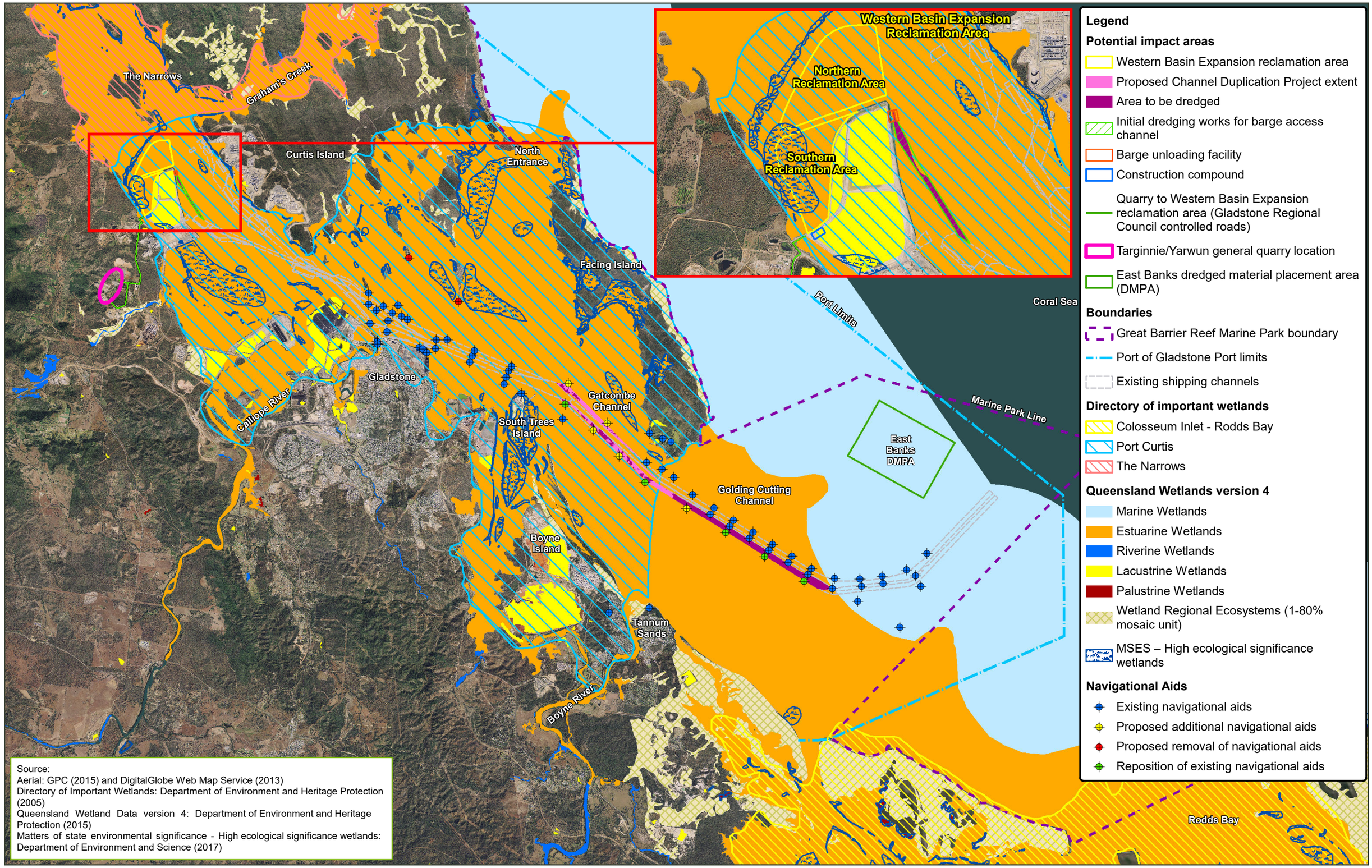

Legend

Potential impact areas
- Western Basin Expansion reclamation area
- Proposed Channel Duplication Project extent
- Area to be dredged
- Initial dredging works for barge access channel
- Barge unloading facility
- Construction compound
- Quarry to Western Basin Expansion reclamation area (Gladstone Regional Council controlled roads)
- Targinnie/Yarwun general quarry location
- East Banks dredged material placement area (DMPA)

Boundaries
- Great Barrier Reef Marine Park boundary
- Port of Gladstone Port limits
- Existing shipping channels

Directory of important wetlands
- Colosseum Inlet - Rodds Bay
- Port Curtis
- The Narrows

Queensland Wetlands version 4
- Marine Wetlands
- Estuarine Wetlands
- Riverine Wetlands
- Lacustrine Wetlands
- Palustrine Wetlands
- Wetland Regional Ecosystems (1-80% mosaic unit)
- MSES – High ecological significance wetlands

Navigational Aids
- Existing navigational aids
- Proposed additional navigational aids
- Proposed removal of navigational aids
- Reposition of existing navigational aids

Source:
Aerial: GPC (2015) and DigitalGlobe Web Map Service (2013)
Directory of Important Wetlands: Department of Environment and Heritage Protection (2005)
Queensland Wetland Data version 4: Department of Environment and Heritage Protection (2015)
Matters of state environmental significance - High ecological significance wetlands: Department of Environment and Science (2017)

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Gatcombe and Golding Cutting Channel Duplication Project

Figure 9.11: Location of Directory of Important Wetlands wetland values

Flora values

The WBE reclamation area and BUF are located within a marine zone, and does not extend into areas of terrestrial vegetation (refer Figure 9.10). Therefore, establishment of the WBE reclamation area and BUF will not result in the direct loss of terrestrial flora species/communities.

During the Project EIS field investigations, the absence of Coastal Saltmarsh TEC and mangrove communities within the WBE reclamation area and BUF were also confirmed. Consequently, the establishment of the WBE reclamation area and BUF will not result in the direct loss of these values. The location of adjacent Saltmarsh TEC and mangrove communities are shown in Figure 9.10.

Wetlands

The construction of the reclamation area and BUF bund walls will result in the permanent loss of wetland areas from within the Port Curtis DIWA wetland and overlapping HES mapping.

The WBE reclamation area and BUF are situated in estuarine waters, which are exposed mudflats at low tide (refer Figure 9.11). The Port Curtis DIWA wetland mapping encompasses the entire WBE reclamation area and BUF, thus, the area of permanent loss of DIWA values equates to approximately 278.20ha. The total permanent loss of the Port Curtis DIWA as a proportion of the entire wetland is estimated to be approximately 0.89%.

Construction of the southern portion of the WBE reclamation area will result in the permanent loss of 47.47ha of mapped Queensland HES wetlands, and construction within the northern portion of the WBE reclamation area will result in the permanent loss of 1.16ha of HES wetlands (refer Table 9.16). Overall, construction of the entire WBE reclamation area will result in the permanent loss of 48.63ha, or 0.16% of the mapped Queensland HES wetlands. There is no loss of mapped Queensland HES wetlands associated with the construction of the BUF.

Table 9.16 Western Basin Expansion and barge unloading facility reclamation footprint areas and the wetland areas within the reclamation areas

Reclamation area (area in ha)	Area within the mapped Port Curtis DIWA wetland[1] (proportion of the total Project direct impact area as a percentage)	Area within mapped 'wetland areas' on the Queensland wetlands data map[2] (proportion of the total Project direct impact area as a percentage)
WBE reclamation area (southern area) (111.12ha)	111.12ha (100%)	47.47ha (42.71%)
WBE reclamation area (northern area) (164.98ha)	164.98ha (100%)	1.16ha (0.70%)
Barge unloading facility	2.10ha (100%)	0ha (0%)
Total (278.08ha)	**278.08ha (100%)**[3]	**48.63ha (17.49%)**
Total proportion of the Port Curtis DIWA wetland (31,232ha)[1]	**0.89%**	**0.16%**

Table notes:

1 Source: Environment Australia (2001)
2 Source: DES (2019)
3 This value also represents the area within the mapped Estuarine Wetlands (Queensland Wetlands, version 4)

The permanent loss of these wetland areas as a result of the establishment of the WBE reclamation area and BUF is likely to result in the loss of habitat for a range of flora and fauna species, including:

- Seagrass meadows and epibenthic macroalgae (refer Section 9.9)
- Habitat for fish and marine reptiles (excluding marine turtles) (refer Section 9.13).
- Benthic habitat and associated benthic flora and fauna communities (refer Section 9.15)
- Foraging habitat for migratory and resident shorebird species and waders (refer Section 9.17)

- Potential habitat for intertidal fauna species, including species of conservation significance (refer Section 9.7).

