

Priority port master planning

Evidence base documentation

Master planning evidence base assessment

Priority Port of Gladstone

Queensland | Australia | February 2016

The Department of State Development

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Evidence Base Report for the

Proposed Gladstone Port Master Planned Area

PREPARED FOR QUEENSLAND DEPARTMENT OF STATE DEVELOPMENT



Evidence Base Report for the Proposed Gladstone Port Master Planned Area

Final Report

Client: Queensland Department of State Development

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List of acronyms and abbreviations

Acronym	Meaning
ABS	Australian Bureau of Statistics
ACH Act	Aboriginal Cultural Heritage Act 2003
AHC Act	Australian Heritage Council Act 2003
AHD	Australian Heritage Database
AMSA	Australian Maritime Safety Authority
APLNG	Australia Pacific Liquefied Natural Gas
ATSIHPA	<i>Aboriginal and Torres Strait Islander Heritage Protection Act</i>
BSL	Boyne Smelter Limited
BPCT	Barnet Point Coal Terminal
CICSDA	The Callide Infrastructure Corridor State Development Area
CHL	Commonwealth Heritage List
COAG	Council of Australian Governments
CSG	Coal Seam Gas
DATSIP	Department of Aboriginal and Torres Strait Islander Partnerships
DEO	Desired Environmental Outcome
DEEDI	Former Department of Employment, Economic Development and Innovation
DEHP	Department of Environment and Heritage Protection
DIDO	Drive in, drive out
DSDIP	Department of State Development, Infrastructure and Planning
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EIS	Environmental Impact Statement
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999

Acronym	Meaning
ERP	Estimated Resident Population
FID	Final Investment Decision
FIFO	Fly in, fly out
FTE	Full-time equivalent
GBRMPA	Great Barrier Reef Marine Park Authority
GBRNHP	Great Barrier Reef National Heritage Place
GBRWHA	Great Barrier Reef World Heritage Area
GGCCDP	Port of Gladstone Gatcombe and Golding Cutting Channel Duplication Project
GLNG	Gladstone Liquefied Natural Gas
GPC	Gladstone Ports Corporation
GPNR	Gladstone Pacific Nickel Refinery
GREAN	Gladstone Region Environmental Advisory Network
GSDA	Gladstone State Development Area
GSMF	Gladstone Steel Making Facility
ICOMOS	International Council on Monuments and Sites
MLPA	Million litres per annum
MSQ	Maritime Safety Queensland
LGA	Local Government Area
LNG	Liquefied Natural Gas
MEDQ	Minister for Economic Development Queensland
MNES	Matters of National Environmental Significance
MPA	Master Planned Area
MTPA	Million tonnes per annum
NHL	National Heritage List

Acronym	Meaning
MSQ	Maritime Safety Queensland
NTQ	National Trust of Queensland
OUV	Outstanding Universal Value
PCCC	Port Curtis Coral Coast
PDA	Priority Development Area
PPDA	Priority Port Development Area
QAL	Queensland Alumina Limited
QCLNG	Queensland Curtis Liquefied Natural Gas
QGSO	Queensland Government Statistician's Office
QH Act	Queensland Heritage Act 1992
QHR	Queensland Heritage Register
RGTCT	RG Tanna Coal Terminal
RNE	Register of the National Estate
SEIFA	Socio-Economic Indexes for Areas
SIA	Social Impact Assessment
SIMP	Social Impact Management Plan
SISP	Social Infrastructure and Strategic Plan
SGICSDA	Stanwell to Gladstone Infrastructure Corridor State Development Area
SDPWOA	State Development and Public Works Organisation Act 1971
SP Act	Sustainable Planning Act 2009
SP Reg	Sustainable Planning Regulation 2009
TUMRA	Traditional Use of Marine Resources Agreement
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WAV	Worker Accommodation Village

Acronym	Meaning
YCT	Yarwun Coal Export Terminal

1 | Introduction



1.0 Introduction

Queensland ports play a critical role in the growth of the Queensland economy.

There are 11 trading ports in Queensland operating adjacent to the Great Barrier Reef World Heritage Area (GBRWHA), located at Gladstone, Rockhampton (Port Alma), Hay Point, Mackay, Abbot Point, Townsville, Lucinda, Mourilyan, Cairns, Cape Flattery and Quintell Beach. Figure 1 provides an overview of the Port of Gladstone's regional context and spatially illustrates its proximity to Port Alma and the Port of Bundaberg.

The Great Barrier Reef is important to all Queenslanders and the Queensland Government is committed to protecting this natural wonder for future generations.

The state government is working to foster economic development and create jobs while protecting the Great Barrier Reef.

The Queensland Government is implementing actions of the Reef 2050 Long Term Sustainability Plan (Reef 2050), the most comprehensive plan ever developed to secure the health and resilience of the Great Barrier Reef for generations to come.

In accordance with the Reef 2050 the state government will work with stakeholders to implement a range of initiatives to ensure that port activity adjacent to the Great Barrier Reef is better managed.

On 3 June 2015 the Queensland Government introduced the Sustainable Ports Development Bill 2015 to implement key port-related actions of Reef 2050. The Bill was passed by the Queensland Parliament on 12 November 2015 and assented to on 20 November 2015 as the *Sustainable Ports Development Act 2015* (SPD Act).

Consistent with Reef 2050, the SPD Act mandates the development of master plans for the priority ports of Gladstone, Abbot Point, Townsville and Hay Point/Mackay to optimise use of existing infrastructure and address operational, economic, environmental and community relationships, as well as supply chains and surrounding land uses.

The master planning process for the Port of Gladstone commenced in June 2015, with the release of a proposed master planned area boundary for public consultation. This boundary was refined based on the feedback received during this process, and will continue to be reviewed throughout the master planning process. The boundary will not be finalised until the Port of Gladstone master plan is made, and the boundary is set by regulation.

This report provides the evidence base that informs the Port of Gladstone master plan and port overlay. It will provide an overview of:

- the history and current function of the port
- the regulatory and policy context within which the port operates
- existing land uses and activities within the proposed Port of Gladstone master planned area
- environmental values
- social and cultural heritage values
- economic factors affecting the future development of the proposed master planned area.

The report draws on a range of sources to provide a consolidated overview of the primary issues that influence the development and operation of the port, the proposed Port of Gladstone master planned area, and port related activities. This includes cumulative impacts associated with multiple projects occurring within the Gladstone region. Data sources include:

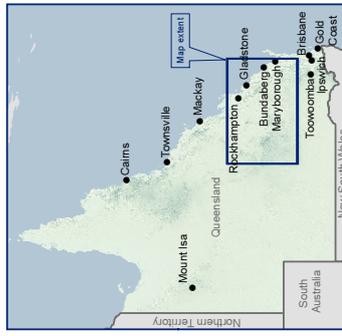
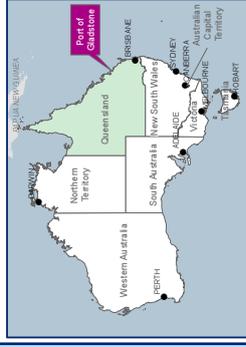
- background reports and studies prepared by the Queensland Government, the Australian Government and international agencies
- Environmental Impact Statements and supporting reports prepared for coordinated projects
- background reports prepared on behalf of Gladstone Regional Council
- background reports prepared on behalf of Gladstone Ports Corporation
- relevant legislation and guidelines.

Figure 1

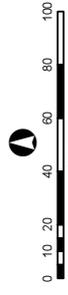
Regional context

Legend

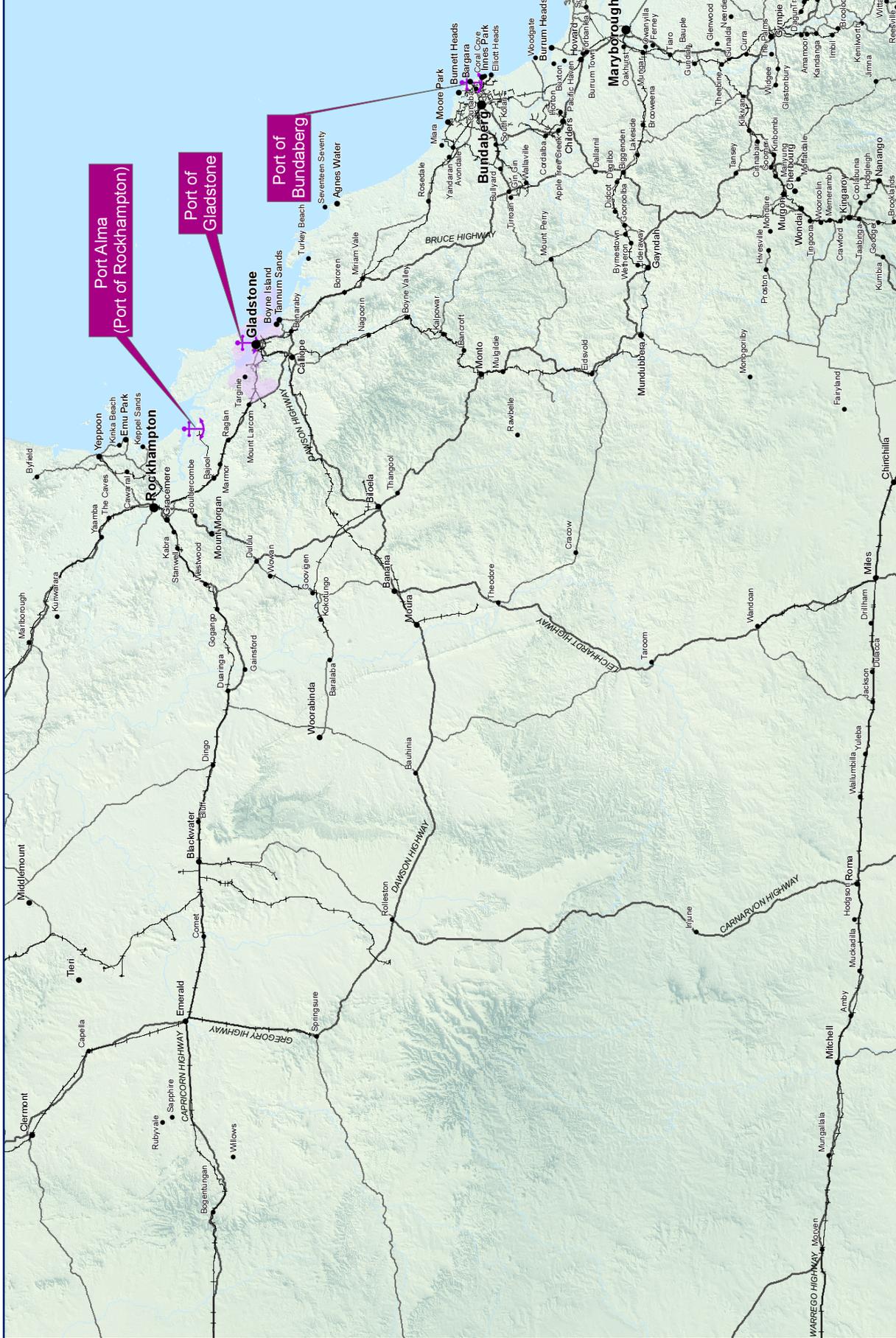
- Cities
- Urban centres
- Local centres
- Major rivers
- Railway
- Highways
- Major roads
- Proposed Gladstone port master planned area boundary



10 November 2015



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Datum: GDA 1994
Units: Degree



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2 | Location



2.0 Location

The Port of Gladstone is located 525 kilometres north of Brisbane. The port is just south of the Tropic of Capricorn at Latitude 23°49.61'S, Longitude 151°34.6'E, immediately adjacent to the Gladstone CBD, and within the GBRWHA. The port also borders the boundaries of several Gladstone State Development Area (GSDA) precincts.

The proposed Gladstone port master planned area encompasses an area of approximately 75,000 hectares, covering both land and marine components (refer to Figure 2). The proposed boundary for the Gladstone port master planned area includes:

- the Gladstone State Development Area
- marine areas within Port of Gladstone port limits that are not commonwealth or state marine parks
- strategic port land
- small areas regulated by the local government planning scheme.

The proposed boundary has been identified by the Queensland Government in consultation with Gladstone Ports Corporation and other key stakeholders. As part of early steps of the port master planning process, public consultation was conducted on the proposed boundary for the Gladstone port master planned area from 9 June 2015 to 20 July 2015. Submissions received during the public consultation period informed a review of the proposed boundary for the Gladstone port master planned area.

The Port of Gladstone is strategically located to capture the economic growth associated with the rapid expansion of the resource sector, including the coal seam gas (CSG) and coal sectors. Access to both heavy rail and pipeline supply chain infrastructure direct to the port is key to the value realisation of those commodities.

There is a significant opportunity for the Port of Gladstone to continue to develop as a logistical hub for both the import and export of a wide variety of commodities to/from the Central Queensland region and beyond.

The port has national significance as one of the few, naturally sheltered and deep water ports on the east coast of Australia. This provides efficient shipping outcomes through a well serviced import and export gateway with access to international markets.

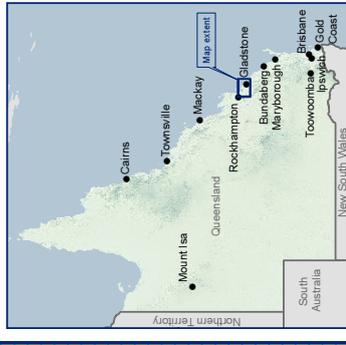
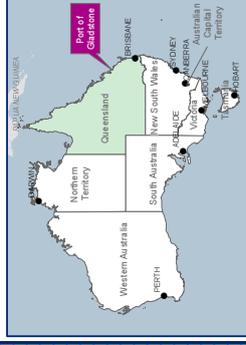
The port is within a 10 to 12 day sailing time to the Asia Pacific region. This is significant as China, Japan, South Korea and India represent 82 per cent of exports from the port.¹

¹ Gladstone Ports Corporation 2014, *Annual Report 2013/14*,
http://www.gpcl.com.au/Portals/0/pdf/AnnualReports/GPC_Annual_Report_2013-14.pdf.

Figure 2

Location context

- Legend**
- Cities
 - Urban centres
 - Local centres
 - Major rivers
 - Railway
 - Highways
 - Port limits
 - Proposed Gladstone port master planned area boundary
 - Great Barrier Reef Marine Park



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Datum: GDA 1984
Units: Degree



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3 | Port History



3.0 Port history

The first major wharf at Gladstone was built in 1885. Exports through the port initially included meat, butter, wool, sugar, horses and cattle. The current major cargo, coal, was first handled in 1925 at Auckland Point.

During the early 1950s the port transformed from a declining primary industry export base to the multi-million tonne export centre it is today. In 1954 the port pioneered bulk coal handling in Queensland by developing and operating coal handling facilities.

Facilities to service the growing requirements of industrial processing activities at Gladstone were constructed from the late 1960s. The South Trees Wharves were completed in 1967 to provide for Queensland Alumina Limited (QAL), the Barney Point Coal Terminal facility was completed in 1968, and a grain export terminal was opened in 1971.

Traffic handled at the port increased from 206,000 tonnes in 1960 to more than 10 million tonnes in 1970.

The first stage of the RG Tanna Coal Terminal was completed in 1980 and the first shipment of coking coal was exported to Japan that year. The RG Tanna Coal Terminal is now the fifth largest coal export port in the world.

Berths at Fisherman's Landing were established to provide for the cement production facility (now Cement Australia) with construction commencing in 1980. Construction was completed in 1981, the same year that the Great Barrier Reef was inscribed on the United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage List.

The Boyne Wharf was established to provide for an aluminium smelter that was opened in 1982. Construction for the Boyne Wharf commenced prior to the inscription of the Great Barrier Reef on the UNESCO World Heritage List.

The Gladstone State Development Area was declared in 1993 following the completion of a Gladstone Industrial Land Study which was undertaken by the Queensland Government to identify appropriate locations to accommodate future industrial development for a period of at least 30 years.

In the late 1990s, additional berths were also established at Fisherman's Landing to provide for the alumina refinery (now Rio Tinto) and a multi-user bulk liquids berth.

In 1994 the Port of Gladstone became a government owned corporation, and in 2004 formed part of the Central Queensland Ports Authority. In 2008, the Central Queensland Ports Authority became the Gladstone Ports Corporation.