These potential impacts will be reduced through the use of adaptive design measures implemented during the Project detailed design phase (refer Section 9.27). Project design will reduce, where practical, the permanent loss of values from within the reclamation areas.

The post mitigation risk ratings associated with a permanent and irreversible loss of wetland values within contained extent during the establishment of the WBE reclamation area and BUF are very high. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.2.2 Permanent or irreversible fragmentation or loss of connectivity values

Context of impact

The construction activities associated with the establishment of the WBE reclamation area and BUF have the potential to temporarily impact the connectivity values between the coastline and estuarine environments. However, it is considered unlikely that these potential impacts will result in adverse impacts on the function or values of the Port Curtis DIWA.

No terrestrial or intertidal flora are known to occur within the WBE reclamation area and BUF, as discussed in Sections 9.4.2 and 9.4.3. However, mapped wetlands (i.e. Port Curtis DIWA, Queensland HES) occur within the WBE reclamation area and BUF, as discussed in Section 9.4.4. Therefore, this impact and risk assessment addresses the permanent or irreversible fragmentation or loss of connectivity values associated with mapped wetlands, as a consequence of the establishment of the WBE reclamation area and BUF.

Flora values

The WBE reclamation area and BUF are located within a marine zone, and do not extend into areas of terrestrial vegetation (refer Figure 9.10). Therefore, establishment of the WBE reclamation area and BUF will not result in the permanent or irreversible fragmentation, or loss of connectivity values, associated with terrestrial vegetation.

During the Project EIS field investigations, the absence of Coastal Saltmarsh TEC and mangrove communities within the WBE reclamation area and BUF was also confirmed (refer Appendix I1 (Section 4)). Consequently, the establishment of the WBE reclamation area and BUF will not result in the permanent or irreversible fragmentation, or loss of connectivity values, associated with these communities. The location of adjacent Saltmarsh TEC and mangrove communities are shown in Figure 9.10.

Wetlands

Hydrodynamic modelling results from the WBE reclamation area and BUF indicate that there would be a reduction in velocity magnitudes to the north of the reclamation area, immediately adjacent to the BUF and in the main Port channels (due to reduced tidal prism) and an increase in velocity magnitudes in the channels adjacent to the WBE reclamation area (refer Appendix G). Further, the construction of the WBE reclamation area may result in a reduction in wave height along the shoreline and increase the current magnitude in the channel between the shoreline and reclamation area and could cause an adjustment in the morphology (refer Appendix G).

The design of the bund wall with armour material and geotextile fabric will ensure that there is no erosion from bund walls once they are constructed. The construction methodology will limit the disturbance to adjacent coastal environments (refer Section 2.5.7).

These potential impacts will be managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

The post mitigation risk ratings associated with the permanent or irreversible fragmentation, or loss of connectivity values of wetlands in a contained extent (i.e. moderate magnitude) during the establishment of the WBE reclamation area and BUF are medium. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.2.3 Introduction and spread of weed and/or pest species and increased edge effects

Context of impact

Vegetation clearing activities have the potential to result in habitat degradation in areas adjacent to the WB and WBE reclamation areas and associated bund wall construction haul roads due to edge effects (i.e. alterations in light penetration and radiation, microclimate changes, changes in species composition and community structure). These edge effects can promote the growth of different vegetation types (including weed species), promote the introduction or spread of pest fauna species specialising in edge habitat, and the potential to modify the behaviour of native fauna species utilising adjacent habitats. Edge effects have the potential to result in the degradation of habitat quality in intertidal and estuarine habitats adjacent to the WB and WBE reclamation areas, and terrestrial areas alongside the proposed haul road.

The key edge effects that have the potential to impact on these areas include the introduction and spread of weed and pest species, and alterations to the behaviour of native fauna species within adjacent areas, which may have a medium term impact within the local area. It is noted however, that these adjacent areas have been subject to edge effects previously due to existing industrial and residential land uses, and associated infrastructure.

As outlined in Appendix I1 (Sections 3, 13 and 16), a number of declared weed and pest species have been identified within the Project direct or potential indirect impact areas. Truck movements, placement of rock and other material to form the bund walls, and vegetation clearing (and associated edge effects), are all potential risks in terms of the introduction and spread of weed and/or pest species, including species declared under the Biosecurity Act.

Flora values

The potential indirect impact of the introduction and spread of weed and/or pest species into terrestrial and intertidal vegetation communities adjoining the WB and WBE reclamation areas and vehicle routes may occur due to vehicular movements associated with the transport of bund wall material. Introduced species are known to have a negative impact on native wildlife, through increasing competition for resources, causing physical harm, and decreasing habitat value.

Remnant terrestrial vegetation was observed adjacent to the WB and WBE reclamation areas, and has the potential to be indirectly impacted by Project activities (refer Section 9.4.3). This potentially includes approximately 23.68ha of mapped remnant vegetation, consisting of Least concern RE (21.69ha) and Endangered RE (1.99ha) under the provisions of the VM Act (refer Sections 9.4.2 and 9.4.3. A description of the terrestrial REs within the potential indirect impact areas are described in Section 9.4.2.

Potential habitat for seven flora species of conservation significance and that are considered to have a moderate likelihood of occurrence, was present within the Project indirect impact areas (refer Table 9.6 and Appendix I1(Appendix B)). This includes areas located approximately 200m west of the WB and WBE reclamation areas and along the adjoining bund wall material vehicle route.

The magnitude and likelihood of habitat degradation, occurring as a result of the introduction and spread of weed and/or pest species, will be managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2). These potential impacts will occur in the short term within a contained extent, and are therefore low in magnitude.

The post mitigation risk ratings associated with the introduction and spread of weed and/or pest species and increased edge effects on terrestrial and intertidal flora during the establishment of the WBE reclamation area and BUF are medium for potential habitat for flora species of conservation significance, and low for all other flora values. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

Wetlands

Introduction and spread of weed and pest species may result in the degradation of adjacent wetland habitats, decline in the suitability of available habitat for wetland fauna species, introduction of disease that may adversely impact native flora and/or fauna species, and other potential adverse impacts on native flora and fauna (i.e. invasive species have the potential to be toxic to native fauna, and compete for available resources). These potential impacts will be managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

There were no aquatic weed species recorded within the Project impact areas during the EIS field investigations (refer Appendix I1 (Appendix C)). Therefore, the potential impacts associated with the spread or introduction of aquatic weeds is considered unlikely to have a significant impact on the Port Curtis DIWA wetland and Queensland HES wetland areas. These potential impacts will occur in the short term within a contained extent, and are therefore low in magnitude. Any potential impacts will be managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

The post mitigation risk ratings associated with the introduction and spread of weed and/or pest species and increased edge effects on wetland values during the establishment of the WBE reclamation area and BUF are low.

9.5.2.4 Potential hydrodynamic impacts and short term declines in water quality

Context of impact

Establishment of the WBE reclamation area (northern and southern areas) and the BUF will be undertaken over a three year period and will involve the placement of core material directly over existing sediments, followed by armour material being placed along the seaward exposed face. The construction activities associated with the establishment of the WBE reclamation area and BUF have the potential to impact the water quality of the receiving environment (i.e. enclosed coastal waters of Port Curtis) and may impact on intertidal flora and wetlands, through exposure to contaminants or increased turbidity. A detailed assessment of the potential impacts to water quality as a result of Project activities is provided in Section 8.6.

The Project EIS coastal processes assessment has only identified minor changes to the extent of mangrove cover at the existing WB reclamation area, however the shoreline alignment appears to be largely unchanged. Due to the construction of the existing WB reclamation area the hydrodynamics, wave climate and sediment dynamics on the intertidal flats has been modified and over time this could be expected to cause changes in the bathymetric features and ecology of the intertidal area (e.g. may promote siltation and mangrove growth) (refer Appendix G).

There is potential for some erosion to occur in the channels surrounding the WBE reclamation area. This erosion would continue (provided the bed material is erodible) until the channel reaches a new equilibrium depth.

Flora values

Erosion, sedimentation and decreased water quality in adjacent Coastal Saltmarsh TEC and mangrove communities may occur due to the transport of sediments from the disturbed areas within and adjoining the WBE reclamation area and BUF. The establishment of the WBE reclamation area and BUF will result in changes in marine water velocities which has the potential to result in erosion and siltation of the foreshore and intertidal environments during the placement of core and armour material at the WBE reclamation area. Saltmarsh sediments are protected from erosion by their vegetation cover, and therefore the loss or weakening of the vegetation can initiate local erosion, which over time can expand to affect much larger areas. The rate of erosion depends on the integrity of vegetation cover, landscape stability and runoff (Adam 2002).

Mangroves are not sensitive to reduced light as a result of increased turbidity, although it has been noted that excess levels of sedimentation can cause stress to mangroves as a result of smothering and burial of the root system, resulting in the sediment overcoming the filtering ability of mangroves (BMT WBM 2017a). Sedimentation can thus lead to reduced vigour, or death, depending on the amount and type of sediment, and of mangroves (BMT WBM 2017a).

It is not expected that erosion, siltation and short term declines in water quality will impact on terrestrial flora values. Potential impacts associated with erosion, sedimentation and decreased water quality in adjacent Coastal Saltmarsh TEC, mangrove communities will be avoided, minimised and mitigated through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

The potential declines in water quality in the marine environment as a result of the establishment of the WBE reclamation area will be short term in duration and within a contained extent, and are therefore low in magnitude.

The post mitigation risk ratings associated with erosion, sedimentation and decreased water quality within terrestrial and intertidal vegetation communities during the establishment of the WBE reclamation area and BUF are medium for coastal saltmarsh TEC and potential habitat for flora species of conservation significance, and low for all other flora values. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

Wetlands

As outlined for flora values, the establishment of the WBE reclamation area will result in changes in marine water velocities which has the potential to result in erosion and siltation of the foreshore and intertidal environments during the placement of core and armour material at the WBE reclamation area. It is not expected that erosion, siltation and short term declines in water quality will significantly impact on the function of the wetlands adjacent to the WBE reclamation area. The potential impacts will be short term in duration and will occur within a contained extent, and therefore the magnitude of these potential impacts is low.

Potential impacts will be managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

The post mitigation risk ratings associated with erosion, sedimentation and decreased water quality of wetlands during the establishment of the WBE reclamation area and BUF are low. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.2.5 Increase in dust due to increased truck movements and construction works

Context of impact

Construction of the proposed reclamation bund walls will require the transportation of rock and other material by truck, which has the potential to result in dust generation along the public haul road and WB and WBE reclamation areas (refer Section 1.4).

Excessive deposition of dust on leaves of plants can suppress growth and photosynthesis, resulting in the reduced quality of fauna habitat. Excessive deposition of dust on intertidal areas may also decrease water quality, subsequently reducing the quality of intertidal fauna habitat.

Flora values

Potential damage to the adjacent intertidal and terrestrial vegetation communities (including potential habitat for flora species of conservation significance) may occur as a result of elevated dust levels due to increased truck movements associated with the transport of reclamation bund wall material and during the placement of core, and armour material, and geotextile fabric at the WBE reclamation area and BUF.

The potential impacts will be temporary in duration and within a contained extent, and are therefore low in magnitude. The magnitude of potential dust impacts will be managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

The post mitigation risk ratings associated with an increase in dust generation on terrestrial and intertidal vegetation communities during the establishment of the WBE reclamation area and BUF are low to medium. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

Wetlands

Vehicle movements and the placement of core material associated with establishment of the WBE reclamation area and BUF have the potential to increase the levels of dust/sediments entering the marine environment, which has the potential to impact on wetland values.

These potential impacts will be temporary in duration and within a contained extent, and are therefore low in magnitude. Any potential impacts will be managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

The post mitigation risk ratings associated with dust impacts on wetland values during the establishment of the WBE reclamation area and BUF are low. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.2.6 Short term decline in water quality in the marine environment

Context of impact

Construction activities associated with the establishment of the WBE reclamation area and BUF has the potential to result in short term declines in water quality as a result of erosion, sedimentation and the accidental release of contaminants (e.g. hydrocarbons). These potential impacts may have medium term impacts on wetland values and intertidal flora communities.

The proposed establishment of the WBE reclamation area and BUF has the potential to impact on water quality within the Project impact areas via the following impact sources:

- Transport of sediment and nutrients by stormwater runoff
- Dust from construction activities and vehicle movements (refer Section 9.5.2.5)

- Leachate and/or runoff from any exposed ASS
- Hydrocarbon spills from construction equipment or onsite storage facilities.

Transportation of sediment and nutrients into adjacent wetland areas has the potential to result in:

- Smothering of aquatic flora and fauna (i.e. benthic and epibenthic communities)
- Increasing turbidity and decreasing light penetration, thereby potentially impacting on the growth/survival of aquatic flora species (e.g. seagrass, macroalgae) (refer Section 9.9)
- Increasing availability of nutrients resulting in the growth of algal blooms, which can reduce levels of dissolved oxygen (i.e. resulting in direct impacts on the survival of aquatic flora and fauna)
- Toxic effects to some species of marine fauna (e.g. impacts on the food chain as a result of the effects of bioaccumulation) (refer to potential impact sections for marine fauna values for further discussion on this impact).

During the establishment of the WBE reclamation area and BUF, the accidental release of contaminants from machinery operation or onsite storage facilities has the potential to result in adverse impacts to adjacent terrestrial and intertidal flora and wetland environments.

The potential for the release of contaminants into the adjacent marine environment has the potential to impact on the overall ecosystem health and functioning of marine wetland within the Project impact areas. Furthermore, an increase in contaminants may cause significant damage to mangrove communities, including mangrove dieback, and oil spills have the potential to smother mangrove roots and suffocate the trees (Australian Government 2000).

The limited amount of chemicals likely to be stored onsite, and size of machinery being used for the establishment of the reclamation area, indicates that this activity is unlikely to result in a significant impact in the event that there is an accidental release from storage facilities or machinery. These potential impacts will be managed and mitigated through the implementation of the Dredging EMP (refer Appendix Q2).

Flora values

Short term declines in water quality in the marine environment have the potential to impact on intertidal communities adjacent to the WB and WBE reclamation areas. However, as the terrestrial vegetation communities are situated away from the coastline, it is considered unlikely that terrestrial flora values will be impacted as a result of short term declines in water quality in the marine environment.

The potential impacts to water quality and intertidal flora communities through a release of sediment laden runoff and/or contaminants during the establishment of the WBE reclamation area and BUF will be generally restricted to a contained area and within the medium term, and are therefore moderate in magnitude. The magnitude of these potential impacts will be managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

During the establishment of the WBE reclamation area and BUF, the post mitigation risk ratings associated with the potential impacts to the terrestrial and intertidal vegetation communities due to short term declines in water quality are low to medium. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

Wetlands

Short term declines in water quality in the marine environment have the potential to impact on wetlands adjacent to the WB and WBE reclamation areas. This has the potential to cause degradation of adjacent wetland habitats and the decline in the suitability of available habitat for wetland flora and fauna species.