In recent years, the port has continued to expand, with the construction of liquefied natural gas (LNG) plants on Curtis Island, and the first stage of the Wiggins Island Coal Terminal (WICT), which will provide 27 million tonnes per annum (mtpa) of new export capacity from the Port of Gladstone. The terminal can expand to a total of approximately 84 mtpa of long-term export capacity when fully developed.

In addition to the Port of Gladstone, Gladstone Ports Corporation also administers the Ports of Rockhampton and Bundaberg. These ports are not priority ports and are not part of the Port of Gladstone master planned area. They are not within the scope of this report, the Port of Gladstone master plan, or the port overlay.

4 | Current Port Function



4.0 Current port function

The Port of Gladstone is Queensland's largest multi-cargo port and the fifth largest coal export terminal in the world (by throughput). The Port of Gladstone is a major centre for the import and export of products for the manufacturing, mining and processing industries. Handling more than 1800 vessels annually, it is one of the busiest ports in Australia and plays a vital role in the local, state and national economies.

The port's major functions are to facilitate:

- the export of Queensland resources
- the import of raw material
- the export of finished products from major industry established in Gladstone.

The specific functions of the port authority are defined under the *Transport Infrastructure Act 1994* as outlined within Section 5.3.2 of this report.

Over 30 products are currently handled through the Port of Gladstone and shipped to more than 30 countries. In 2013–14, total trade through Gladstone was 97.66 million tonnes².

By far the largest traded commodity is coal, representing 71 per cent of total cargo throughput in 2013–14, followed by bauxite, alumina, caustic soda, cement products and petroleum products:

- coal – 69,622,499 tonnes (export)
- bauxite – 16,610,286 (import)
- alumina – 5,082,561 tonnes (export)
- caustic soda – 1,854,233 tonnes (import)
- cement/clinker – 1,238,573 tonnes (export)
- petroleum products – 1,185,141 tonnes (import).

All other products handled in 2013–14 were in volumes of less than 500,000 tonnes.

However, as Liquid Natural Gas (LNG) export facilities come online it is expected that LNG exports will also become a significant commodity. Container and break bulk goods, while low compared to the tonnage of other capital city ports, are critical to the operations of industry and development throughout Central Queensland.

² All figures from Department of Transport and Main Roads, (DTMR), February 2015, *Trade Statistics for Queensland Ports, For the 5 years ending 30 June 2014*

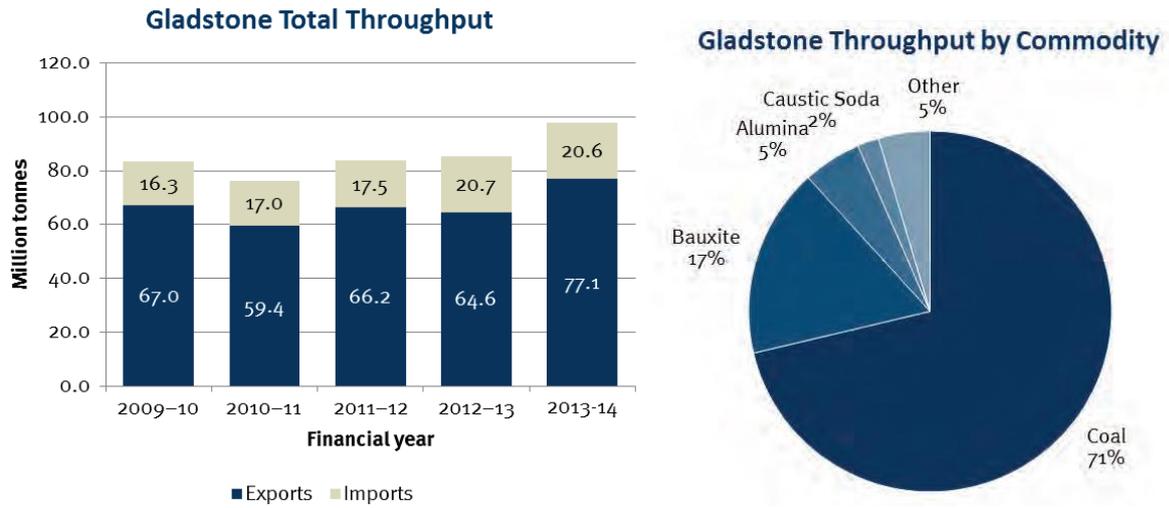


Figure 3 Port of Gladstone total throughput and throughput by commodity

5 | Regulatory and Policy Context



5.0 Regulatory and policy context

5.1 International conventions

A number of international Conventions are relevant to the management of the proposed Port of Gladstone master planned area and surrounding areas of high economic, environmental and cultural significance such as the Great Barrier Reef.

5.1.1 Convention for the protection of the World Cultural and Natural Heritage, 1972 (the World Heritage Convention)

The World Heritage Convention administered by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) is a pillar of the international environmental legal system. It is concerned with the identification, protection and preservation of cultural and natural heritage considered to be of outstanding universal value.

The Convention establishes a list of properties that have outstanding universal value, called the World Heritage List. These properties are part of the cultural and natural heritage of States that are Parties to the Convention. Located within and adjacent to the proposed Port of Gladstone master planned area, the GBRWHA is such a property on the World Heritage List.

5.1.2 Convention on Biological Diversity, 1992 (the Biodiversity Convention)

The Convention on Biological Diversity, 1992 imposes a general obligation on Australia to conserve biodiversity in both terrestrial and marine ecosystems. Article 8 is of particular relevance in the context of the Port of Gladstone in terms of Australia's obligations to 'promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas'.

5.1.3 International Convention for the Prevention of Pollution from Ships, 1973 (the MARPOL 73/78 Convention)

The MARPOL Convention was adopted in 1973 and is administered by the International Maritime Organisation (IMO). The convention is the primary international tool for regulating pollution of marine environments by vessels resulting from accidents or operational waste.

Regulations to prevent pollution from ships in Australian waters are based on the MARPOL Convention and are implemented by both the Australian and Queensland governments. The Australian Maritime Safety Authority (AMSA) is responsible for the application and enforcement of MARPOL in areas of Commonwealth jurisdiction (i.e. to the limit of the 200 nautical mile exclusive economic zone). Maritime Safety Queensland (MSQ) is responsible for enforcement activity in respect of illegal discharges from smaller vessels in the Great Barrier Reef Marine Park.

The Legislation giving MARPOL effect in Australia is the *Pollution Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (Cth) and the *Navigation Act 1912* (Cth), and in Queensland, the *Transport Operations (Marine Pollution) Act 1995*.

5.1.4 The London Protocol

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972, now known as the London Protocol is one of the first global conventions to protect the marine environment from human activities and has been in force since 1975. The aims of the London Protocol are to protect and preserve the marine environment from all sources of pollution and to prevent, reduce and eliminate pollution by controlling the dumping of wastes and other materials at sea. Internationally, guidelines have been developed under the London Protocol and Convention, including guidelines for the implementation of the London Protocol at the national level, specific guidelines for assessment of dredged material, specific guidelines for other waste that may be disposed of at sea, and guidance on action lists and action levels to assist regulators. In Australia, the London Protocol is administered through the *Environment Protection (Sea Dumping) Act 1981* (Cth).

5.2 Australian Government legislation & policy

5.2.1 Reef 2050 Long Term Sustainability Plan (Reef 2050)

The Australian and Queensland Governments released Reef 2050 in March 2015. Reef 2050 builds on the findings of the Great Barrier Reef Strategic Assessment and will guide the sustainable management of the Great Barrier Reef for the next 35 years.

Reef 2050 incorporates the following four elements:

- A vision for the GBRWHA that reflects the diversity of use and interest in the property, protects the outstanding universal value of the reef, sustains its integrity and integrates the three pillars of sustainability (environmental, social and economic).
- An outcomes framework that includes desired outcomes and targets for protection of the GBRWHA's outstanding universal value.
- Adaptive management actions to deliver outcomes and targets (primarily drawn from the two strategic assessments and with a focus on critical areas of new work).
- Integrated monitoring and reporting programs to measure the success of the Plan.

Reef 2050 commits to limiting port-related capital dredging in the GBRWHA to the ports of Abbot Point, Gladstone, Hay Point/Mackay, and Townsville. Additionally, a key action of Reef 2050 is to mandate the beneficial reuse of port-related capital dredge spoil, such as land reclamation in port development areas, or disposal on land where it is environmentally safe to do so (Action WQA19).

Reef 2050 also requires that port master planning be undertaken for the priority ports of Gladstone, Hay Point/Mackay, Abbot Point and Townsville that optimises infrastructure and considers operational, economic, environmental and social relationships as well as supply chains and surrounding land uses.

5.2.2 *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*

The EPBC Act is the Australian Government's central environmental legislation. The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the

EPBC Act as matters of national environmental significance (MNES). The Great Barrier Reef Marine Park is listed as a particular MNES.

The EPBC Act is triggered when a development proposal has the potential to have a significant impact on MNES. The provisions of the EPBC Act transcend state, regional and local planning instruments. If a development is likely to have a significant impact on MNES, it triggers referral to the Commonwealth Minister for assessment as a Controlled Action.

5.2.3 Great Barrier Reef Marine Park Act 1975 (GBRMP Act)

The GBRMP Act is the primary legislation relating to the protection of the Great Barrier Reef Marine Park and is administered by the Great Barrier Reef Marine Park Authority (GBRMPA). The GBRMP Act provides a framework for the management and protection of the Great Barrier Reef Marine Park and prohibits particular activities including mining exploration and extraction within the park. A key aspect of the GBRMP Act is the designation of shipping routes and compulsory pilotage areas for large vessels navigating through the Great Barrier Reef Marine Park into ports, as shown in Figure 4.

An important function of the GBRMPA in administering the Act is the provision of a framework for planning and management of the Marine Park, including through zoning plans, plans of management and a system of permissions. The Act outlines the requirements for permit and management plans for port development and provides an investigation regime, including the appointment of inspectors and powers of investigation for those inspectors. It also provides mechanisms for enforcement including criminal enforcement action, civil penalties, administration action, infringement notices and emergency powers³.

³ Great Barrier Reef Marine Park Authority 2015, Legislation, <http://www.gbrmpa.gov.au/about-us/legislation-regulations-and-policies/legislation>



Figure 4 Designated shipping routes within the Great Barrier Reef Marine Park

5.2.4 Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (ATSIHP Act)

The purpose of the ATSIHP Act is the preservation and protection from injury or desecration of areas and objects that are of particular significance to Aboriginal and Torres Strait Islander people in accordance with their traditions in Australia and in Australian waters. The ATSIHP Act allows the Environment Minister, on the application of an Aboriginal person or group of persons, to make a declaration to protect an area, object or class of objects from a threat of injury or desecration.

5.2.5 The Burra Charter

The Burra Charter adopted by the Australia International Council on Monuments and Sites in 1979, is a set of principles that provide a best practice standard for managing and conserving cultural heritage places in Australia. The Charter was initially designed for the conservation and management of historic heritage. However, after the addition of further guidelines that defined cultural significance and conservation policy, use of the charter was extended to include Indigenous and non-Indigenous places of cultural significance.

Under the Charter 'conservation' is defined as the process of looking after a place so as to retain its cultural significance'. A 'place' is considered significant if it possesses aesthetic historic, scientific or social value for past, present or future generations. All four stated values are reflected in the criteria used to determine the cultural heritage significance under the *Queensland Heritage Act 2003*. The Charter is periodically updated to reflect developing understanding of the theory and practice relating to cultural heritage management and conservation.

5.2.6 Native Title Act 1993

Under the *Native Title Act 1993*, the Federal Court of Australia is responsible for the management and determination of all application relating to native title in Australia. The *Native Title Act 1993* sets out the role of the Court in native title matters and establishes a framework for the protection and recognition of native title. The Act also outlines procedures which determine where native title exists, how future activity impacting upon native title may be undertaken and to provide compensation where native title is impaired or extinguished.

5.2.7 Historic Shipwrecks Act 1976 (Historic Shipwrecks Act)

The Historic Shipwrecks Act administered by the Department of Environment protects all shipwrecks and associated relics that are at least 75 years old, regardless of whether their physical location is known. However, more recent shipwrecks may be declared as historic under the Historic Shipwrecks Act by the Minister for the Environment. The Historic Shipwrecks Act aims to ensure that historic shipwrecks are protected for their heritage values and maintained for recreational and educational purposes. It also regulates activities that may result in the damage, interference, removal or destruction of an historic shipwreck or associated relics. The Historic Shipwrecks Act also provides for protected zones (which can cover up to 200 hectares) to be declared in order to protect historic shipwrecks and relics which are of special significance or sensitivity or at risk of interference. Permits are required to enter protected zones. Currently in Queensland there are 10 shipwrecks located in protected zones.

5.2.8 Environment Protection (Sea Dumping) Act 1981

Dumping of waste or incineration at sea of radioactive material, wastes and other material from any vessel, aircraft or platform in Australian waters is prohibited under this Act, unless a permit has been issued. Permits are most commonly issued for dredging operations and the creation of artificial reefs. Permits have also been issued for dumping of vessels, platforms or other man-made structures and for burials at sea. This Act also fulfils Australia's international obligations under the London Protocol (to prevent marine pollution by controlling dumping of wastes and other matter. The act was made pursuant to the London Convention and applies

to all vessels, aircraft and platforms in Australian waters and Australian vessels, aircraft and platforms in international waters. The Act is administered by the Department of Environment and the GBRMPA (where sea dumping takes place within the Great Barrier Reef Marine Park).

5.2.9 Sea Installations Act 1987

The construction, operation and decommissioning of offshore installations in Australian waters outside State coastal waters (from the 3 nautical mile State limit to the outermost limits of Australian waters) is regulated under this Act. It applies to any human-made structure attached to the seabed other than those used for exploring or exploiting natural mineral resources (including petroleum).

5.2.10 Protection of the Sea (Prevention of Pollution from Ships) Act 1983

The discharge into the ocean of oil, noxious substances, packaged harmful substances, sewage and garbage from ships (including aircraft) is prohibited by this Act. It implements the MARPOL Convention and applies to all vessels within Australian waters but allows State and territory legislation to be accredited for coastal waters. This Act is administered by AMSA.

5.2.11 National Ports Strategy (NPS)

The NPS was published by Infrastructure Australia in 2011 and endorsed by the Council of Australian Governments (COAG). The NPS sees “ports and related land-side logistics chains [as being] critical to the competitiveness of Australian businesses, which rely on them to deliver business imports and to take exports to the global market”. The overarching purpose of the NPS is “to drive the development of efficient, sustainable ports and related freight logistics that together support the needs of a growing Australian community and economy and the quality of life aspirations of the Australian people’.

The NPS provides a nationally coordinated approach to the future development and planning of Australia’s port and freight infrastructure. It provides a national action plan and a number of recommended actions, which include:

- governments to recognise the central role of ports and related freight supply chains to trade and thus to Australia’s future;
- state governments to prepare State plans that recognise key maritime spaces and landside access routes of strategic importance; and
- ports to prepare precinct plans that reflect the challenges of a port and demonstrate how the port capacity will be provided to meet forecast needs with an outlook horizon of a minimum of 15 to 30 years.

5.3 Queensland Government legislation & policy

5.3.1 Sustainable Ports Development Act 2015 (SPD Act)

The purpose of the *Sustainable Ports Development Act 2015* is to provide for the protection of the GBRWHA through managing port-related development in and adjacent to the area. The Act gives effect to the government’s commitments made in Reef 2050 to better manage

the impacts of port development on the environment, particularly on the GBRWHA, while allowing Queensland's economy, jobs and regions to grow. The Act was passed by the Queensland Parliament on 12 November 2015 and enacted on 20 November 2015.

The purpose of the Act is to:

- protect greenfield areas by restricting new port development in and adjoining the GBRWHA to within current port limits
- restrict capital dredging for the development of new or expansion of existing port facilities to within the regulated port limits of Gladstone, Hay Point/Mackay, Abbot Point and Townsville (to optimise the use of infrastructure at these long established major bulk commodity ports)
- prohibit the sea-based disposal of material into the GBRWHA generated by port-related capital dredging
- mandate the beneficial reuse of port-related capital dredged material, such as for land reclamation, or disposal on land where it is environmentally safe to do so
- require master plans at the long-established major bulk commodity ports of Gladstone, Hay Point/Mackay, Abbot Point and Townsville to optimise the use of existing port infrastructure and address operational, economic, environmental and social relationships as well as supply chains and surrounding land uses.