The potential impacts to wetland values as a result of short term declines in water quality during the establishment of the WBE reclamation area and BUF will be generally restricted to a contained area and within the medium term. These potential impacts are therefore considered to be moderate in magnitude. The magnitude of these potential impacts will be managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

The post mitigation risk ratings associated with short term declines in water quality and potential impacts on wetlands, during the establishment of the WBE reclamation area and BUF, are medium. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.3 Dredging activities

9.5.3.1 Permanent loss of values from the areas to be dredged

Context of impact

Benthic habitats are an important component of wetland ecosystems as they provide primary producer habitat, and food resources for a range of key taxa (e.g. fish and other nekton, marine mammals, marine turtles). The direct loss of benthic communities as a result of dredging the barge access channel is a permanent and contained impact. Dredging to duplicate the channels is an activity that is situated directly adjacent to the existing shipping channel, and these benthic habitats have experienced previous disturbance due to capital and maintenance dredging operations associated with the existing shipping channel.

Dredging of the barge access channel will result in the direct loss of the following ecological values from the Port Curtis DIWA wetland:

- Seagrass meadows and macroalgae (refer Section 9.9)
- Habitat for fish and marine reptiles (excluding marine turtles) (refer Section 9.13)
- Benthic habitat and associated benthic flora and fauna communities (refer Section 9.15)
- Potential habitat for marine fauna species, including species of conservation significance (refer Sections 19.19 and 19.21).

The specific impacts on these values are discussed within the relevant sections, however the overall impacts in the context of the ecosystem processes and values of the Port Curtis DIWA wetland are discussed below.

Flora values

The dredging activities are located within a marine zone, and do not extend into areas of terrestrial vegetation, mangroves or coastal saltmarshes (refer Figure 9.10). Therefore, dredging activities will not result in the direct loss of flora species/communities.

Wetlands

The proposed channel duplication areas to be dredged are partially situated within the Port Curtis DIWA wetland (refer Figure 9.11). Approximately 50.04ha of the areas to be dredged is located within the Port Curtis DIWA wetland, which equates to 0.16% of the total mapped Port Curtis DIWA wetland extent (refer Table 9.17). All of the areas to be dredged (i.e. 381.90ha) are located within areas identified as estuarine wetlands on the Queensland wetlands data map, as shown in Figure 9.11.

There are no HES wetlands mapped within the areas to be dredged (refer Figure 9.11).

Table 9.17 Wetland areas within the channel duplication areas to be dredged

Areas to be dredged for channel duplication (area in ha)	Area within the mapped Port Curtis DIWA wetland[1] (proportion of the total Project direct impact area as a percentage)	Area within mapped 'wetland areas' on the Queensland wetlands data map[2] (proportion of the total Project direct impact area as a percentage)
Areas to be dredged (381.90ha)	50.04ha (13.10%)	269.48ha (100%)
Total proportion of the Port Curtis DIWA wetland (31,232 ha)[1]	**0.16%**	**Not calculated as part of this area as the areas to be dredged are located outside of the mapped Port Curtis DIWA wetland**

Table notes:

1 Source: Environment Australia (2001)
2 Source: DES (2019b).

The barge access channel will be dredged to allow barge access to the proposed BUF as shown in Figure 9.11, at any point in the tidal cycle (i.e. eliminating low or receding tide constraints on barge movements into these shallow coastal waters). The barge access channel is situated completely within the Port Curtis DIWA wetland and Queensland wetlands data map (refer Figure 9.11), however will not result in the direct loss of mapped HES wetlands.

The direct loss of wetland values associated with the barge access channel is considered to be contained, and result in long term impacts. Though the potential impacts on wetland values are considered to have long term impacts, the estimated percentage of the loss (relative to the total mapped area of the Port Curtis DIWA wetland) is very low at 0.06% of the total 31,232ha area (refer Table 9.18). Therefore, it is considered unlikely that dredging activities will result in significant impact to wetland ecosystems within Port Curtis.

Table 9.18 Wetland areas within the barge access channel

Area to be dredged for barge access channel (area in ha)	Area within the mapped Port Curtis DIWA wetland[1] (proportion of the total Project direct impact area as a percentage)	Area within mapped 'wetland areas' on the Queensland wetlands data map[2] (proportion of the total Project direct impact area as a percentage)	Area within the mapped HES wetlands
Areas to be dredged to establish barge access channel to the BUF (21.48ha)	19.03ha (88.5%)	21.48ha (100%)	0ha
Total proportion of the Port Curtis DIWA wetland (31,232 ha)[1]	**0.06%**	**0.06%**	**0%**

Table notes:

1 Source: Environment Australia (2001)
2 Source: DES (2019b)

The potential impacts on wetland as a result of dredging activities will be permanent and within the local area, and are therefore high in magnitude.

Potential impacts will be managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2). The post mitigation risk ratings associated with a permanent and irreversible loss of wetland values during the dredging activities are medium. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.3.2 Potential short term decline in water quality

Context of impact

Hydrodynamic modelling was undertaken for dredging activities to determine potential impacts to water quality (refer Chapter 8). These models identified potential zones of impact for water quality for the assessment of impacts on marine values. The dredging activities associated with the Project have the potential to impact the water quality in Port Curtis and may impact on intertidal flora and wetlands, through exposure to contaminants or increased turbidity. The risk for contamination from the dredged sediment is low (refer Chapter 6) and potential for changes to water quality are expected to be from an increase in turbidity. The modelled turbidity zones of influence indicate that the turbidity plume may extend north into The Narrows and east of Facing Island. The zone of high impact does not extend into the intertidal areas, and is expected to be contained within the dredging footprint and directly adjacent areas.

The potential for the dredging turbidity plume to result in a decrease in the condition and/or extent of values that comprise wetlands within the zone of influence from the dredging activities is expected to be low. Impacts to water quality are detailed in Chapter 8.

Flora values

The dredging activities are located within a marine zone, and do not extend into areas of terrestrial vegetation (refer Figure 9.10). Therefore, dredging activities will not result in potential impacts to the terrestrial and intertidal vegetation communities.

Wetlands

During the dredging activities, the potential impacts to wetland areas adjacent to the WB and WBE reclamation areas include:

- Impacts on water quality and wetland flora and fauna communities (e.g. intertidal and marine wetland communities) as a result of bund wall failure and/or significant seepage
- Overtopping of the bund walls during a significant wave or flood event, resulting in decreased water quality in adjacent areas and potential impacts on wetland flora and fauna communities.

The dredging activities will result in potential impacts on water quality within the Port Curtis DIWA wetland. Potential water quality impacts are detailed within Chapter 8 of this EIS. The key source of potential impacts on ecological values and process of the Port Curtis DIWA wetland is associated with the potential increase in turbidity and the impact that this may have on seagrass and intertidal flora and associated fauna. The turbidity plume and zone of influence model predicts where the zones of high impact may occur. The high impacts are predicted to occur within and adjacent to the channel duplication dredged channels. The low impact zones are predicted to extend to intertidal areas in some locations.

During the dredging, barging and unloading operations, there is potential for the accidental release of contaminants from dredgers, barges and associated machinery operation resulting in potential adverse impacts to marine wetland environments. An unconfined accidental release of contaminants from a dredger or barge during the Project activities has the potential for impacts on ecological values to be extensive (depending on the volume of the release) and may have long term to permanent impacts on ecological values if mitigation measures are not implemented.

The potential impacts associated with short term declines in water quality during dredging, barging and unloading activities may occur over the short term and will be local in area, and are therefore moderate in magnitude.

The potential impacts associated with dredging plumes and potential water quality impacts during the dredging operations will be minimised and managed through the implementation of a Dredging EMP (refer Appendix Q1).