5.3.2 Transport Infrastructure Act 1994 (TIA)

The TIA establishes the regime under which port authorities plan for the future development of strategic port land and for the identification of port marine operational areas. Specifically, the functions and powers of port authorities under the TIA (Part 3, s.275) are –

- a) to establish, manage, and operate effective and efficient port facilities and services in its port; and
- b) to make land available for –
 - i. the establishment, management and operation of effective and efficient port facilities and services in its port by other persons; or
 - ii. other purposes consistent with the operations of its port; and
- c) to provide or arrange for the provision of ancillary services or works necessary or convenient for the effective and efficient operations of its port; and
- d) to keep appropriate levels of safety and security in the provision and operation of the facilities and services; and
- e) to provide other services incidental to the performance of its other functions or likely to enhance the usage of the port.

Land Use Plans are required by all port authorities as the principal tool for development assessment. Development within strategic port land is not regulated by local government planning schemes. The extent of land currently subject to the provisions of the Gladstone Ports Corporation Land Use Plan is illustrated on Figure 5.

Land Use Plans prepared under TIA are required to:

- contain details of strategic port land;
- coordinate and integrate the 'core matters' relevant to the Land Use Plan;
- identify Desired Environmental Outcomes (DEOs) for the strategic port land; and
- include measures to achieve the DEOs.

As part of the formal approval process established under the TIA for Land Use Plans, the Minister for Transport must also be satisfied that State interests will not be adversely affected.

Regulations under TIA establish the marine-based limits of each port.

5.3.3 Sustainable Planning Act 2009 (SPA)

The SPA forms the overarching framework for Queensland's planning and development system and sets out categories of assessable development. The SPA gives effect to a range of planning instruments such as State Planning Regulatory Provisions, the State Planning Policy, Regional Plans and Local Government Planning Schemes. The SPA confirm that port authorities are the assessment manager for all assessable development on strategic port land.

The SPA is supported by the *Sustainable Planning Regulation 2009* (SP Reg) which provides detailed guidance regarding the application of the SPA's purpose. Key matters identified in the Regulation include exempt and assessable types of development and matters requiring referral to State agencies. The Department of Infrastructure, Local Government and Planning has released the draft planning bills for public consultation which is to replace the *Sustainable Planning Act 2009* and be implemented in late 2016.

5.3.4 Queensland State Planning Policy 2014

The State Planning Policy (SPP) is an integral component of Queensland's land use planning system which enables development, protects our natural environment and allows communities to grow and prosper. The SPP defines the Queensland Government's policies about matters of state interest in land use planning and development which notably includes strategic ports, strategic airports and state transport infrastructure. The SPP Ports state interest not only seeks to protect key transport corridors to ports and protect ports from encroachment by incompatible development, it also seeks to protect sensitive uses from port generated emissions.

The State interest – strategic ports protects the operation of the Gladstone port and enables its growth and development by ensuring that the Gladstone Regional Council Planning Scheme 2015 appropriately integrates the state interest through:

- 1) identifying strategic ports and associated strategic port land and core port land, and
- 2) facilitating development surrounding strategic ports that is compatible with, depends upon or gains significant economic advantage from being in proximity to a strategic port, or supports the strategic port's role as a freight and logistics hub, and
- 3) ensuring sensitive development is appropriately sited and designed to mitigate adverse impacts on the development from environmental emissions generated by port operations, and

- 4) identifying and protecting key transport corridors (including freight corridors) linking strategic ports to the broader transport network, and
- 5) considering statutory land use plans for strategic ports and the findings of planning and environmental investigations undertaken in relation to strategic ports.

5.3.5 State Development and Public Works Organisation Act 1971 (SDPWOA)

The primary purpose of the *SDPWOA* is to support the coordinated development of major infrastructure and development projects in Queensland. The Act gives the Coordinator-General powers including the ability to declare a major project a 'coordinated project' and oversee the environmental impact assessment process for the project. The Act also allows the Coordinator-General to establish State Development Areas (SDAs) to promote economic development in Queensland. SDAs typically take the form of industrial hubs, multi-user infrastructure corridors and major public infrastructure sites. Within declared SDAs, the Coordinator-General assesses and decides development applications in accordance with the approved development scheme.

5.3.6 Environmental Protection Act 1994 (EP Act)

The EP Act is Queensland's key environmental legislation. The EP Act is focused on fostering ecologically sustainable development through the maintenance of an integrated management program that develops and implements effective environmental strategies. The EP Act establishes an assessment regime for the consideration and approval of environmentally relevant activities (ERA).

5.3.7 Queensland Heritage Act 1992 (QHA)

The QHA provides the framework for assessing the significance of items and places of cultural heritage value in Queensland, and is administered by the Department of Environment and Heritage Protection. It makes provision for the conservation of Queensland's cultural heritage by protecting all places and areas listed on the Queensland Heritage Register (QHR).

5.3.8 Aboriginal Cultural Heritage Act 2003 (ACH Act)

Section 4 of the ACH Act defines its main purpose as providing effective recognition, protection and conservation of Aboriginal cultural heritage. The ACH Act defines Aboriginal cultural heritage as anything that is either: a significant Aboriginal area in Queensland; a significant Aboriginal object, or; significant archaeological or historical evidence of Aboriginal occupation of an area of Queensland. The ACH Act also imposes requirements for development under SPA (s. 89).

5.3.9 Native Title (Queensland) Act 1993

The main objects of the *Native Title (Queensland) Act 1993* are to ensure that Queensland law is consistent with standards set by the Commonwealth Native Title Act for future dealings affecting native title and to validate past acts, and intermediate period acts, invalidated because of the existence of native title and to confirm certain rights in accordance with the Commonwealth *Native Title Act 1993*.

5.3.10 Nature Conservation Act 1992 (NCA)

The NCA establishes a framework for the creation and management of protected areas, for example national parks, and the protection and management of native flora and fauna. Under NCA there are 13 classes of protected areas and flora and fauna are listed as being one of the following five classifications; extinct in the wild, endangered, vulnerable, near threatened, and least concern.

5.3.11 Marine Parks Act 2004

The Marine Parks Act 2004 is the marine equivalent of the *Nature Conservation Act 1992*. It provides a framework for the creation of marine parks and the protection of marine species. Three marine parks have been created under the Act: Great Barrier Reef (GBR) Coast Marine Park; Great Sandy Marine Park; and Moreton Bay Marine Park. The GBR Coast Marine Park complements (in adjacent State waters) the GBR Marine park created under the *Great Barrier Reef Marine Park Act 1975* (Cth). The Act creates zoning plans for multiple-use management and a permit system for activities within marine parks such as collecting marine products or commercial whale watching.

5.3.12 Transport Operations (Marine Pollution) Act 1995

Marine pollution from ships in Queensland coastal waters is regulated under the Transport Operations (Marine Pollution) Act 1995. The Act is administered by MSQ and complements the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth), which regulates marine pollution in Australian waters.

5.3.13 Work Health and Safety Act 2011

The *Work Health and Safety Act 2011* (WHS Act) provides a framework to protect the health, safety and welfare of all workers. The WHS Act also provides protection for the general public so that their health and safety is not at risk by work performed by a particular business or industry.

Workplace Health and Safety Queensland regulates Major Hazard Facilities (MHF) in accordance with the WHS Regulation 2011 and the nationally endorsed key principles for MHP regulation. Due to the nature of chemicals stored at MHFs, the WHS Regulation 2011 requires that all MHFs are to be licensed.

5.3.14 Forestry Act 1959

The *Forestry Act 1959*, amongst other matters, regulates the administration and uses of the State forests and timber reserves as well as the commercial harvesting or extraction of forest products and extractive materials where owned by the State. These resources are known to exist, or have the potential to be on areas of State forest and other Crown land, and other parcels of freehold land where the ownership of the quarry material is reserved to the State, within the proposed master planned area boundary. Where development within the master planned area uses quarry materials that belong to the State, authorities are likely to be required under the *Forestry Act 1959* to extract, remove and/or use this quarry material.

5.4 Local planning framework

Detailed land use planning throughout the region is delivered through a combination of the Gladstone Regional Council Planning Scheme, the Port of Gladstone Land Use Plan, the Gladstone State Development Area Development Scheme and Queensland Government Priority Development Area development schemes.

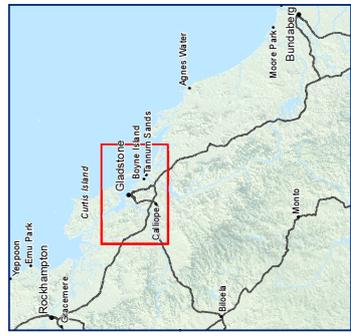
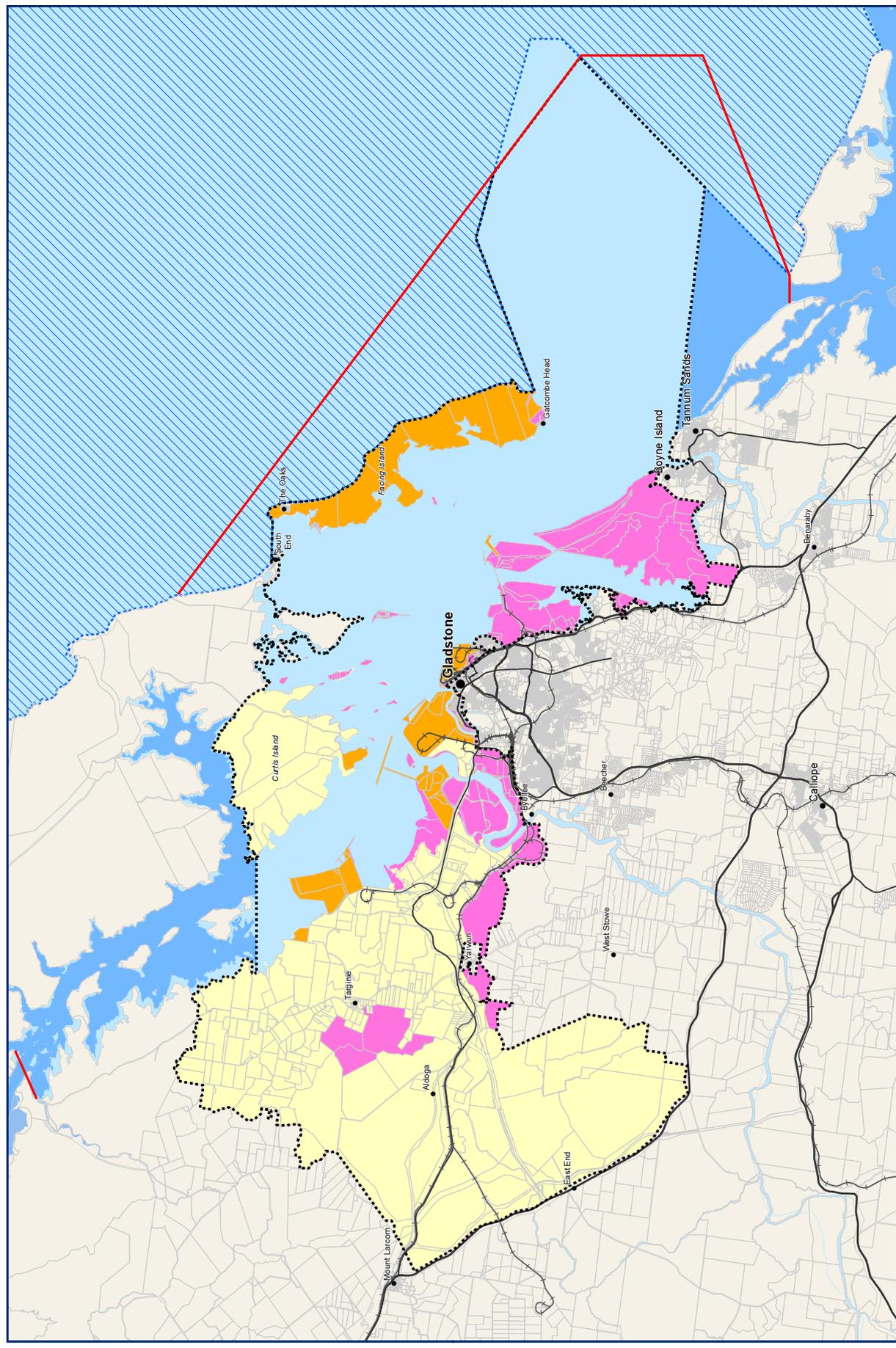
The application and effect of these instruments is described Table 1 and the geographic extents of the land use plans are shown in Figure 5.

Table 1 Applicable planning instruments

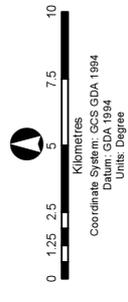
Jurisdiction	Instrument	Application and effect
Gladstone Ports Corporation	Gladstone Ports Corporation Land Use Plan 2012	Applies to all Gladstone Ports Corporation Strategic Port Land in Gladstone and Port Alma, including all premises, roads, waterways and tidal areas within Strategic Port Land boundaries. Any land owned by GPC which is not identified in the plan is subject to the planning provisions of relevant local or state government authorities.
Queensland Government	Gladstone State Development Area Development Scheme 2015	Applies to applications for material change of use within the Gladstone State Development Area (GSDA). Applications seeking approval for reconfiguration of a lot or operational work remain assessable under the relevant local government planning scheme.
	Tannum Sands Urban Development Area Development Scheme 2012	Applies to all development (material change of use, operational work and reconfiguring a lot) within 171 hectares of land located approximately 25 km south east of the Gladstone city centre.
	Clinton PDA Development Scheme 2010	Applies to all development (material change of use, operational work and reconfiguring a lot) within 26 hectares of land located approximately 6 km south west of the Gladstone city centre.
	Toooloa PDA Development Scheme 2013	Applies to all development (material change of use, operational work and reconfiguring a lot) within 180 hectares of land located approximately 6 km south of the Gladstone city centre in the suburb of Toooloa.
Gladstone Regional Council	Gladstone Regional Council Planning Scheme 2015	The Gladstone Regional Council Planning Scheme was adopted by Council on 6 October 2015 and took effect on 12 October 2015. The planning scheme supersedes the previous planning schemes for Gladstone City, Calliope Shire and Miriam Vale Shires providing a consolidated planning document for all planning and development across the region. The planning scheme does not apply on land which is strategic port land for the purposes of the Port of Gladstone Land Use Plan 2012 or land within a priority development area.

Figure 5
Existing planning instruments

- Legend**
- Cities
 - Urban centres
 - Local centres
 - Railway
 - Highways
 - Secondary Roads
 - Property boundaries
 - Port limits
 - ⋯ Proposed Gladstone port master planned area boundary
 - ⋯ Great Barrier Reef Marine Park
 - ⋯ Great Barrier Reef Coast Marine Park
 - ⋯ Gladstone State Development Area
 - ⋯ Development Scheme
 - ⋯ Gladstone Ports Corporation Land Use Plan
 - ⋯ Gladstone Regional Council Planning Scheme



10 November 2015



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6 | Land Use and Infrastructure



6.0 Land use and infrastructure

The Port of Gladstone is located within a diverse region which contains a range of established urban communities, major industrial precincts, resource activities and valuable environmental areas. Over time, the planning arrangements for land and marine areas in the Gladstone region have become increasingly complex and there has been unprecedented growth in the region. Due to the expansion of the resource sector and subsequent additional port expansion, there has been increased urban expansion of many of the existing communities.

The fragmented nature of planning jurisdictions covering the Gladstone Port and its surrounds (refer to Figure 5) creates a complex setting for coordinating appropriate land use planning outcomes. The preparation of a master plan for the Gladstone Port provides an opportunity to coordinate a holistic approach to land use planning matters within the boundary of the proposed master planned area.

6.1 Shipping and marine infrastructure

6.1.1 Shipping channels and external anchorages

Vessels arriving off the Port of Gladstone will be assigned a designated anchorage position by vessel traffic service (VTS) and will then need to await berthing instructions. There are a number of regulated anchorage positions located adjacent to the Fairway.

Port of Gladstone shipping channels are shown on Figure 6 and include:

- Outer Harbour Channel (L 22.45km W 183m D 16.1m)
- Inner Harbour Channel – Auckland (L 8.7km W 180m D 15.8m)
- Inner Harbour Channel – Clinton (L 2.2km W 180m D 16.0m)
- Inner Harbour Channel – Clinton Bypass (L 3.6 W 200m D 13.0m)
- Inner Harbour Channel – Targinie (L 6.1km W 120m D 10.6m).