The post mitigation risk ratings associated with water quality impacts on wetland values during the dredging activities are medium. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.3.3 Introduction and spread of weed and/or pest species

Context of impact

The introduction and spread of weed and/or pest species into areas adjoining the WB and WBE reclamation areas may occur in the short term as a result of dredging activities. This may result in the degradation of adjacent habitats, decline in the suitability of available habitat for fauna species, introduction of disease that may adversely impact native flora and/or fauna species, and other potential adverse impacts on native flora and fauna (i.e. invasive species have the potential to be toxic to native fauna, and compete for available resources). Section 9.5.2.3 includes a description of the potential sources of impact on flora and wetland values as a result of the introduction and spread of weed and/or pest species.

Flora values

The magnitude and likelihood of habitat degradation occurring as a result of the introduction and spread of weed and/or pest species will be managed and mitigated through the implementation of the Dredging EMP and the Project EMP (refer Appendices Q1 and Q2, respectively). Potential impacts on flora values as a result of the introduction and spread of weed and/or pest species will be temporary and contained in extent, and are therefore negligible (for potential habitat for flora species of conservation significance) to low (all other flora values) in magnitude.

The post mitigation risk ratings associated with the introduction and spread of weed and/or pest species into terrestrial and intertidal vegetation communities due to dredging activities are low. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

Wetlands

These potential impacts will be managed and mitigated through the implementation of the Dredging EMP and Project EMP (refer Appendices Q1 and Q2). Potential impacts on wetlands as a result of the introduction and spread of weed and/or pest species will be temporary and contained in extent, and are therefore low in magnitude.

The post mitigation risk ratings associated with the introduction and spread of weed and/or pest species into wetlands due to dredging activities are low. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.3.4 Potential release of contaminants into adjacent environment

Context of impact

The potential release of contaminants from the dredging vessels (e.g. spills, waste materials) and storage facilities (i.e. hydrocarbon storage within the reclamation areas) into adjacent intertidal areas may cause damage to the intertidal flora communities (e.g. mangroves and saltmarsh communities) and wetland values. Any increase of contaminants may cause significant damage to mangrove communities, including mangrove dieback. There is a lower likelihood of these impacts extending into terrestrial areas, due to their location away from the coastline, however there is potential for impacts to extend beyond the intertidal areas.

Dredging has the potential to mobilise nutrients and toxicants into the water column from the disturbance of marine sediment (BMT WBM 2017b). Desktop and field geochemical investigations undertaken for the Project concluded that the marine sediments to be removed from the areas to be dredged are considered 'clean' as per NAGD (2009) and the potential for contaminants to be mobilised into the water column during dredging activities is considered to be low (refer Section 6.5 and Appendices E4 and E6). It is considered unlikely that dredging activities associated with the Project will cause significantly elevated concentrations of toxicants in the associated water column, resulting from the disturbance of marine sediment. It is likely that tidal processes would disperse and dilute any mobilised nutrients in the water column where in proximity to terrestrial and intertidal vegetation communities.

Flora values

The post mitigation risk of the potential release of contaminants during dredging activities (and the potential for impacts on flora values) will be temporary to short term in duration, and restricted to a contained extent. Therefore, the magnitude of the potential impacts will be low.

The potential impacts on flora values will managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Dredging EMP (refer Appendix Q1).

The post mitigation risk ratings associated with the potential release of contaminants from the dredging vessels and other construction equipment/storage facilities into terrestrial and intertidal vegetation communities are medium for potential habitat for flora species of conservation significance, negligible for all other terrestrial vegetation, and low for coastal saltmarsh TEC and mangrove communities. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

Wetlands

The post mitigation risk of the potential release of contaminants during dredging and barging activities (and the potential impact on wetland values) will be short term in duration, and restricted to a contained extent. Therefore, the magnitude of the potential impacts will be low.

Potential impacts will be managed and mitigated through the implementation of mitigation measures in Section 9.27 and the Dredging EMP (refer Appendix Q1).

The post mitigation risk ratings associated with contamination and general waste impacts to wetlands during dredging activities are medium. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.4 Removal and installation of navigational aids

9.5.4.1 Permanent loss of values from removal and installation of navigational aids

Context of impact

The removal of existing navigational aids and the installation of relocated and new navigational aids will result in the direct loss of very small areas of benthic habitat from within the Port Curtis DIWA wetland (refer Figure 9.11). Ten navigational aids are proposed within the Port Curtis DIWA wetland (i.e. five new and five repositioned navigation aids), directly adjacent to the duplicated channels, and will result in the permanent loss of contained areas of benthic communities. These impacts will be contained in extent.

The installation of navigational aids on the bund wall of the WBE reclamation area and the sheet pile (or similar earth retaining structure) wall of the BUF will not disturb benthic or intertidal habitat as this work will be undertaken above the intertidal zone.

Flora values

The removal of existing navigational aids and the installation of relocated and new navigational aids is considered unlikely to have any potential impacts upon intertidal and terrestrial flora communities, due to the proximity of the proposed works. The location of intertidal and terrestrial flora in relation to the location of the navigational aids is shown in Figure 9.10.

Wetlands

The potential impacts associated with permanent loss of areas of benthic communities during removal and installation of navigational aids will be managed through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2). There will be no loss of values from the HES wetlands.

The potential impacts on wetlands as a result of the removal and installation of navigational aids will be temporary and within a contained extent, and are therefore low in magnitude.

The post mitigation risk ratings associated with permanent loss of areas of benthic communities associated with wetlands are medium. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.4.2 Release of contaminants from the pile driving barge

Context of impact

The removal of existing navigational aids and the installation of relocated and new navigational aids have the potential to result in the release of contaminants from the pile driving barge (e.g. spills, waste materials), which may subsequently adversely impact on wetland flora and fauna communities within adjacent wetlands. The impacts on wetland flora and fauna species associated with spills are discussed in Section 9.5.3.2 in relation to the dredging activities, and also apply to this Project activity.

Flora communities

The removal of existing navigational aids and the installation of relocated and new navigational aids is considered unlikely to have any potential impacts upon intertidal and terrestrial flora communities, due to the proximity of the proposed works.

Wetlands

The potential impacts associated with accidental releases of contaminants within the marine environment will be managed through the implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

The potential impacts on wetlands as a result of the accidental release of contaminants during the removal and installation of navigational aids will be temporary and within a contained extent, and therefore low in magnitude.

The post mitigation risk ratings associated with the release of contaminants from the pile driving barge and potential for impacts on wetland values are low. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.5 Stabilisation and maintenance activities

9.5.5.1 Introduction and spread of weed and/or pest species

Context of impacts

The introduction and spread of weed and/or pest species into the terrestrial and intertidal flora communities, including potential habitat for flora species of conservation significance, located adjacent to the WB and WBE reclamation areas, may occur during surface stabilisation and maintenance works within the reclamation areas. The introduction and spread of weed and/or pest species has the potential to harm wildlife, and decrease habitat values.

Maintenance activities on the WB and WBE reclamation areas has the potential to result in adverse impacts on adjacent wetland areas. Potential impacts on wetland values during stabilisation and maintenance activities include the introduction and spread of weed and/or pest species into areas adjoining vehicle routes within the final Project landform area due to vehicle movements associated with the maintenance activities. However, these potential impacts are discussed in detail in Section 9.5.2 with respect to the establishment of the WBE reclamation area. The potential impact pathways and receptors are similar for the maintenance activities on the final Project landform area.

Flora values

The potential impacts associated with the introduction and spread of weed and/or pest species will be mitigated through implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2). These potential impacts are expected to be short to medium term in duration and within a contained extent, and therefore moderate in magnitude.

The post mitigation risk ratings associated with the introduction and spread of weed and/or pest species into terrestrial and intertidal communities due to maintenance works are medium for coastal saltmarsh TEC and potential habitat for flora species of conservation significance, and low for other terrestrial vegetation and mangroves. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

Wetlands

Due to the predominantly terrestrial nature of activities associated with stabilisation and maintenance activities, there is limited potential for the introduction and spread of pest and weed species into the marine environment and adjacent wetlands. These impacts are expected to be short term and contained in extent, and are therefore low in magnitude. Any potential impacts will be mitigated through implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

The post mitigation risk ratings associated with the introduction and spread of weed and/or pest species into wetland areas due to maintenance works are low. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.5.2 Short term decline in water quality

Context of impact

Sedimentation and decreased water quality in adjacent terrestrial and intertidal flora and wetland areas may occur during stabilisation and final Project landform works, due to erosion from the WB and WBE reclamation areas. The rate of erosion of saltmarsh sediments depends on the integrity of vegetation cover, landscape stability and runoff, and over time, erosion can expand to affect much larger areas (Adam 2002). The potential impacts on flora values and wetlands as a result of short term declines in water quality are further discussed in Section 9.5.2.6 relative to the establishment of the WBE reclamation area. The potential impact receptors and impact pathways are similar for stabilisation and maintenance activities, though impacts will be shorter in duration and lower in magnitude.

Mangroves are not sensitive to reduced light as a result of increased turbidity, although it has been noted that excess levels of sedimentation can cause stress to mangroves as a result of smothering and burial of the root system, resulting in the sediment overcoming the filtering ability of mangroves (BMT WBM 2017a). Sedimentation can thus lead to reduced vigour, or death, depending on the amount and type of sediment, and the mangrove species (BMT WBM 2017a).

The release of contaminants from vehicles into intertidal environments may occur as a result of surface stabilisation and maintenance works within the WB and WBE reclamation areas. This may result in potential impacts to adjacent Coastal Saltmarsh TEC areas and mangrove communities and decreased habitat quality.

Other minor impacts may occur in association with the operation of vehicles onsite, including potential accidental releases of hydrocarbons and other contaminants, noise impacts and potential for interaction between fauna and vehicles onsite resulting in injury or mortality of fauna species. These impacts are expected to be negligible as the post-dredging workforce will require a minimal onsite workforce of 8 people during the stabilisation and maintenance activities.

Flora values

Impacts associated with the potential short term decline in water quality will be mitigated through implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2). These potential impacts are expected to be temporary in duration and within a contained extent, and are therefore low in magnitude.

The post mitigation risk ratings associated with sedimentation and decreased water quality in terrestrial and intertidal vegetation communities due to erosion from the WB and WBE reclamation areas is low. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

Wetlands

These potential impacts are discussed in detail in Section 9.5.2 with respect to the establishment of the WBE reclamation area. The potential impact pathways and receptors are similar for maintenance activities on the final Project landform area. The potential impacts will be temporary in duration and may impact the local area, and are therefore low in magnitude.

These impacts will be mitigated through implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2).

The post mitigation risk ratings associated with sedimentation and decreased water quality in wetlands due to erosion from the WB and WBE reclamation areas is low. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.5.3 Increase in dust during surface stabilisation and maintenance activities

Context of impact

Damage to the adjacent intertidal flora values may occur as a result of an increase in dust during surface stabilisation and maintenance activities on the WB and WBE reclamation areas. Excessive deposition of dust on leaves of plants can suppress growth and photosynthesis, resulting in the reduced quality of fauna habitat. It is unlikely that there would be impacts on terrestrial vegetation as a result of this activity.

Surface stabilisation and maintenance activities on the WB and WBE reclamation areas have the potential to result in adverse impacts on adjacent wetland areas. Potential impacts on wetland values during maintenance activities include excessive deposition of dust from the final Project landform area into adjacent intertidal and marine areas.

Section 9.5.2.5 discusses the potential impacts associated with dust on the adjacent flora and wetland values, and the impacts during this activity are expected to have a similar type of impact on the adjacent flora and wetland values.

Flora values

These impacts will be mitigated through implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2). These potential impacts will be short term in duration and within a contained extent, and are therefore low in magnitude.

The post mitigation risk ratings associated with the potential increase in dust in intertidal flora communities due to maintenance works are low. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

Wetlands

These impacts will be mitigated through implementation of mitigation measures in Section 9.27 and the Project EMP (refer Appendix Q2). These potential impacts will be short term in duration and within a contained extent, and are therefore low in magnitude.

The post mitigation risk ratings associated with excessive deposition of dust in wetlands due to stabilisation activities are low. Appendix I4 provides detail on the assessment of this potential impact and the resultant risk rating.

9.5.6 Threatening processes for species of conservation significance and threatened ecological communities

Threatening processes which may lead to the progressive loss of species of conservation significance or TECs, including ecologically significant habitat, have been assessed with regards to the potential Project impacts. Threatening processes for flora species of conservation significance and TECs which have been confirmed to occur, or are considered to have a high or moderate likelihood of occurrence within the Project impact areas (refer Appendix I3), have been identified from the relevant recovery plan, conservation listing advice and/or threat abatement plan.

The potential Project impacts which have been identified in Sections 9.5.2 to 9.5.5 have been assessed with regard to their potential contribution to the species threatening processes (refer Appendix I3).

Residual impacts on a threatening process have the potential to result where an impact has a high or very high risk rating. Terrestrial and intertidal flora and wetlands for which potential Project impacts are considered to have a residual impact on a threatening process which may lead to the progressive loss of a species or ecologically significant habitat (refer Appendix I3), will be subject a significant residual adverse impact assessment. The significant residual adverse impact assessment is provided in Section 9.5.7.

9.5.7 Significant residual adverse impact assessment

9.5.7.1 Summary of flora values requiring assessment

The analysis presented in Appendix I3 did not identify any MNES or MSES flora values for which potential Project impacts are considered to have a residual impact on a threatening process which may lead to the progressive loss of the species or ecologically significant habitat (refer Appendix I3, Item 1.1 to 1.7). With respect to the nature of the Project activities and the implementation of appropriate mitigation measures, the Project is not anticipated to have a residual impact on flora values that area considered a MNES or MSES flora values. Consequently, a significant residual adverse impact assessment has not been conducted for the Project.

Prescribed REs, as defined under the *Environmental Offsets Regulation 2014*, are areas of regulated vegetation which qualify as a MSES. Potential impacts to Prescribed REs are subject to significant adverse impact assessment under the *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (EHP 2014a). As the Project activities will not involve the direct disturbance of Prescribed REs, a significant residual adverse impact assessment for MSES Prescribed REs has not been conducted for the Project.

9.5.7.2 Summary of wetland values requiring assessment

Wetlands of international importance (i.e. a Ramsar wetland) are an EPBC Act MNES. Potential residual impacts to wetlands of international importance are subject to significant impact assessment in accordance with the *Matters of National Environmental Significance Significant Impact Guidelines, Version 1.1* (DoEE 2013b). There are no Ramsar wetlands situated within, or within close proximity to, the Project impact areas. The Shoalwater and Corio Bay Ramsar wetlands, located approximately 98km to the north of the WB and WBE reclamation areas, is the nearest Ramsar site to the Project impact areas. As there are no Ramsar wetlands situated within close proximity to the Project impact areas, the Project is not considered likely to have an impact on the ecological character of wetlands of international importance and a MNES significant impact assessment for wetland values has not be conducted for the Project.

A wetland is considered a MSES and subject to significant impact assessment in accordance with the *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (EHP 2014a) if the wetland is one of the following:

- A wetland in a wetland protection area as shown on the map of referable wetlands under schedule 12, part 2 of the *Environmental Protection Regulation 2008*
- A wetland of high ecological significance as shown on the Map of referable wetlands under schedule 12, part 2 of the *Environmental Protection Regulation 2008*
- A wetland in a high ecological value waters as identified under the *Environmental Protection (Water) Policy 2009*, schedule 2.

The Project impact areas include HES wetlands. As such, a significant residual adverse impact assessment for MSES wetlands has been conducted for the Project (refer Table 9.19).

This assessment of significant residual adverse impacts considers the significance of potential Project impacts after the implementation of the Project mitigation measures included in Section 9.27.