Gladstone Ports Corporation is seeking to develop the existing Gatcombe and Golding Cutting shipping channels to accommodate a predicted increase in shipping traffic as a result of ongoing industrial growth within the Port. Existing channel depths and anchorage locations are shown on Figure 7.

The duplicate channel is proposed to be developed adjacent to the existing shipping channel. This represents approximately two thirds of the length of the outer harbour channel. The development will be undertaken in two stages and will allow deep draft Panamax and light draft Capes to pass deep draft Capes in at the completion of the first phase. The proposed duplicate channel will be approximately 14.0km long. Dredging is proposed to be undertaken to an ultimate depth of RL-16.1m and a channel width of 200m (toe to toe). Approximately 12 million cubic metres of seabed material will be removed during the dredging programme. This will reduce the bottleneck that may be created as a result of an increase in the total number of vessels handled annually in order to meet the committed trade.

Since the commencement of shipping from the Wiggins Island Coal Terminal (WICT) it has also been identified that there is a need to deepen the existing Clinton Bypass channel to allow the safe passage of Capesize vessels passing the RG Tanna Coal Terminal wharf in

the Port of Gladstone. The project would result in the area being deepened from around 12 metres to 16 metres to allow Capesize vessels to use the channel without impacting the vessels berthed at the RG Tanna Coal Terminal.

6.1.2 Limitations of existing channels

The existing shipping channels are essentially one way operation with limited passing capacity. Passing in the Gatcombe and Golding Channels is possible through the use of natural depths adjacent to these channels in the outer harbour.

6.1.2.1 Tidal influences

The tide plays a significant influence of the alignment of channels and berths. The tidal velocity within the Port of Gladstone can be as high as four knots on spring tides with a tidal range up to 4.83m.

For Capesize vessels, manoeuvrability is tidally constrained with assistance of the tidal range of up to 4.83m being relied upon to transit deep draft vessels. Dependent on the draft of the vessels and the tidal range, a tidal window for sailing may be limited to a couple of hours around high water. Growth in the use of Capesize vessels may be a limiting factor for the capacity of the Port. Currently all Capesize vessels are only used for the export of coal from RG Tanna Coal Terminal and Wiggins Island Coal Terminal.

In the event that product is imported in Capesize vessels, then severe constraints are imposed on the capacity of the Port in that both inbound and outbound vessels are tidally constrained for transit in a one way channel. The existing base tidal data for Gladstone (Auckland Point) is summarised in Table 2. Gladstone Harbour experiences large tidal ranges up to 4.83m. The large range generates strong tidal currents up to 1.5m/s in the main channels and up to 0.35m/s in the shallower extents of the estuary⁴.

Targinie Channel presents a similar issue for Panamax vessels transiting to Fisherman's Landing. The channel depth of 10.6m LWD constrains vessel movement with drafts of 13.0m being common on the import of Bauxite to the Rio Tinto Alumina Refinery. There is sufficient capacity for the operation of the channel; however, increased trade in deep draft Panamax vessels will impact capacity of the upper reaches of the harbour.

Table 2 Gladstone tidal planes⁵

Tidal Planes	Gladstone (Auckland Point)	
	m LAT	m AHD
Highest Astronomical Tide (HAT)	4.83	2.56
Mean High Water Springs (MHWS)	3.96	1.69
Mean High Water Neaps (MHWN)	3.11	0.84

⁴ GHD 2009c, Gladstone Ports Corporation: Report for Western Basin Dredging and Disposal Project – Coastal Processes Assessment, < <http://eisdocs.dsdip.qld.gov.au/Port%20of%20Gladstone%20Western%20Basin%20Dredging/EIS/appendix-m-coastal-processes-assessment.pdf>>.

⁵ Department of Transport and Main Roads, Maritime Safety Queensland, Queensland Tide Tables Standard Port Tide Times 2015, Gladstone Port

Tidal Planes	Gladstone (Auckland Point)	
Mean Level (ML)	2.34	0.07
Australian Height Datum (AHD)	2.268	0.0
Mean Low Water Neaps (MLWN)	1.57	-0.7
Mean Low Water Springs (MLWS)	0.72	-1.6
Lowest Astronomical Tide (LAT)	0.0	-2.268
Port Datum (PD)	0.0	-2.268

Tidal currents are also a significant factor in determining berth alignments. The most ideal scenario is to align the berth face with the current. In the circumstance where the current pushes away from the berth face, the mooring loads are increased with an increased risk of a vessel moving off. In the circumstance where the current is pushing into the berth face, there is an additional berthing load imposed due to the additional velocity onto the wharf.

6.1.2.2 Seabed properties and profile

The existence of hard material (rock) will control the potential for channel development. The cost of removal of the rock is an order of magnitude of cost higher than conventional material with increased environmental harm from blasting. Sands and gravels are less of an issue for both dredging and reclamation. Soft clays and silts in reclamation or other onshore disposal areas present issues in relation to the retention time for water discharge and settlement to bring into use for other beneficial uses.

Observations of the seabed will indicate natural channels and gutters and may indicate areas of self-cleaning with respect to siltation. Steep batter slopes may be indicative of stiffer materials and represent areas of lower risk for maintenance.

6.1.2.3 Relationship of deep water to the shoreline

The relationship of deep water to the shoreline is a determining factor for the development of new berths. The shallow embayments between WICT and Fisherman's Landing are not conducive to the development of wharves.

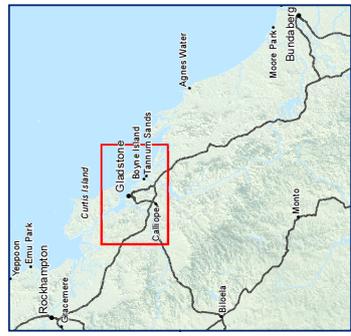
The length of conveyors can be achieved to allow bulk materials to be handled; however, the cost of construction and maintenance, together with risks around spills over environmentally sensitive areas, present potential long-term issues. Dredging may be undertaken to get closer to the shoreline; however, the creation of basins in shallow areas present issues with the need for ongoing maintenance dredging.

Figure 6

Shipping channels and anchorages

Legend

- Cities
- Urban centres
- Local centres
- ⚓ Anchorages
- Railway
- Highways
- Secondary Roads
- Property boundaries
- Port limits
- ⋯ Proposed Gladstone port master planned area boundary
- ⋯ Great Barrier Reef Marine Park
- ⋯ Existing and proposed Shipping Channels
- ⋯ East Banks Sea Disposal Site



10 November 2015



Coordinate System: GCS GDA 1984
Datum: GDA 1984
Units: Degree

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6.1.3 Boyne wharves

The Boyne wharf is located at the southern end of Gladstone Port Corporation's land holdings (refer to Figure 8). The wharf is primarily dedicated to the aluminium industry and services the Boyne Smelter Limited (BSL). The facilities are accessed via a private road and are well separated from existing sensitive land uses in South Gladstone.

Ships that arrive to load aluminium products or discharge liquid pitch and can berth bow-in or bow-out, depending on the state of the tide. Principal cargoes include aluminium ingots, petroleum coke, general cargo and liquid pitch. Berth depth is 15.0 metres (LAT).

This facility has good deep water access and throughput to the wharf is expected to increase. Access to the wharf is restricted as it must be gained via agreements from the private road owners.

6.1.4 South Trees wharves

The two South Trees wharves are dedicated to the aluminium industry, primarily serving Queensland Alumina. Berth depth is 12.8 metres (LAT).

The principal cargoes at South Trees East are alumina, caustic soda and fuel oil and the principal cargo handled at South Trees West is bauxite.

The bunker barge berthing facility is located adjacent to the South Trees berths and is dedicated to the barge operation.

6.1.5 Barney Point Terminal (part of Port Central)

The Barney Point terminal currently includes a wharf for the export of coal and other bulk commodities and is accessible by road and rail. The future development of this facility will see coal being relocated following the commencement of operations at the Wiggins Island Coal Terminal. Future use of the Barney Point Terminal will need to address potential dust impacts on the surrounding land uses and will change the visual aesthetics of the area from stockpiling of raw exposed materials to increased break bulk, petroleum, raw materials and containerised cargo. Berth depth is 15.0 metres (LAT). GPC will continue handling bulk products, including open stockpile, where issues of dust controls and other environmental issues can be addressed appropriately.

6.1.6 Auckland Point wharves (part of Port Central)

There are four wharves at Auckland Point accessible by road and rail. The Auckland Point wharves are the original port area established in the 1890s and are adjacent to the Gladstone central business district.

Auckland Point Wharf 1 is a multi-user/multi-product facility for export of dry bulk products. It is used by ships that arrive in ballast to load mostly magnesia, calcite or occasional break bulk. It is noted that bulk loading infrastructure at Wharf 1 has reached the end of its effective life and bulk loading operations will cease in 2016. Bulk loading requiring new infrastructure will not be precluded from future development at this berth.

Auckland Point Wharf 2 is used by ships that arrive in ballast to load mostly grain cargoes.

Auckland Point Wharf 3 is a multi-user wharf where the principal cargoes handled are refined oil products (such as diesels, jet fuels, petrol, liquid petroleum gas) and caustic soda. Other cargoes include containers, break bulk, general cargo and heavy lifts.

Auckland Point Wharf 4 is a multi-user berth used by ships to load/discharge general cargo, heavy lifts, containers, break bulk, gypsum, magnetite and scrap metal. Wharf 4 is located directly in front of the Gladstone Container Terminal which is operated as a multi-user facility that has been designed to handle all forms of containerised, break bulk and general cargoes.

An additional three wharves can be added in the future between Auckland Point Wharf 4 and Barney Point to provide for Panamax vessels. These wharves could be land backed and able to provide for clean cargo such as containerised cargo, petroleum and break bulk.

P&O Cruises has added Gladstone to its cruising itinerary and ships will berth at Auckland Point.

Due to relative low utilisation, these berths are occasionally used as lay berths for inspection and maintenance.

6.1.7 RG Tanna Coal Terminal

RG Tanna Coal Terminal at Clinton includes four wharves (Clinton Wharf 1, 2, 3 and 4) and three ship loading facilities. The terminal is accessible by road and rail. All product is received by rail.

The terminal provides for ships ranging in size from 25,000 to 220,000 dead weight tonnage arriving in ballast, ready to load coal and swing in the area at the western end of Clinton Channels to berth bow-out at all RG Tanna coal berths. Ships berths have a depth of 18.8 metres (LAT).

Future expansion of the RG Tanna Coal Terminal could accommodate a fourth ship loader and provision of a fifth berth at the western end of the existing berths.

6.1.8 Wiggins Island Coal Terminal

The Wiggins Island Coal Terminal (WICT) began operations in 2015. The terminal will service the increasing demand for the export of coal from the Surat and Bowen Basins. The facility will ultimately provide four berths to handle coal and two berths for other bulk cargo. Berths will be designed to accommodate Capesize vessels.

The site is accessed via Mt Larcom Road. The terminal will be built in stages in response to demand and once fully commissioned, it will provide for up to 84 mtpa in export coal capacity, effectively doubling existing coal export capacity at the Port of Gladstone.

The terminal is connected to the North Coast rail line, with rail unloading facilities connected to the Golding Point stockyard via a 5.6km long overland conveyor.

Stage 1 of WICT is operational and provides capacity for the export of up to 27 million tonnes of coal per annum.

6.1.9 Fisherman's Landing

With the reclamation undertaken in the Western Basin expansion, Fisherman's Landing is planned to accommodate a total of 11 berths. The facility connects directly to the adjoining

Gladstone State Development Area (GSDA) with access corridors for road, rail, conveyor and pipelines. The proximity of berths to land provides opportunity for bulk and break bulk operations. A large land area will be available for stockpiling and materials handling.

Fisherman's Landing Wharf 1 is used by ships that arrive loaded to discharge bauxite. Loaded tankers will berth occasionally to discharge caustic soda.

Fisherman's Landing Wharf 2 is used by ships that arrive in ballast ready to load alumina and berth bow-out. Loaded tankers will berth occasionally to discharge caustic soda.

Fisherman's Landing Wharf 4 handles bulk cement clinker, cement and fly ash. It is used by ships that arrive in ballast to load cement clinker, and will berth stemming the tide.

Fisherman's Landing Wharf 5 is a multi-user facility that handles bulk liquids. It is used by chemicals tankers that arrive in loaded condition to discharge liquid ammonia, caustic soda and sulphuric acid.

6.1.10 Curtis Island-LNG Precinct

Three berths have been completed for the LNG export industry. There is capacity to expand the number of berths for LNG to seven subject to industry growth.

The growing export of LNG is a result of expanding coal seam gas production in the Surat Basin in southern Queensland. A 380 kilometre long underground gas pipeline has been constructed and runs from near Miles connecting to the GSDA and adjoining Port of Gladstone. The coal seam gas will be liquefied (LNG) at a plant on Curtis Island and then transferred by pipeline to ships for export. The LNG facilities on Curtis Island currently fall within the GSDA and are therefore subject to the GSDA Development Scheme.

6.1.11 Curtis Island-Hamilton Point (proposed)

Gladstone Ports Corporation owns land at Hamilton Point and has identified the area as having potential for the development of port facilities to accommodate multiple Capesize vessels. Land backed berths will provide flexibility for development and major cargo anticipated includes break bulk and containers. Development of port facilities at Hamilton Point will require a road and rail bridge to connect to the mainland.

6.1.12 Small craft marine infrastructure

The Port of Gladstone includes a marine industry precinct, including the marina (land and water based facilities) and public boat ramps. The precinct provides opportunities for public access to the water and harbour in appropriate locations where it does not conflict or create safety concerns with general maritime and core port activities.

The Gladstone Marina and Auckland Creek are home to many of the port's recreational and commercial vessels. At the height of construction for the three LNG plants, there were approximately 450 Queensland registered commercial vessels operating in the Port of Gladstone with many more ships registered elsewhere also working in the area.

The GPC has recently completed construction on a new tug boat base behind the RG Tanna Coal Terminal to service the increased shipping in the port resulting from the development of the three LNG plants and the Wiggins Island Coal Terminal. The efficient deployment of tugs is critical to the operation of the port and this new facility will accommodate 12 vessels.

The port is also home to a growing recreational fleet. There are over 7,300 Queensland registered recreational vessels in the Gladstone area. The Gladstone Marina is a hub for recreational activities. Boat ramps are provided at locations across the harbour. Recreational vessels generally operate throughout all the waterways of the proposed Gladstone port master planned area.

6.2 Supply chain and supporting infrastructure

The efficient operation of the port relies on various elements of supporting infrastructure and transportation corridors to enable supply chains. There are a number of key pieces of linear infrastructure that service existing industry and/or transport materials to the Port of Gladstone. Key considerations in supporting the optimisation and efficient use of Gladstone's port and supply chain infrastructure include:

- **Corridor routes:** The need to ensure that the corridors between industrial development and port facilities are suited to the materials handling options is an important consideration. These links are critical to the efficient transportation and handling of materials.
- **Accessibility to wharves:** The facilitation of direct truck access is an important consideration in the efficient loading/unloading of goods at port wharves. It is necessary that a truck can manoeuvre to gain maximum efficiency where it is required to attend at the vessel's side (i.e. for containers, logs and general cargo). The optimal facility for such an operation is a land-backed wharf where maximum manoeuvrability of the vehicle is achieved. The majority of existing wharves at the port have been designed to accommodate bulk loading operations. This generally entails a narrow wharf which limits the turning circle and a single approach roadside which restricts the frequency of vehicle movement.
- **Berth utilisation:** A berth is impacted by the inter-vessel time; for a vessel with a short at-berth time an occupancy rate of 60 per cent may be the capacity. For a long at-berth time occupancy may be as high as 90 per cent. The future optimisation of Gladstone's available berths to vessel types will minimise the total service time of a vessel (waiting time for berths and the handling of vessels at their allocated berths).
- **Product compatibility:** While a particular facility may be capable of handling a range of bulk products, issues associated with contamination need to be resolved. In some instances, there is potential to undertake belt/system cleaning between products to address quality assurance standards; while in others, products will not be able to be handled using the same infrastructure. As an example, products such as coal and woodchips could not be handled using the same system due to the rigorous quality assurance requirements regarding carbon contamination.

6.2.1 Road infrastructure

Road infrastructure is critical to the port to provide a direct link with the major highway network. The road network within the proposed Gladstone port master planned area is shown on Figure 9. The principal elements of the road network servicing port areas comprise:

- Bruce Highway
- Calliope River Road
- Gladstone Benaraby Road
- Gladstone Port Access Road
- Hanson Road
- Dawson Highway
- Landing Road
- Gladstone Mount Larcom Road.

Gladstone Port Central is directly connected to the surrounding region by the Port Access Road which bypasses the Gladstone central business district. The Port Access Road provides a direct link to the Dawson Highway and Gladstone-Mt Larcom Roads which connect to the Bruce Highway to the south and north of the port respectively.

The Port Access Road currently connects with Glenlyon Road. The planned western extension to the Port Access Road has the potential to improve transport efficiency and road safety within Gladstone by alleviating the impact of large vehicles and hazardous good movements on local and general commuter traffic.

The Office of the Coordinator-General is currently preparing a road infrastructure study for the GSDA. The timing of development in the GSDA needs to be carefully managed so that the number of development fronts and associated demand for access roads is both reasonable and affordable.

The expected staging of road infrastructure up until 2031 in the GSDA is provided within Table 3.

Table 3 Anticipated roadworks required within the GSDA⁶

Infrastructure	Timeframe
Upgrade of Landing Road (OSOM Connection)	Short term priority
Complete duplication of Gladstone-Mt Larcom Road / Port Curtis Way between New Aldoga South Road and Blain Drive	The timeframe is dependent on: <ul style="list-style-type: none"> a) Rate of traffic growth; and b) Posted speed. <p>Note: Should the posted speed remain 100kph and growth remain as per recent years, the works need to be completed by 2026.</p> <p>Should posted speed be reduced for safety reasons, the duplication will be required up to five years earlier.</p>
Second Crossing of Calliope River	The timeframe is dependent on: <ul style="list-style-type: none"> a) Rate of traffic growth; and b) Posted speed.
New Aldoga South Road (construction has commenced)	Subject to GSDA development demand
Intersection of the Bruce Highway and Mt Larcom-Gladstone Road	Pre 2031

The Road Infrastructure Study provides an outline of how the road network for the GSDA should be developed into the future taking into account anticipated economic growth. The planning and approval of any additional access roads will need to consider the proposed interim road networks so as not to impede access to lots and to preserve the appropriate

⁶ PSA Consulting Australia 2014, Gladstone State Development Area: Road Infrastructure Study Final Draft Report, September 2014

hierarchy within the wider road network⁷. It is acknowledged that there are existing constraints on the capacity for heavy goods vehicles and road trains to access the proposed Gladstone port master planned area. It is therefore imperative that transport corridor requirements are carefully considered within the master planning process to ensure that future road network capacity requirements are adequately accommodated.

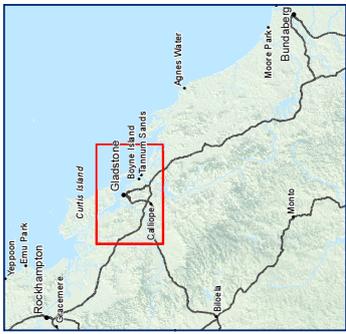
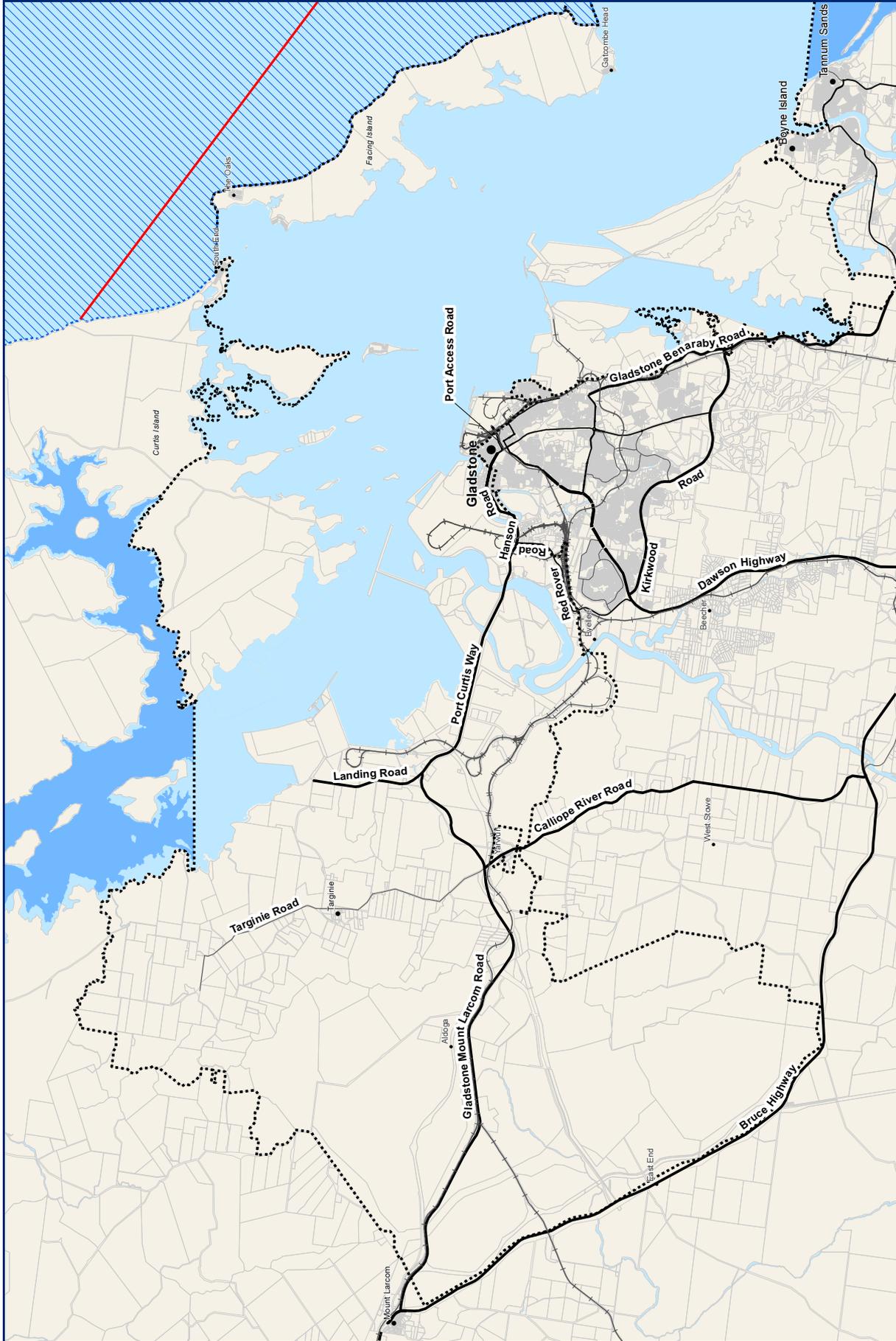
⁷ PSA Consulting Australia 2014, Gladstone State Development Area: Road Infrastructure Study Final Draft Report, September 2014

Figure 9

Road infrastructure

Legend

- Cities
- Urban centres
- Local centres
- Localities
- Railway
- Critical road infrastructure
- Secondary Roads
- Local Connector Roads
- Property boundaries
- Port limits
- Proposed Gladstone port master planned area boundary
- Great Barrier Reef Marine Park
- Great Barrier Reef Coast Marine Park



10 November 2015



0 0.5 1 2 3 4 5
Kilometres
Coordinate System: GCS GDA 1984
Datum: GDA 1984
Units: Degree

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6.2.2 Rail infrastructure

The proposed Gladstone port master planned area is well serviced by an existing railway network as shown on Figure 10. It is recognised that the location of off road haulage and rail corridors is constrained by changes in grade and alignment. Efficiency in these material transfer systems come from high mass haulage and the corridors need to have minimal grades and smooth transitions in alignment to result in maximum efficiency of the logistics system.

North Coast Line

The North Coast Line is a 'shared service' railway and is the principal regional freight and passenger line within the Queensland Rail network, running the length of coastal Queensland between Nambour in the south and Cairns in the north. The North Coast Line provides Gladstone with a direct freight linkage to Brisbane. The system carries various freight products, including containerised and industrial freight, minerals, livestock and bulk commodities including sugar and grain. Containerised freight services operate between Brisbane and major centres in central and north Queensland. Long distance passenger and high speed tilt train services also operate on the line servicing central and north Queensland.

Moura and Blackwater systems

The Moura system and Blackwater system form part of the Central Queensland Coal Network. The Moura system is narrow gauge 1,067 mm (3 ft 6 in) and is used by diesel electric locomotives, while the Blackwater system is narrow gauge 1,067 mm (3 ft 6 in) and electrified, used by both electric and diesel locomotives.

Together, these systems transport coal to the Gladstone Power Station (NRG), Rio Tinto, Queensland Alumina Limited (QAL), Cement Australia and the RG Tanna, Barney Point and Wiggins Island coal terminals at the Port of Gladstone.

The Moura system includes the rail infrastructure comprising the rail corridor from the port of Gladstone (including domestic coal terminals in the vicinity of Gladstone) to Moura mine and the loading facility for Baralaba mine in the vicinity of Moura mine, and all branch lines directly connecting coal mine loading facilities to that corridor but excluding the corridor to Blackwater (and beyond).

The Blackwater system means the rail infrastructure comprising the rail corridor from the port of Gladstone (including domestic coal terminals in the vicinity of Gladstone) to Gregory, Minerva and Rolleston mines, and all branch lines directly connecting coal mine loading facilities to those corridors, with the exception of the corridor to Oaky Creek (and beyond) and the corridor to the Moura mine (and beyond).

6.2.3 Pipelines and conveyors

A range of pipelines and conveyors are required to facilitate land and marine functions of the port. Above ground conveyors are used to transport materials such as coal, bauxite and alumina between land-based operations within and adjoining the port (within the GSDA). Pipelines are required to provide a direct link between land-based storage and shipping berths to allow for import and export of bulk liquids and gases through the Port of Gladstone.

There is a wide range of underground pipelines required to transport liquids and gases. Such pipelines may be located in land and/or marine environments. Services such as domestic gas and water supply are provided via pipelines from locations outside the port. These pipes vary in size and are generally located within road reserves or dedicated infrastructure corridors.

Various existing and future pipelines provide direct linkages between natural resource areas and the Port of Gladstone. The GSDA includes a Materials Transportation and Services Corridor (MTSC) that provides for the colocation of pipelines and other compatible linear infrastructure.

The Stanwell to Gladstone Infrastructure Corridor State Development Area (SGICSDA) provides for a range of pipeline infrastructure and connects with the GSDA MTSC through to the Port of Gladstone. The proposed Arrow Bowen Pipeline is an underground high-pressure steel pipeline to transport coal seam gas from the Bowen Basin to a gas hub 22km west of Gladstone.

The Callide Infrastructure Corridor State Development Area (CICSDA), located in Central Queensland, provides for up to four LNG pipelines that will traverse the GSDA and link directly to the Port of Gladstone. The 44km long CICSDA is intended to accommodate multiple underground pipelines. It is designed primarily for pipelines to transport coal seam gas from the Surat Basin to the LNG plants on Curtis Island.

The identification of potential future corridors is critical to address linkage constraints between industrial developments and port facilities. Conveyor routes are capable of handling limited changes in grade and elevation with these variables attracting additional operating costs. The horizontal alignment can accommodate changes through the use of transfer stations and sweeping curves of conveyors. Transfers attract additional capital investment and introduce additional elements for environmental controls.

Pipelines are generally less impacted by the terrain and can be circuitous in the route between the two sites. Transits over ridge lines and abrupt changes of horizontal alignment add to the cost of operations of the pipeline due to increased head issues.

6.2.4 Water, power and sewerage infrastructure

Water

The Gladstone Area Water Board (GAWB) supplies bulk raw and treated water to the Gladstone region. GAWB's reticulated water infrastructure services the Port of Gladstone including a pipeline connection to Curtis Island.

GAWB operates a water delivery system of raw (non-potable) water and of treated (potable) water. The water delivery system comprises a network of pipelines, pump stations, chlorination units and reservoirs for balancing storage.

Reticulated water supply is available at Port Central. There are some water pressure issues, but generally it is adequate to service current needs. Fuel farms and any other hazardous facility supplement the water supply in their own facilities to meet Australian Standards for firefighting.

A new water supply network upgrade has recently been installed to service current and future demands for the RG Tanna Coal Terminal and the Gladstone Marina.

Fisherman's Landing is currently supplied with raw water only from GAWB. Any future industry requirement for reticulated water services will need to be funded/provided by industry in response to demand.

Power

The Port of Gladstone is serviced through links into the surrounding high voltage Powerlink electricity network.

Gladstone Power Station is operated by NRG Gladstone Operating Services and is Queensland's largest coal-fired power station. The 1,680 megawatt power station accounts for approximately 13 per cent of Queensland's installed electricity generation capacity and plays a pivotal role in the supply of electricity in central Queensland. Gladstone Power Station receives its primary fuel supplies from coal mines in Central Queensland.

Sewerage

Gladstone Regional Council is responsible for collecting sewage and treating it to a suitable standard for discharge for serviced properties. Sewage is transported from properties through Council's sewerage network. The sewage is either pumped through the system or flows directly under gravity to one of two sewage treatment plants.

Reticulated sewerage is available at Port Central. Future services can be provided in response to any need for additional services identified by industry.

A sewerage network upgrade has recently been installed to service current and future demands for the RG Tanna Coal Terminal and Gladstone Marina.

There is an existing sewerage connection from Gladstone to Curtis Island to service the LNG plants and future development.

There are no sewerage services currently available at Fisherman's Landing.

6.3 Port related facilities and supporting industries

Beyond the activities conducted immediately adjacent to port infrastructure on strategic port land, there are a range of activities which have a direct relationship with the port and rely on the logistics functionality that the port provides in terms of the transportation, storage and handling of goods (refer to Figure 11). Table 4 and Table 5 outline these existing and proposed port related facilities within the proposed Gladstone port master planned area.

Table 4 Existing port related facilities

Location	Details
South Trees and Boyne Island	<ul style="list-style-type: none"> - Queensland Alumina Limited (QAL) – Alumina production - Boyne Smelter Limited (BSL) – Aluminium production
Gladstone Marina	<ul style="list-style-type: none"> - Various marine industries and coastal rescue services
Yarwun	<ul style="list-style-type: none"> - Rio Tinto Alumina Refinery – Alumina refining - Orica – Chemical Manufacturing - Northern Oil Refinery – Base oil recycling - Earth Commodities Quarry – Coarse Aggregate extraction - Yarwun Quarry - Coarse Aggregate extraction
	<ul style="list-style-type: none"> - Cement Australia – Cement production - Transpacific – Industrial solutions - Queensland Energy Resources Limited (QERL) – Oil Shale Mining
Curtis Island	<ul style="list-style-type: none"> - Gladstone Liquefied Natural Gas (GLNG) - Australia Pacific Liquefied Natural Gas (APLNG) - Queensland Curtis Liquefied Natural Gas (QCLNG)

Table 5 Proposed port related facilities

Location	Details
South Trees and Boyne Island	<ul style="list-style-type: none"> - Large special industry precincts (GRC Planning Scheme) located at South Trees and Boyne Island
Gladstone State Development Area	<ul style="list-style-type: none"> - High Impact Industry Precinct – This precinct is to accommodate high impact industrial development that is difficult to locate in conventional industrial estates such as; mineral and resource refining and processing, chemical and industrial material manufacturing, metal product manufacturing and processing, abattoir, rail dependant industries including rail marshalling yards, which require a very large land parcel and separation from sensitive receptors. - Waste Management Precinct – The purpose of this precinct is to accommodate waste management development such as residue storage facilities, waste disposal, recycling and waste incineration that require large land parcels that are isolated from sensitive receptors. - Medium – High Impact Industry Precinct – The purpose of this precinct is to accommodate medium and high impact industrial development such as boiler making or engineering works, storage of dangerous goods, food processing, manufacture of wood, metal, glass, plastic, plastic products and workshops that require large land parcels.