The MSES significant impact assessment criteria for wetlands and watercourses (EHP 2014a) has been used for the wetland significant residual adverse impact assessment (refer Table 9.19). The significant residual adverse impact assessment concluded that the proposed Project activities will have a significant residual adverse impact on MSES wetlands (HES wetlands).

Table 9.19 Significant residual adverse impact assessment – MSES wetlands (high ecological significance wetlands)

Significant impact assessment criteria and likelihood of the action resulting in a significant residual adverse impact
MSES – Wetlands ■ Areas of the wetland being destroyed or artificially modified
Potentially significant impact MSES Wetlands (HES wetlands) are mapped within the Project impact areas. Areas of HES wetlands will be removed as a result of Project activities. The establishment of the WBE reclamation area will result in the direct disturbance of approximately 48.62ha of mapped HES wetlands. Project activities have the potential to have an indirect adverse impact on HES wetlands which are situated within proximity to the Project impact areas. Approximately 190.49ha of HES wetlands are mapped within a 500m radius of the WBE reclamation area and BUF. The Project may have a potential indirect adverse impact on HES wetlands through impacts such as sedimentation and decreased water quality, changes in hydrodynamic regimes, increases in contaminants and general waste, spread of invasive species and the release of contaminants. The Project will implement mitigation measures provided in the Project EMP and associated management plans to reduce the likelihood and magnitude of potential Project impacts on wetland values. Mitigation measures to minimise potential impacts on wetland values will be included in the Project EMP and Dredging EMP. With the implementation of Project mitigation measures, potential indirect impacts associated with the Project activities are not anticipated to have a significant adverse impact on HES wetlands situated adjacent to the Project impact areas.
MSES – Wetlands ■ A measurable change in water quality of the wetland – for example a change in the level of the physical and/or chemical characteristics of the water, including salinity, pollutants, or nutrients in the wetland or watercourse, to a level that exceeds the water quality guidelines for the waters
Unlikely to have a significant impact Project activities have the potential to result in a measurable temporary change in water quality at HES wetlands. Potential Project impacts which have the potential to impact on the water quality of HES wetlands include the transport of sediment and nutrients during the establishment of the WBE reclamation area and BUF, the dredging turbidity plume generated during dredging activities, leachates and/or runoff from any exposed ASS, hydrocarbon or chemical spills from vehicle, plant or site storage facilities, seepage associated with bund wall and the overtopping of bund walls. Decreased water quality has the potential to have an adverse impact on the ecological character of HES wetlands via impacts, including the smothering of aquatic flora and fauna (i.e. benthic and epibenthic communities), increased turbidity and decreased light penetration which has the potential to impact on the growth and survival of aquatic flora species (e.g. seagrass, macroalgae), increased availability of nutrients resulting in the growth of algal blooms which can reduce levels of dissolved oxygen (i.e. resulting in direct impacts on the survival of aquatic flora and fauna), impacts to the health of marine fauna due to toxic elements (e.g. impacts on the food chain as a result of the effects of bioaccumulation) and tissue damage or irritation in some aquatic fauna species. The turbidity plume and zone of influence model indicate that zones of high impact are expected to occur within and adjacent to the channel duplication dredged channels. Impacts decrease away from these areas with the low impacts zones extending to intertidal areas in some locations. The Project will implement mitigation measures provided in the Project EMP (refer Appendix Q2) and associated management plans to reduce the likelihood and magnitude of potential Project impacts which have the potential to reduce water quality in HES wetlands. Mitigation measures to minimise potential Project impacts on water quality values will be included in the Project EMP (refer Appendix Q2) and Dredging EMP (refer Appendix Q1). With the implementation of Project mitigation measures, the Project activities are not anticipated to result in measurable changes in water quality which would exceed water quality objectives.

Significant impact assessment criteria and likelihood of the action resulting in a significant residual adverse impact

MSES – Wetlands

- The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected

Potentially significant impact

The direct disturbance of HES wetlands mapped within the WBE reclamation area has the potential to impact on the habitat and lifecycle of native wetland species. The permanent loss of HES wetlands mapped at the WBE reclamation area has the potential to result in the loss of habitat for native species, including:

- Foraging habitat for migratory and resident shorebird species and waders. Note that an important roost site is situated in proximity to the WBE reclamation area at Friend Point
- Potential habitat for native intertidal fauna species, including species of conservation significance
- Coastal saltmarsh assemblages
- Seagrass meadows and macroalgae
- Benthic habitat and associated benthic flora and fauna communities
- Habitat for fish and marine reptiles.

The Project Vegetation Management Plan and Fauna Management Plan include a number of mitigation measures to minimise any potential adverse impact on native wetland flora and fauna species (refer Section 9.27). Following the implementation of management measures, Project activities at the WBE reclamation area are anticipated to have a potential residual significant impact on resident and migratory shorebirds due to the direct loss of foraging habitat associated with the HES wetland. The HES wetland situated within the WBE reclamation area is considered likely to provide foraging habitat for resident and migratory shorebirds which roost at Friend Point. The Friend Point roost site has been assessed as being of national, state and regional importance, and ranked as the third most important roosting area in Port Curtis (after South End Claypan and Facing Island Claypan) and the most important in the Upper Gladstone Port (QGC 2013).

Project activities have the potential to have an indirect impact on native flora and fauna species associated with HES wetlands situated adjacent to the Project impact areas. Indirect Project impacts which have the potential to affect the habitat or lifecycle of wetland flora and fauna species include the introduction and/or spread of invasive species, dust deposition and sedimentation, decreased water quality, and the generation of noise. Indirect Project impacts on native wetland flora and fauna species are considered to be effectively managed through the implementation of mitigation measures contained within the Project EMP and Dredging EMP.

MSES – Wetlands

- A substantial and measurable change in the hydrological regime or recharge zones of the wetland, e.g. a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland

Unlikely to have a significant impact

The hydrodynamic modelling and coastal processes impact assessment (refer Appendix G) indicate that the Project will have no effect on water levels within the region. Construction of the WBE reclamation area will include a channel between the northern and southern reclamation areas to allow for tidal flushing (approximately 100m in width). The models indicate that there is expected to be a reduction in the velocity magnitudes to the north of the WBE reclamation area (due to reduced tidal prism), however, the tidal flows to intertidal areas will be maintained. It is therefore expected that the Project activities will not result in changes to the levels of inundation of coastal habitats.

MSES – Wetlands

- An invasive species that is harmful to the environmental values of the wetland being established (or an existing invasive species being spread) in the wetland

Unlikely to have a significant impact

Project activities have the potential to introduce and/or spread invasive species. Project activities which have the potential to introduce and/or spread invasive species include the movement of vehicles and plant during site establishment works, dredging activities and the stabilisation and maintenance activities for the final Project landform.

Significant impact assessment criteria and likelihood of the action resulting in a significant residual adverse impact
The introduction and/or spread of invasive species in HES wetland areas has the potential to have a significant impact on the ecological characteristics of a wetland through potential impacts, including habitat degradation and modification, alterations to the behaviour of native fauna species, introduction of disease that may adversely impact native flora and/or fauna species, and predation and competition pressures on native flora and fauna species. The likelihood of the Project introducing or spreading invasive species across the local landscape and impacting HES wetlands is considered to be reduced and effectively managed via the implementation of mitigation measures included within the Project EMP (refer Appendix Q2) and Dredging EMP (refer Appendix Q1). The Project is not considered to result in invasive species that are harmful to the environmental values of HES wetlands being established in wetland areas.

9.5.8 Assessment summary

9.5.8.1 Flora values

The Project impact areas contain 'flora values', incorporating native flora species and vegetation communities, including species or communities listed as having conservation significance under the NC Act and/or EPBC Act. Flora values include Coastal Saltmarsh TEC (listed as Vulnerable under the provisions of the EPBC Act), mangrove communities (excluding seagrass meadows) and terrestrial vegetation communities (including flora species of conservation significance).