Location	Details
	<ul style="list-style-type: none"> - Medium – High Impact and Port Related Industry Precinct - This precinct is to accommodate medium and high impact industrial development such as mineral and resource refining and processing, chemical and industrial material manufacturing, metal product manufacturing and processing, engineering works, storage of dangerous goods that require large land parcels, are difficult to locate in conventional industrial estates outside the Gladstone SDA and require separation from sensitive receptors. Uses in this location have links to the port through the import or export of material and benefit from close proximity to port related infrastructure and services. - Medium Impact Industry Precinct – In the long term this precinct is to accommodate medium impact industrial development such as food processing and manufacturing. In the short to medium term rural and agricultural uses may be supported where they do not compromise existing or future industrial development in the Gladstone SDA. Rural and agricultural uses may also act as buffer areas to sensitive receptors external to the Gladstone SDA. This precinct provides opportunities for environmental offsets. - Low – Medium Impact Industry Precinct – This precinct is to accommodate low to medium impact industrial development such as warehousing, repairing and servicing, engineering works, assembling metal products and manufacturing that supports and compliments industrial activities located within the GSDA. - Transport and Support Services Precinct – The purpose of this precinct is to accommodate low impact industrial development such as warehousing, exploration and mining support services, machinery and equipment servicing, construction services, transport depot, distribution centre, contractors depot and storage yard and compliment the industrial activities located within the Gladstone SDA. - Industry Investigation Precinct – The purpose of this precinct is to recognise and protect land for future industrial development, linear infrastructure and linear infrastructure corridors. - Curtis Island Industry Precinct – Uses in this location have links to the port through the import or export of material and benefit from close proximity to port related infrastructure and services. Development within this precinct must recognise the adjacent Curtis Island Environmental Management Precinct. - Transition Precinct – The purpose of this precinct is to accommodate low impact industrial development such as repairing and servicing, fitting and turning workshops, assembling wood or metal products that require a small to medium sized development parcel and compliment industrial activities located within the Gladstone SDA. - Materials Transportation and Services Corridor Precinct - This precinct is to provide an efficient and effective route for linear infrastructure to link infrastructure to industries within the Gladstone SDA and the Port of Gladstone. The precinct is to accommodate linear infrastructure such as gas transportation pipelines, potable and sea water pipelines, sewage pipelines and slurry pipelines, conveyors, rail lines, roads and haul roads.

In addition to facilities located on strategic port land or with a direct relationship to the Port, there are a number of other industrial areas. These may provide general services including support to port operations however they do not necessarily need to be co-located with port land and facilities.

In addition to the GSDA, two industrial precincts exist within the proposed Port of Gladstone master planned area, including:

- Barney Point Low Impact Industry Area
- Hanson Road Mixed Business and Low Impact Industry Area

Currently there is approximately 505.7 hectares of total industrial zoned land within the identified industrial precincts of the Gladstone Region. Of this, approximately 171.9 hectares is developed for industrial purposes and 13.7 hectares is developed for other purposes.

Of the remaining 320.1 hectares of vacant industrial zoned land, 95.3 hectares is serviced, or has the potential to be serviced with reticulated infrastructure through the priority infrastructure plan. The remaining 220.7 hectares is unserviced industrial zoned land.

Outside of the Gladstone State Development Area further industrial growth may occur as extensions to existing industrial precincts. These areas generally represent opportunities for the short to medium term provision of industrial land. Potential extension areas have been identified at:

- Hanson Road Precinct
- Barney Point Precinct
- Toolooa Precinct
- Calliope Precinct
- Boyne Tannum Precinct.

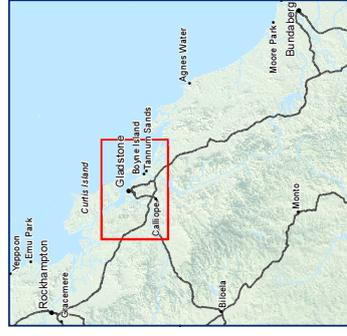
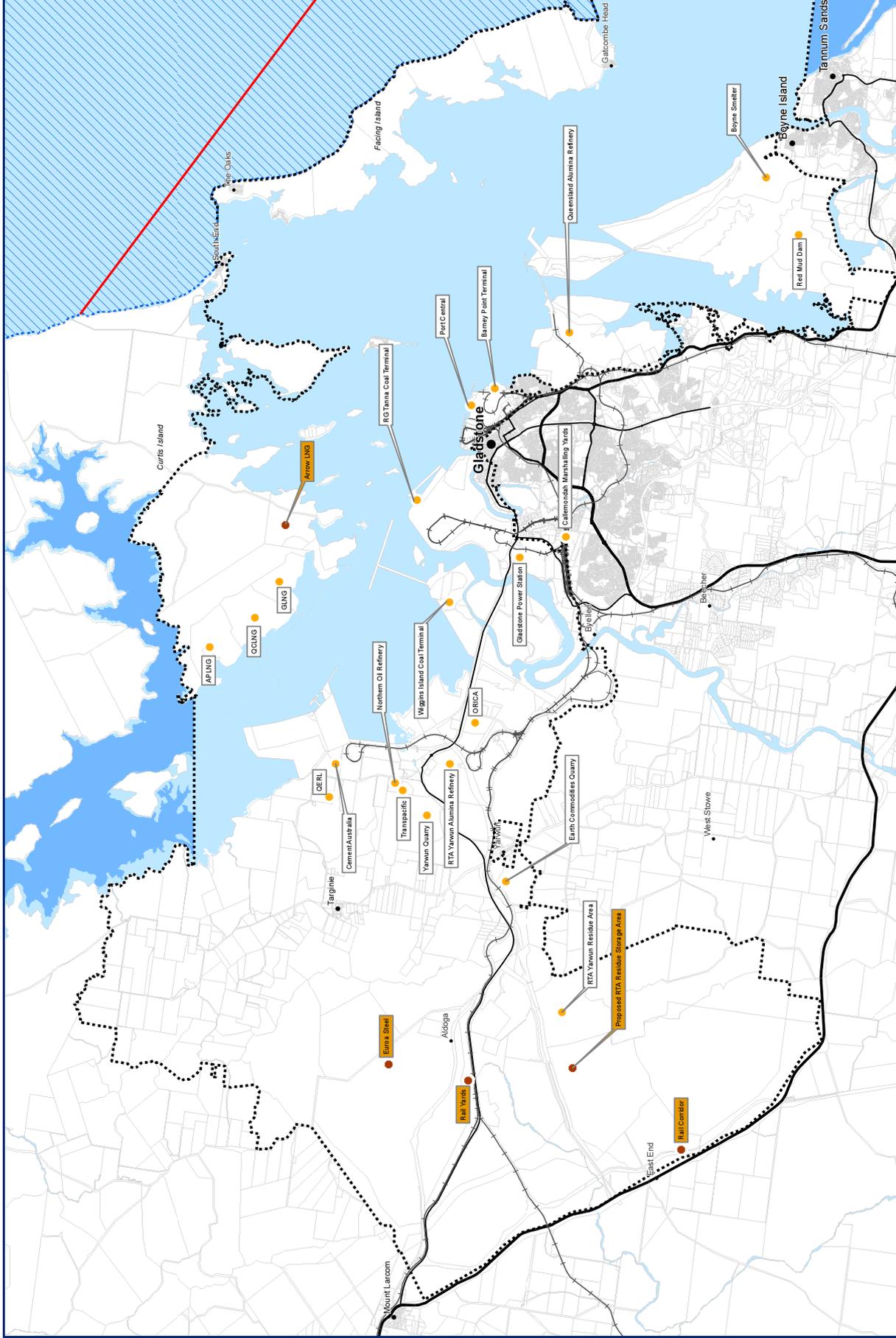
Possible extensions to industrial precincts outside of the State Development Area represent 94 hectares of new industrial land for the Gladstone Region which is broadly suitable for mixed use, low impact and limited medium impact industry.

Figure 11

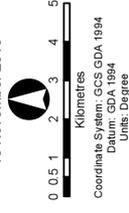
Port related activities

Legend

- Cities
- Urban centres
- Local centres
- Localities
- Existing port related activity
- Proposed port related activity
- Railway
- Highways
- Secondary Roads
- Property boundaries
- Port limits
- Proposed Gladstone port master planned area boundary
- Great Barrier Reef Marine Park
- Great Barrier Reef Coast Marine Park



10 November 2015



6.4 Urban areas

Existing residential land uses within Gladstone City are predominantly located throughout the suburbs of West Gladstone, South Gladstone, Sun Valley, Toolooa, Kin Kora, Telina, New Auckland, Clinton and the southern end of Barney Point. This is in addition to the outer urban areas of Calliope, Tannum Sands and Mount Larcom which to varying degrees have experienced residential growth. The majority of housing stock is comprised of detached houses however there are also precincts within Barney Point and West Gladstone which contain a mix of both detached houses and unit complexes. Further information on these residential communities is at Section 8—Social values.

Most new housing development in the Gladstone region up to 2031 will be undertaken on greenfield land.

Existing local planning instruments identify areas for residential development (greenfield and infill), throughout the city which may influence, or be impacted by, port operations and development. These include:

- Toolooa—Toolooa comprised 429 dwellings as at the 2011 Census. Approximately 188 hectares of greenfield land has been earmarked within the Toolooa Priority Development Area (PDA) to accommodate up to 1000 new residential dwellings with a mix of densities.
- East Shores—the East Shores precinct, currently administered by the Gladstone Ports Corporation contains land which provides a significant community benefit through the development of a world-class recreational hub. Key features of the precinct include an interactive water play park, barbeque areas, playground, fishing platform and extended jetty structure and a waterfront promenade and viewing platform with shade structures. The precinct has potential to undergo further urban regeneration which may include a range of residential, commercial, retail, cultural, recreational, tourism and educational uses.
- Barney Point—the suburb of Barney Point was comprised of 570 dwellings as at the 2011 Census date. The established residential area along Barney Street, immediately adjacent to the Barney Point Coal Terminal has been zoned as Medium Density Residential under the Gladstone Regional Council Planning Scheme 2015 which will allow for the future development of four to six storey residential complexes.
- Gladstone Central—the suburb of Gladstone Central was comprised of 855 dwellings as at the 2011 Census date. The area to the north-east of the CBD along Auckland Street is zoned as a Medium Density Residential under the Gladstone Regional Council Planning Scheme 2015 which will allow for development of four to six storey residential complexes.
- Mount Larcom—Mount Larcom is a small rural township 35km west of the Gladstone CBD. The suburb of Mount Larcom comprised 278 residents and 134 dwellings as at the 2011 Census within a low density/rural residential setting. Any encroachment of industrial land uses associated with the operation of the Port of Gladstone would need to be appropriately protected from residential development at Mount Larcom. There is also opportunity for this township to expand in the future, subject to suitable infrastructure and services upgrades.

There is increasing pressure being placed on some industrial and sensitive land use interfaces from encroaching residential development within the Gladstone Regional Council LGA. This is particularly evident at the periphery of Barney Point. Future instances of land

use incompatibility need to be avoided through the retention and reinforcement of buffers/separation precincts. This will ensure that residential amenity is appropriately protected and industrial operations are not compromised.

6.5 Environmental areas and separation precincts

Each of the land use planning instruments operating within the proposed Gladstone port master planned area include areas either set aside for environmental purposes or to ensure appropriate separation between incompatible developments (e.g. between residential and heavy industry).

6.5.1 Gladstone Regional Council Planning Scheme 2015

- Limited Development Zone and Major Industry Buffer at Gladstone Power Station, South Trees and Boyne Island. The function of each large special industry area is protected by Major Industry Buffer precincts which prevent inappropriate adjacent development of a sensitive nature.
- Conservation Zone towards the western fringe of Gladstone City provides for the protection, restoration and management of areas (such as National Parks) identified as supporting significant biological diversity and ecological integrity.
- Environmental Management Zone limits the scale of development in areas of environmental and visual amenity significance such as on the Gladstone harbour islands (e.g. Facing Island).

6.5.2 Gladstone Ports Corporation Land Use Plan 2012

- Parkland and Education Precinct at Gladstone Marina allows public access to the water and harbour and give recreational and community benefit.
- Buffer Precincts at RG Tanna Coal Terminal and Hanson Road separate potentially incompatible port land use activities or may be used as part of the port's impact mitigation measures to separate port activities from surrounding sensitive land uses; and preserve land for future port uses.
- Environment Precinct - designated to protect land because of identified significant ecological values (including cultural heritage) (e.g. Facing Island); and to separate potentially incompatible port land use activities or is used as part of the port's impact mitigation measures to separate port activities from surrounding sensitive land uses.

6.5.3 GSDA Development Scheme 2015

- Separation Precinct – The Separation Precinct provides an appropriate separation between industrial activities within the GSDA and sensitive receptors outside the GSDA. This precinct supports the development of rural and agricultural uses where they do not compromise existing or future industrial development in the GSDA.
- Curtis Island Environmental Management Precinct - This precinct is to recognise and protect environmental values, provide opportunities for rehabilitation and enhancement of existing values, recognise and protect wetlands, vegetation and fauna habitats closely related to the Great Barrier Reef Marine Park and the Great Barrier Reef World Heritage Area.

6.6 Conclusions

This section has provided an overview of the location and nature of land use activities within the proposed Gladstone port master planned area. Activities and supporting infrastructure critical to the function of the port need to be protected from incompatible development and the future capacity of supply chain and supporting infrastructure needs to be safeguarded through appropriate land use designations within the Master Plan.

Key activities and functions of the port identified through the land use review include:

- Shipping and marine infrastructure:
 - Shipping channels and anchorages (Figure 6)
 - Wharf centres (Figure 8)
- Supply chain and supporting infrastructure:
 - Road (Figure 9)
 - Rail (Figure 10)
- Pipelines and conveyors
- Water, power and sewerage infrastructure
- Port related activities (Figure 11)
- Urban areas
- Environmental areas and separation precincts.

7 | Environmental Values



7.0 Environmental values

7.1 Introduction and context

The proposed Gladstone port master planned area is characterised by hot summers with average maximum temperatures above 30°C from December to March, and warm winter days with cool mornings. Rainfall is highest between December and February and relatively little rain falls between April and September at Gladstone. Winds are relatively strong and typically from the south east in the mornings and east to northeast in the afternoons⁸.

The desired outcomes for the environment to be achieved in the proposed Gladstone port master planned area for these values are directly related to the objectives of the Commonwealth, State and local legislative requirements which protect these values. These requirements are summarised in Table 6 and it is noted that desired outcomes for the environment for developments would require scrutiny on a case-by-case basis whilst also considering cumulative impacts of such developments to help facilitate broad-scale protection of environmental values within the proposed Gladstone port master planned area and surrounding areas.

Table 6 Environmental Values and Corresponding Protective Legislation, Policy and Planning Initiatives

Legislation and Planning Instruments	Categories of Environmental Value
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	Matters of National Environmental Significance such as World, Heritage Properties, threatened species and ecological communities, migratory species and wetlands of international importance
<i>Nature Conservation Act 1992</i> (NC Act)	Endangered and Vulnerable Species
	Near Threatened and Special Least Concern Species
	National Parks
	Other conservation areas
<i>Vegetation Management Act 1999</i> (VM Act) / <i>Sustainable Planning Act 2009</i> (SPA)	Essential Habitat
	Remnant Vegetation / Regional Ecosystems (REs)
<i>Great Barrier Reef Marine Park Act 1995</i> (GBRMP Act)	Great Barrier Reef World Heritage Area (GBRWHA), Great Barrier Reef Marine Park (GBRMP)
	Dugong Protection Areas
Strategy for the Conservation and Management of Queensland's Wetlands 1999	Wetlands
Reef Water Quality Protection Plan (Reef Plan)	Great Barrier Reef
<i>Fisheries Act 1994</i>	Declared Fish Habitat Areas
	Marine Plants

⁸ Australian Bureau of Meteorology 2015, <http://www.bom.gov.au/>

Legislation and Planning Instruments	Categories of Environmental Value
<i>Queensland Environmental Offset Act 2014</i>	Matters of National, State and Local Environmental Significance
State Planning Policy July 2014	Environment and Heritage (Biodiversity, Coastal Environment, Cultural Heritage, Water Quality)
Environmental Protection (Water) Policy 2009	Water Quality
Environmental Protection (Air) Policy 2008	Air Quality

This section identifies the terrestrial and marine environmental values present within the proposed Gladstone port master planned area with significant regard given to:

- World Heritage attributes of Outstanding Universal Value (OUV)
- Matters of National Environmental Significance (MNES)
- Matters of State Environmental Significance (MSES)
- other notable environmental features.

7.2 Outstanding Universal Value of the Great Barrier Reef World Heritage Area

An environmental value of significance within the proposed Gladstone port master planned area is the Great Barrier Reef World Heritage Area. The environment values relate to the expression of a number of attributes and maintenance of integrity that contributes to the Outstanding Universal Value of the Great Barrier Reef (GBR) at the Port of Gladstone and its surrounding area.