The Coastal Saltmarsh TEC was confirmed during Project EIS field investigations as being analogous with RE 12.1.2 and within areas mapped as RE 11.1.4. No Coastal Saltmarsh TEC was observed within the WBE reclamation area and BUF during Project EIS field investigations; however areas of Coastal Saltmarsh TEC occur in areas adjacent to the WBE reclamation area and the haul route between the WB and WBE reclamation areas and the Targinnie/Yarwun quarry. Areas below the daily high tide level directly adjacent to the WB and WBE reclamation areas were characterised by large expanses of exposed mudflats supporting scattered saltmarsh communities that were analogous with RE 12.1.3 and RE 11.1.2.

No mangrove communities were observed within the WBE reclamation area and BUF during Project EIS field investigations. Adjacent to the WB and WBE reclamation areas, the mangrove communities were analogous with RE 12.1.3, with mangrove regeneration evident and appeared to be of good health with minimal signs of insect or disease damage notable. Some areas of minor disturbance were noted during the Project EIS field investigations and were associated with areas that had been previously cleared. The creation of raised access tracks have resulted in the creation of bunds which have altered the hydrology in areas and likely attributed to mangrove dieback.

The WBE reclamation area is located within a marine zone and does not extend into areas of terrestrial vegetation.

Areas located approximately 200m west of the WBE reclamation area and/or adjacent to the bund wall material haul route to the WBE reclamation area and BUF contain potential habitat for several flora species of conservation significance, listed under the provisions of the EPBC Act and/or NC Act. However, during the Project EIS field investigations, no flora species of conservation significance were identified within the WBE reclamation area.

The establishment of the WBE reclamation area and BUF will not result in the permanent loss of Coastal Saltmarsh TEC, mangrove communities and terrestrial vegetation communities. Proposed works associated with the dredging and barging activities, the removal and installation of navigational aids, and stabilisation and maintenance works on the final Project landform will not result in the permanent loss of flora values. As the Project activities will not involve the direct disturbance of Prescribed REs, no significant residual adverse impacts are expected to occur as a result of the Project activities.

Potential indirect impacts from Project activities may occur adjacent to the WB and WBE reclamation areas. The introduction and spread of weed and/or pest species, as a result of material transport associated with the bund wall construction, can have negative impacts on native wildlife, including increased competition for resources, physical harm and decreased habitat value. Flora values also have the potential to be indirectly impacted by erosion, sedimentation and decreased water quality in adjacent TEC areas as a result of sediment transport from disturbed areas within the WB and WBE reclamation areas as well as changes in marine water velocities, and minor erosion and siltation of intertidal environments.

The Project will implement mitigation measures provided in the Project EMP (refer Appendix Q2), Dredging EMP (refer Appendix Q1) and associated management plans to reduce the likelihood and magnitude of potential Project impacts on flora values.

9.5.8.2 Wetland values

The Port Curtis DIWA wetland includes all tidal areas in the vicinity of Gladstone, from the Boyne River Estuary in the south to Friend Point in the north, and to the seaward side of Facing Island in the east; with a total area of 31,232ha (Environment Australia 2001). This wetland is listed on the DIWA as a nationally important wetland due to its important ecological and hydrological role within the Port of Gladstone. The Port Curtis wetland supports a range of flora and fauna species that are dependent on wetlands for all, or part, of their life cycle, it contains important habitat for species of conservation significance, and it is of historical and cultural significance (Environment Australia 2001). Potential Project impacts are assessed on the integrity and condition of the Port Curtis DIWA wetland from an ecosystem-wide scale.

There are HES wetlands mapped within the Project impact areas, including 48.62ha mapped within the WBE reclamation area. These wetlands are protected under the provisions of the Planning Act with respect to maintaining the ecological values and ecosystem function of important wetlands.

The WBE reclamation area is situated in estuarine waters, which are exposed mudflats at low tide. Construction of the WBE southern reclamation area will result in the permanent loss of 111.12ha of estuarine wetlands and 47.47ha of HES wetlands. Construction of the northern reclamation area will result in the permanent loss of 164.98ha of estuarine wetlands and 1.16ha of HES wetlands. Overall, construction of the BUF and WBE reclamation area will result in the permanent loss of 278.20ha, or 0.89% of the mapped Port Curtis DIWA wetland area and the permanent loss of 48.62ha, or 0.16% of the mapped Queensland HES wetlands.

The proposed areas to be dredged are partially situated within the Port Curtis DIWA wetland, however are not located within HES wetlands. Approximately 50.04ha of the area to be dredged is located within the Port Curtis DIWA wetland, which equates to 0.16% of the total mapped Port Curtis DIWA wetland extent. The complete areas to be dredged (i.e. 381.90ha) is mapped as an estuarine wetland on the Queensland wetlands data map (DES 2019b). The proposed barge access channel is wholly located within the Port Curtis DIWA wetland, totalling 21.48ha in area however, these areas to be dredged are not located within HES wetlands.

Dredging activities have the potential to impact on habitat for marine fauna species, including species of conservation significance, seagrass meadows and macroalgae, benthic habitat and associated flora and fauna communities as well as fish and marine reptile habitats. Dredging activities are expected to have a temporary impact on water quality in Port Curtis wetlands, as a result of the dredging plumes and through accidental contaminant release, with the potential to impact on a range of marine flora and fauna species. These potential impacts will be mitigated through the implementation of the Dredging EMP (refer Appendix Q1).

The removal of existing navigational aids and the installation of relocated and new navigational aids will result in the direct loss of small areas of benthic habitat from within the Port Curtis DIWA wetland. Ten navigational aids are proposed within the Port Curtis DIWA wetland, directly adjacent to the duplicated channels, and will result in the permanent loss of contained areas of benthic communities. Due to the contained extent of this loss, it is unlikely to impact on the values of the Port Curtis DIWA wetlands, or overall ecological function.

Potential indirect impacts may also occur in the Port Curtis DIWA wetland as a result of Project activities relating to WB and WBE reclamation areas. Introduction of weed and/or pest species as well as alteration in the behaviour of native species in the medium term are potential indirect impacts caused through truck movements, material transport and vegetation clearing causing edge effects as a result of Project activities.

The Project will implement mitigation measures provided in the Project EMP (refer Appendix Q2), Dredging EMP (refer Appendix Q1) and associated management plans to reduce the likelihood and magnitude of potential Project impacts on wetland values.

It is likely that the Project will have a significant residual adverse impact on HES wetlands due to the direct and permanent loss of HES wetlands associated with the WBE reclamation area. This will be mitigated through the provision of the Project offset strategy.

9.6 Intertidal and terrestrial fauna – existing environment

9.6.1 Background

As the WB and WBE reclamation areas are situated directly adjacent to the coastline within the Port of Gladstone, the potential direct and indirect impact areas encompass a variety of fauna habitats, including both the terrestrial environment and the intertidal zone (transitional habitat between the marine and terrestrial environments). Furthermore, due to the unique and complex geological and geomorphological processes that have shaped the coastline within the Port, there is a diverse range of intertidal and terrestrial habitats along the coast within the Port Curtis region.

The intertidal habitat and areas which are tidally influenced provide distinctly different habitats, in comparison to freshwater areas, and are host to a range of species that specialise in utilising resources within the intertidal zone (e.g. shorebirds and migratory birds). As the intertidal zone is a transitional ecosystem between marine and terrestrial habitats, it also provides habitat for species common to both marine and terrestrial habitats. The intertidal environments within the Project impact areas are comprised of a diverse range of vegetation communities, including mangroves, mudflats and saltmarshes, as described in Section 9.4.

Terrestrial habitats are situated in the Project potential indirect impact areas and comprise Eucalyptus woodlands on alluvial plains with Melaleuca species in the understorey. These areas are discussed in detail in Section 9.4.

The field assessment traversed intertidal and terrestrial habitats present within the Project impact areas. The location of the survey sites is shown in Figure 9.12.

The methodology implemented to describe intertidal and terrestrial fauna values is provided in Appendix I1 (Section 13.2).