This section provides:

- a brief description of the Great Barrier Reef World Heritage Area (GBRWHA)
- background to the concept of Outstanding Universal Value, including descriptions of World Heritage listing criteria, integrity, protection and management measures and Statement of Outstanding Universal Value
- identification of Outstanding Universal Value key attributes represented at Gladstone.

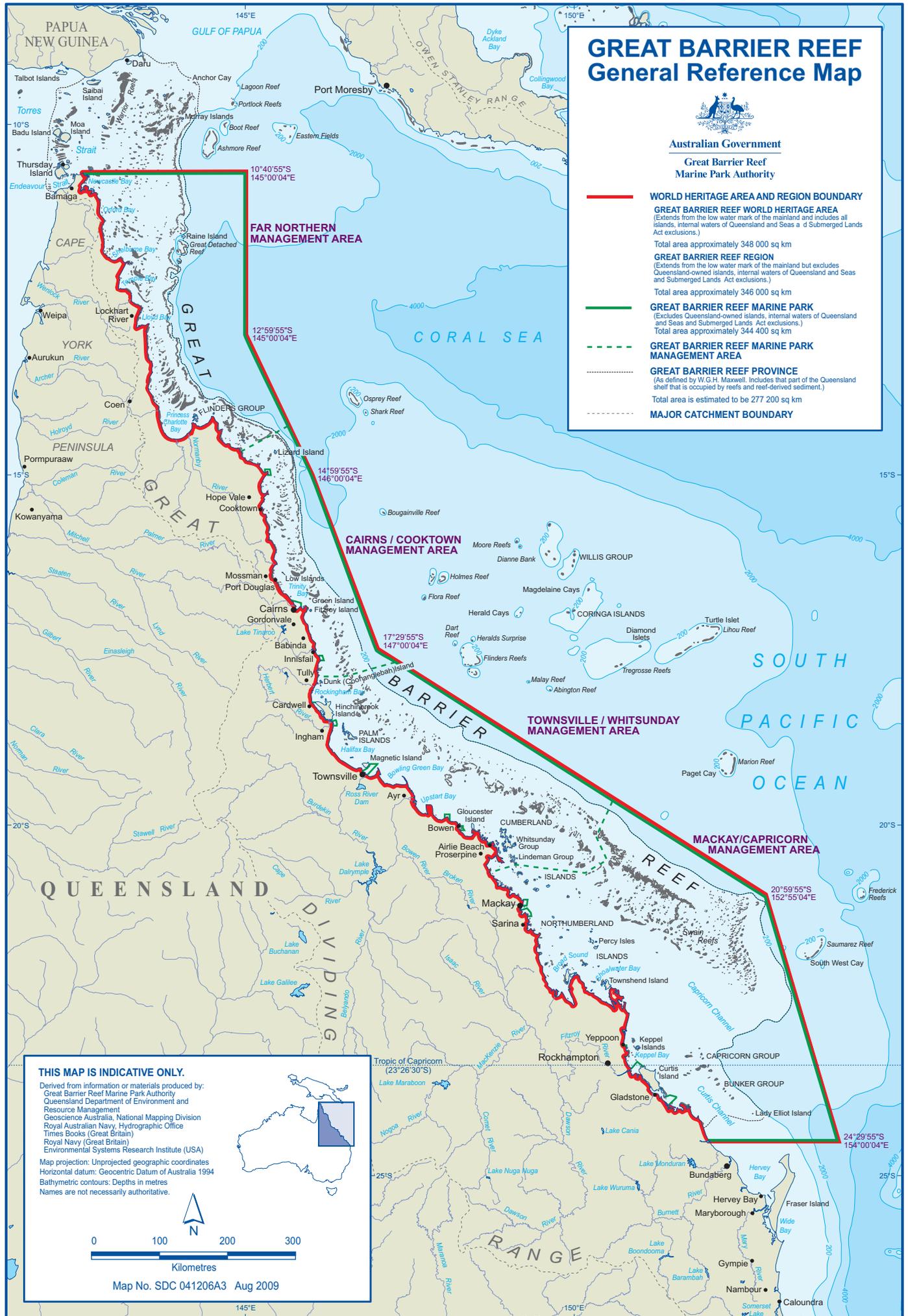
7.2.1 Great Barrier Reef World Heritage Area

The Great Barrier Reef was inscribed on the World Heritage List in recognition of its Outstanding Universal Value in 1981. It covers an area of 348,000 km² and includes:

- along the coast of Queensland for 2,000 km from the top of Cape York to just north of Fraser Island
- all islands within the outer boundary (about 1,050 islands)
- all waters seaward of low water mark (including internal waters of Queensland and port waters)
- 11 trading ports.

The GBRWHA includes the Great Barrier Reef Marine Park (refer to Figure 12).

Figure 12: Great Barrier Reef Boundaries



7.2.2 Concept of Outstanding Universal Value

Outstanding Universal Value is the fundamental concept of the World Heritage Convention and underpins the listing of properties on the World Heritage List. To be considered of Outstanding Universal Value a property needs to:

- meet one or more of ten criteria set out in the convention
- meet the conditions of integrity
- if a cultural heritage property, meet the conditions of authenticity
- have an adequate system of protection and management to safeguard its future⁹.

7.2.3 Criteria for assessing Outstanding Universal Value

For a property to be listed under the Convention, it must meet one or more of the following criteria:

- Criterion (i) – represent a masterpiece of human creative genius
- Criterion (ii) – exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design
- Criterion (iii) – bear a unique or at least exceptional testimony to a cultural tradition or to a civilisation which is living or which has disappeared or to a cultural tradition or to a civilisation which is living or which has disappeared
- Criterion (iv) – be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates a significant stage or stages in human history
- Criterion (v) – be an outstanding example of a traditional human settlement, land use or sea use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change
- Criterion (vi) – be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance
- Criterion (vii) – contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance
- Criterion (viii) – be outstanding examples representing major stages of earth's history, including the record of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features
- Criterion (ix) – be outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, freshwater, coastal; and marine ecosystems and communities of plants and animals
- Criterion (x) contain the most important and significant natural habitats for in situ conservation of biological diversity, including those containing threatened species of Outstanding Universal Value from the point of view of science or conservation.

⁹ UNESCO (2013). Operational Guidelines for the Implementation of the World Heritage Convention.

The GBR was inscribed under four of natural criteria identified above. These are:

- superlative natural beauty (Criterion vii)
- outstanding geological, geomorphic or physiographic features (Criterion viii)
- outstanding examples of ecological and biological processes (Criterion ix)
- the most important and significant natural habitats for biological diversity (Criterion x).

The GBR was the first coral reef ecosystem in the world to be made a World Heritage area¹⁰. The GBR is a place of great significance to its Traditional Owners, who continue to maintain a unique and continuing connection the Reef and adjacent coastal areas.

7.2.4 Statement of Outstanding Universal Value

A retrospective statement of the Outstanding Universal Value of the GBR was approved by the World Heritage Committee in 2012¹¹. The statement highlights the values of the GBR under each criterion as summarised briefly below:

Superlative natural beauty

The GBR provides above and below water some of the most spectacular scenery on earth. It is one of the few living structures visible from space, is an unparalleled aerial panoramic seascape of reef, islands, coral cays, mangrove forests and rugged vegetated mountains of Hinchinbrook Island. Beneath the ocean surface are spectacular coral assemblages and thousands of species of reef fish. Annual coral spawning, migrating whales, nesting turtles and significant spawning of many fish add to the superlative natural phenomena.

Outstanding geological, geomorphic or physiographic features

The GBR has evolved over millennia. The area has been exposed and flooded by at least four glacial and interglacial cycles, and in the last 15,000 years reefs have grown on the continental shelf. It is the world's largest coral reef ecosystem, with inshore fringing, mid-shelf and exposed outer reefs. The GBR has been moulded by changing climates and sea levels and through wind and water erosion over long time periods.

Outstanding example of ecological and biological processes

The unique biological diversity of the GBR reflects its maturity and includes evidence of the evolution of hard corals and some fauna. The reef currently supports over 400 species of coral, 4,000 species of molluscs, over 1,500 fish species, a great diversity of sponges, anemones, marine worms, crustaceans, as well as 240 bird species astride 2,500 individual reefs and 900 islands.

The most important and significant natural habitats for biological diversity

The GBR is one of the richest and most complex natural ecosystems on earth. Its size and diversity supports tens of thousands of marine and terrestrial species, many of which have global significance. The reef is a major feeding ground for the world's largest population of dugong, is a significant area for humpback whale calving, and supports thirty species of

¹⁰ Commonwealth of Australia. 2014. Great Barrier Reef Region Strategic Assessment – Strategic Assessment Report.

¹¹ Australian Government 2015. Reef 2050 Long-Term Sustainability Plan.

whales and dolphins, and six of the world's seven species of turtle, including the world's largest green turtle breeding site at Raine Island.

7.2.5 World heritage attributes relevant to the proposed Gladstone port master planned area

An environmental value of significance within the proposed Gladstone port master planned area is the GBRWHA. The values relate to the expression of a number of attributes and maintenance of integrity that are expressed in the terrestrial and marine environments of Gladstone and its surrounds.

The GBRWHA area includes waters seaward of the low water mark, including those around Gladstone Port, and about 1,050 islands. Figure 12 shows the proposed Gladstone port master planned area boundary in relation to the World Heritage Area and the Great Barrier Reef Marine Park, which excludes some coastal areas. Port Curtis and surrounds primarily lies within the WHA, but is situated outside the State and Commonwealth Marine Parks. The GBRMP boundary is the eastern side of Facing Island and Curtis Island and extends offshore to the limit of Australian territorial waters.

Attributes of the OUV of the GBRWHA are present within the proposed Gladstone port master planned area. Curtis Island is the largest island in the GBRWHA. Curtis Island has relatively extensive low-lying lands, no mountain range, lower rainfall and is located at the southern limit of coral reefs. The shallow sedimentary seabed and sheltered waters of the Port Curtis Basin with linked mudflat, mangrove, sandy beaches and intact vegetation shoreline areas are core physical attributes.

Water quality and the extent, condition and associated communities of seabed habitat for seagrasses and intertidal and subtidal habitat of mangroves are critical marine habitat matters within and beyond the proposed Gladstone port master planned area. The area sustains a broad range of plant and animal biological diversity of the GBRWHA. This includes mangrove communities, seagrass meadows, invertebrates, mud crabs, fish, dugong and turtles. Sheltered waters are habitat for many marine mammals and saltmarshes and wetlands are habitat for resident and migratory shorebirds and seabirds.

Some work has previously been carried out under several EIS projects to understand the relevant OUV attributes of the Great Barrier Reef World Heritage Area at Gladstone. Further guidance on how to understand OUV of the GBR WHA has been provided in:

- EPBC Act referral guidelines for the Outstanding Universal Value of the Great Barrier Reef World Heritage Area (DoE 2014)
- Great Barrier Reef Outlook Report 2014 (GBRMPA 2014)
- Independent Review of the Port of Gladstone. Report on Findings. July 2013 (Commonwealth of Australia 2013).

These documents provide examples of key attributes that contribute to OUV for the WHA. DOE indicate that attributes are not expressed equally over the whole of the property and that attributes can change over time as new information is found.

Table 7 provides an overview of the key attributes relevant to each listing criterion and if they are applicable to the proposed Gladstone port master planned area and surrounds.

Table 7 OUV attributes expressed in the proposed Gladstone port master planned area and surrounds¹²

Overview of attributes	Criterion vii – aesthetic values and superlative natural phenomena	Criterion vii – ongoing geological processes	Criterion ix – ecological and biological processes	Criterion x – biodiversity conservation
Connectivity: cross-shelf, longshore & vertical		✓	✓	✓
Continental islands	✓	✓	✓	✓
Beaches	✓			
Dune systems	✓	✓		
Fringing reefs	✓	✓	✓	✓
Inshore turbid reefs		✓	✓	✓
River deltas	✓	✓	✓	✓
Marine faunal groups diversity	✓		✓	✓
Coral species – diversity & extent	✓	✓	✓	✓
Total species diversity	✓		✓	✓
Island plant species diversity	✓		✓	✓
Seagrass	✓	✓	✓	✓
Mangroves	✓	✓	✓	✓
Marine turtles	✓			✓
Whales	✓			✓
Threatened & endangered species				✓
Dolphins	✓			✓
Seabirds	✓		✓	✓
Traditional Owner interaction with the natural environment			✓	

7.3 Methodology

Assumptions

This report has relied on the following searches of publically available ecological databases and mapping systems, accessed in September 2015. It has been supplemented by a limited literature search and it is acknowledged that there is other information on the environmental values available in the public domain which has not been reviewed for this report. It is

¹² Department of Environment and Heritage Protection. 2013. *Independent Review of the Port of Gladstone*. July 2013. DOE, Canberra.

assumed that further environmental information will be sought as the Gladstone port master planning process progresses.

- Commonwealth Department of the Environment (DOE) Protected Matters Search Tool and SPRAT profiles for threatened species and threatened ecological communities
- Queensland Department of Environment and Heritage Protection (DEHP) Wildlife Online
- Atlas of Living Australia (flora and fauna known records)
- Queensland Department of Natural Resources and Mines (DNRM) Vegetation Management Mapping and Regional Ecosystems Description Database
- DEHP Protected Plants Flora Survey Trigger Area Mapping
- DEHP Environmentally Sensitive Areas Mapping
- DEHP Referable Wetlands Mapping
- Queensland Department of Agriculture and Fisheries (DAF) Declared Fish Habitat Area Mapping, and
- DILGP SPP interactive mapping system.

A number of publically available Environmental Impact Statement (EIS) studies associated with major projects in the greater Gladstone region were also reviewed to identify environmental values and constraints pertaining to the proposed Gladstone port master planned area (Table 8).

Table 8 EIS studies undertaken within the greater Gladstone area

Date	Project	Scope and Method of Study	URL
2006 / 2007	Wiggins Island Coal Export Terminal	EIS / SEIS	http://www.wicet.com.au/irm/content/environment.aspx?RID=329
2007/2008	GPN or GNP Gladstone Nickel Project	EIS / SEIS	http://www.dilgp.qld.gov.au/assessments-and-approvals/gladstone-pacific-nickel-refinery.html
2008	Moura Link –Aldoga Rail Project	EIS	Not available
2009	QCLNG Curtis LNG Project	EIS	http://www.qgc.com.au/environment/environmental-impact-management/qclng-environmental-impact-statement-(eis).aspx
2010	APLNG Australia Pacific LNG Project	EIS	http://www.aplng.com.au/environment/our-environmental-impact-statement

Date	Project	Scope and Method of Study	URL
2010	Western Basin Dredging and Disposal Project	EIS	http://www.westernbasinportdevelopment.com.au/eis_documentation
2012	Queensland Curtis LNG Project	EIS / SEIS	http://www.qgc.com.au/environment/environmental-impact-management/qclng-environmental-impact-statement-(eis).aspx
2012	Santos Gladstone LNG Project	EIS / SEIS	http://www.santoslng.com/resource-library/glng-supplementary-eis/introduction.aspx
2013	Gladstone Steel Plant Project	EIS	http://www.statedevelopment.qld.gov.au/resources/project/gladstone-steel-making-facility/gladstone-steel-making-executive-summary.pdf
2013	Arrow LNG Plant	EIS / SEIS	http://www.dilgp.qld.gov.au/assessments-and-approvals/arrow-lng-plant.html

7.4 Landform and biota

7.4.1 Flora

7.4.1.1 Threatened Flora

Description and Context

Eighteen threatened flora species have been identified within the proposed Gladstone port master planned area with a likelihood of occurrence of either 'known' or 'possible' including:

- Yarwun Whitewood (*Atalaya collina*) - small tree to 5 m tall
- Broad-leaved Bertya (*Bertya opposens*) – slender shrub to 5 m tall
- Three-leaved Bosistoa (*Bosistoa transversa*) – medium-size tree to 22 m tall
- Miniature Moss-orchid (*Bulbophyllum globuliforme*) – tiny epiphytic orchid to 1.5 cm tall
- Wedge-leaved Tuckeroo (*Cupaniopsis shirleyana*) – small tree to 10 m tall
- Large-fruited Zamia Palm (*Cycas megacarpa*) – trunked cycad to 5 m tall
- Marlborough Blue Zamia Palm (*C. ophiolitica*) – trunked cycad to 4 m tall
- Dansiea (*Dansiea elliptica*) – large tree to 35 m tall
- Bristly Bluegrass (*Dichanthium setosum*) – densely tufted grass to 70 cm tall
- Germainia Grass (*Germainia capitata*) – tufted grass to 60 cm tall
- Scarlet Fuchsia (*Graptophyllum excelsum*) – dense shrub to 3 m tall
- Byfield Spider Flower (*Grevillea venusta*) – dense shrub to 5 m tall
- Grease Nut (*Hernandia bivalvis*) – small tree to 12 m tall
- Smooth-barked Bonewood (*Macropteranthes leiocaulis*) – tree to 25 m tall

- Mount Larcom Monkey-rope (*Parsonsia larcomensis*) – semi-woody creeper to 5 m long
- Quassia (*Samadera bidwillii*) – small shrub or tree to 6 m tall
- Coastal Xylosma (*Xylosma ovata*) – shrub to 2 m tall, and
- Mount Larcom Zieria (*Zieria actites*) – dense shrub to 1 m tall.

It is noted that this list does not include those species that are identified as ‘unlikely’ to occur within the proposed Gladstone port master planned area (as identified in Table 9). The conservation status of these species at the Commonwealth (EPBC Act) and State (NC Act) level are provided in Table 9 along with their habitat preferences, known distributional range and the likelihood of their occurrence within the master planned area.

The areas at high risk of containing these threatened or near threatened flora species in the proposed Gladstone port master planned area are reflected in the regulated vegetation mapping category for MSES in Figure 13. There is a potential for all of these species to occur within the area within and outside of their current known extent.

A key gap in relation to these species is site-specific survey information within the proposed Gladstone port master planned area in areas of potential habitat.

Potential Threats, Pressures and Impacts

Direct threats to threatened flora species in the proposed Gladstone port master planned area include:

- clearing and associated fragmentation

Indirect threats are also present in the area including:

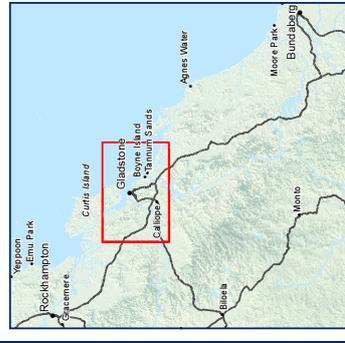
- weed invasion and disturbance
- fire or altered fire regimes
- pests
- grazing by domestic stock and agricultural practices
- timber harvesting
- damage to host trees from roadworks
- illegal harvesting
- inappropriate collection practices
- modification of water flows and soil erosion
- drought
- loss of insect pollinators, and
- low abundance leading to inbreeding and loss of genetic variation.

Figure 13

Matters of State Environmental Significance

Legend

- Cities
- Urban centres
- Local centres
- Localities
- Railway
- Highways
- Secondary Roads
- Property boundaries
- Port limits
- area boundary
- Proposed Gladstone port master planned area boundary
- Great Barrier Reef Marine Park
- MSES - Regulated vegetation (intersecting a watercourse)
- MSES Drainage
- MSES - High Ecological Significance wetlands
- MSES - Wildlife habitat
- MSES - Regulated vegetation
- MSES - Protected area



10 November 2015



0 0.5 1 2 3 4 5
Kilometres

Coordinate System: GCS GDA 1984
Datum: GDA 1984
Units: Degree

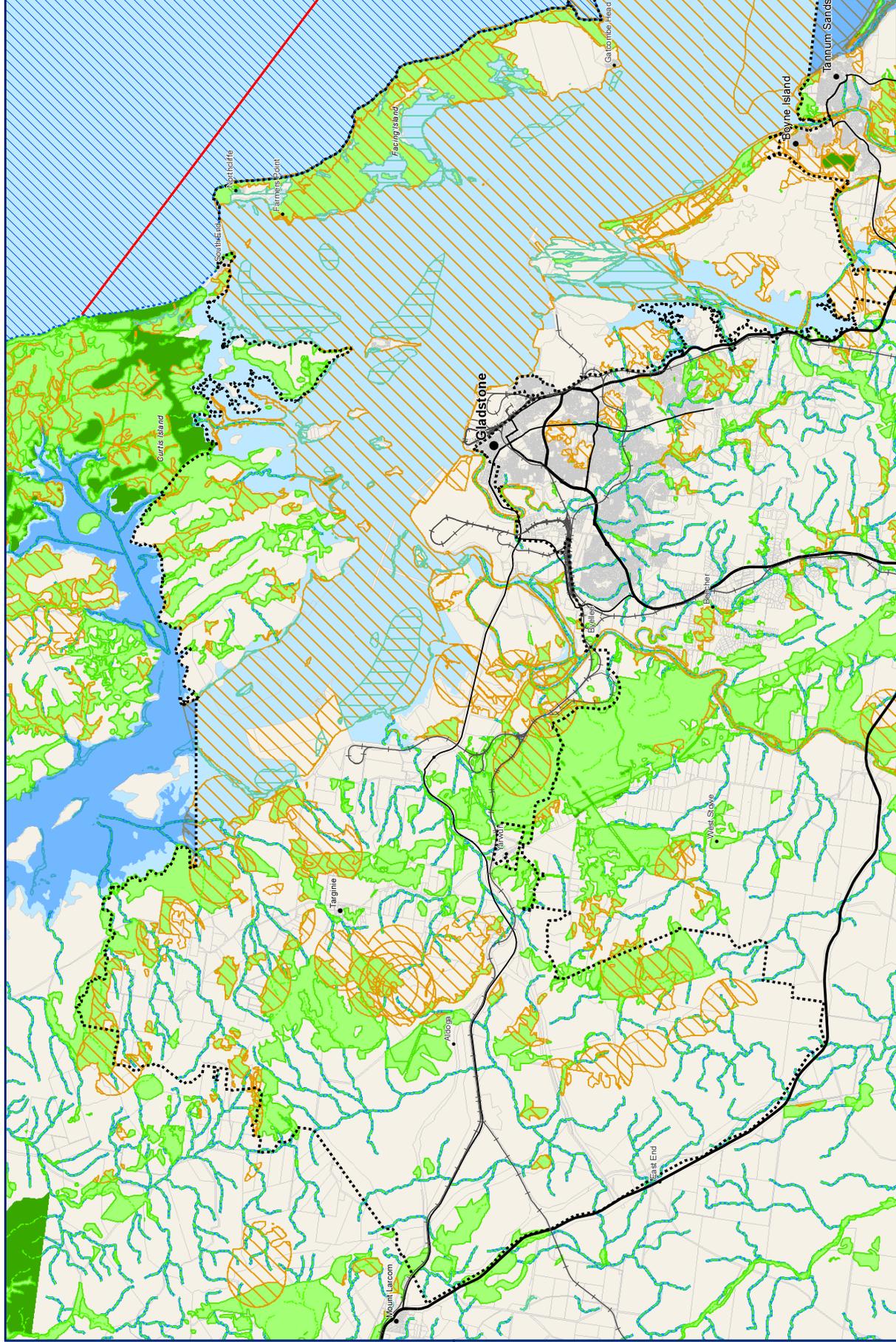


Table 9 Likelihood of occurrence of listed flora species within the proposed Gladstone port master planned area

*Conservation Status: CTH = Commonwealth (listed under the EPBC Act), QLD = Queensland (listed under the NC Act), EX = Extinct, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, NL = Not Listed.

Botanical Name Common Name Family Name	Status *		Preferred Habitat	Likelihood of Occurrence ¹³
	CTH	QLD		
<i>Acacia</i> sp. Castletower (N.Gibson TOI345) Mount Castletower Wattle Mimosaceae	NL	VU	Little known species restricted to Mount Castletower south of Gladstone in CE QLD ¹⁴ .	Unlikely. Highly restricted species known only from the type locality at Mount Castletower south of the area.
<i>Acacia storyi</i> Story's Wattle Mimosaceae	NL	NT	Open eucalypt forests with a shrub or wattle dominated understorey in sandy and shallow skeletal soils over sandstone in C QLD, from Blackdown Tablelands to the coast ¹⁴ .	Unlikely. Highly restricted species known only from the type locality on the Blackdown Tablelands in C QLD. Known record on Curtis Island north of Graham Creek is suspected to be incorrect ¹⁵ .
<i>Apatophyllum olsenii</i> Olsen's Apatophyllum Celastraceae	VU	EN	Open forests and tall shrublands in association with Queensland Peppermint (<i>Eucalyptus exserta</i>), Brush Box (<i>Lophostemon confertus</i>) and Forest Grasstree (<i>Xanthorrhoea johnsonii</i>) on granitic ridges and granite boulder outcrops in the Many Peaks Range region of C QLD ¹⁶ . This species is known from two locations south of the area.	Unlikely. Highly restricted species known only from the Many Peaks range south of the area.
<i>Atalaya collina</i> Yarwun Whitewood Sapindaceae	EN	EN	Dry rainforest and semi-evergreen vine thicket communities in dark clay soils and on hillsides in the Yarwun – Miriam Vale region of C and SE QLD ¹⁷ .	Known. Suitable habitat present in the proposed Gladstone port master planned area and populations known to the West

¹³ Atlas of Living Australia. 2015. *Atlas of Living Australia*. <http://www.ala.org.au/> viewed 24th September 2015.

¹⁴ Maslin, B.R. (coordinator). 2001. *WATTLE: Acacias of Australia. CD-ROM, Version 1.0*. Australian Biological Resources Study, Canberra, and Department of Conservation and Land Management, Perth.

¹⁵ Queensland Herbarium. 2015. pers. com.

¹⁶ McGillivray, D.T. 1971. *Apatophyllum*: An interesting new Australian genus in the Family Celastraceae. *Kew Bulletin*. 25(3): 401-6.

¹⁷ Threatened Species Scientific Committee. 2009a. *Commonwealth Conservation Advice on Atalaya collina*. DEWHA, Canberra.

Botanical Name Common Name Family Name	Status*		Preferred Habitat	Likelihood of Occurrence ¹³
	CTH	QLD		
<i>Bertya opponens</i> Broad-leaved Bertya Euphorbiaceae	VU	LC	Broad habitat range including mixed shrublands, Lancewood (<i>Acacia shirleyi</i>) woodlands, mallee, <i>Eucalyptus - Acacia</i> open forests with shrubby understorey, <i>Eucalyptus - Calltris</i> open woodlands and semi-evergreen vine thickets, in shallow red soils in coastal regions of eastern Australia ¹⁸ .	Stowe – Gravel Creek area of the proposed Gladstone port master planned area. This species is also known to the Boyne Valley area south of the area. Possible. Suitable habitat present within the study area and species is known to several areas in the vicinity of the proposed Gladstone port master planned area including Mount Muchison and Mount Castletower.
<i>Bosistoa transversa</i> Three-leaved Bosistoa Rutaceae	VU	LC	Lowland subtropical rainforests of subtropical coastal regions to 300 m altitude ¹⁹ .	Known. Suitable habitat present within the proposed Gladstone port master planned area and several populations present in the Targinie – Mount Larcom area.
<i>Bulbophyllum globuliforme</i> Miniature Moss-orchid Orchidaceae	VU	NT	Epiphyte on the scaly bark of the branches and upper trunk of mature Hoop Pine (<i>Araucaria cunninghamii</i>) trees of subtropical coastal ranges in SE QLD and NE NSW at 500 - 800 m altitude ²⁰ .	Possible. This species is known from several locations along the eastern coastline of Queensland and New South Wales. It is known from the Kroombit Tops area south-west of the area and preferred host trees are known to occur within the area.
<i>Cupaniopsis shirleyana</i>	VU	VU	Dry rainforests and scrubby urbanised areas on moderate to very	Known. Suitable habitat is present within

¹⁸ Halford, D.A. and Henderson, R.J.F. 2002. Studies in Euphorbiaceae A.L.Juss. sens. lat. 3. A revision of *Bertya* Planch. (Ricinocarpeae Mull.Arg., Bertyinae Mull.Arg.). *Austrobaileya* 6(2): 221 – 223.

¹⁹ Department of Environment, Water, Heritage and Arts (DEWHA). 2008. *Bosistoa transversa* in *Species Profile and Threats Database*. Department of the Environment and Water Resources, Canberra. http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=16091 viewed 24/09/2015.

²⁰ Department of Natural Resources. 1999. *Species Management Profiles: Flora and Fauna Information System 2*. DNR, Brisbane.

Botanical Name Common Name Family Name	Status*		Preferred Habitat	Likelihood of Occurrence ¹³
	CTH	QLD		
Wedge-leaved Tuckeroo Sapindaceae			steep slopes, scree slope gullies and rocky stream channels at 60 – 550 m altitude in SE QLD, from Brisbane to Curtis Island ²¹ .	the proposed Gladstone port master planned area and this species is known from several locations in Queensland including on the southern end of Curtis Island and Aldoga area.
<i>Cycas megacarpa</i> Large-fruited Zamia Palm Cycadaceae	EN	EN	Woodlands and open woodlands dominated by Lemon-scented Spotted Gum (<i>Corymbia citriodora</i>), Narrow-leaved Red Ironbark (<i>Eucalyptus crebra</i>), Gum-topped Bloodwood (<i>C. eynthropioides</i>), Silver-leaved Ironbark (<i>E. melanophloia</i>) and Brush Box, on rocky substrates derived from acid volcanics, ironstone and mudstone and rarely alluvium and at 40 – 680 m altitude in the Bouldercombe-Woolooga of SE QLD ²² .	Known. Suitable habitat present within the proposed Gladstone port master planned area and this species is known several populations within and in the vicinity of the port master planned area including the Targinie – Mount Larcom area.
<i>Cycas ophiolitica</i> Marlborough Blue Zamia Palm Cycadaceae	EN	EN	Woodlands and open woodlands dominated by Ghost Gum (<i>Corymbia dallachiana</i>), Gum-topped Bloodwood, Serpentine Bloodwood (<i>C. xanthope</i>) and Broad-leaved Red Ironbark (<i>Eucalyptus fibrosa</i>) on serpentine substrates; Ghost Gum, Gum-topped Bloodwood and Narrow-leaved Red Ironbark on mudstone; and Pink Bloodwood (<i>C. intermedia</i>), Narrow-leaved Red Ironbark and Queensland Blue Gum (<i>E. tereticornis</i>) on alluvial loams and at 80 – 400 m altitude in the Marlborough – Rockhampton area of C QLD ²³ .	Possible. Suitable habitat present with the proposed Gladstone port master planned area and the known extent of this species lies to the north of the area.

²¹ Threatened Species Scientific Committee. 2009b. *Commonwealth Conservation Advice on Cupaniopsis shirleyana*. DEWHA, Canberra.

²² Queensland Herbarium. 2007. *National Multi-species Recovery Plan for the Cycads, Cycas megacarpa, Cycas ophiolitica, Macrozamia lomandroides, Macrozamia pauli-guilelmi and Macrozamia platyrrhachis*. DEWHA, Canberra.

²³ Queensland Herbarium. 2007. *National Multi-species Recovery Plan for the Cycads, Cycas megacarpa, Cycas ophiolitica, Macrozamia lomandroides, Macrozamia pauli-guilelmi and Macrozamia platyrrhachis*. DEWHA, Canberra.

Botanical Name Common Name Family Name	Status*		Preferred Habitat	Likelihood of Occurrence ¹³
	CTH	QLD		
<i>Dansiea elliptica</i> Dansiea Combretaceae	NL	NT	Coastal notophyll vine forests and semi-evergreen vine thickets in sandy soils at low altitudes (30 - 150 m) in SE QLD and rainforests and rainforest margins at 100 - 500 m altitude in NE QLD ²⁴ .	Known. Suitable habitat present within the proposed Gladstone port master planned area and this species known from a number of locations within and in the vicinity of the master planned area including the West Stowe – Targinie area.
<i>Dichanthium setosum</i> Bristly Bluegrass Poaceae	VU	VU	Moderately disturbed areas including cleared woodlands, grassy roadside remnants, grazed lands and highly disturbed pastures, in heavy basaltic soils and stony red-brown hard-setting loams with clay subsoil in S QLD and N NSW ²⁵ .	Possible. Suitable habitat is present in the proposed Gladstone port master planned area and this species is known south of the master planned area in the vicinity of Lake Awoonga.
<i>Germainia capitata</i> Germainia Grass Poaceae	VU	VU	Eucalypt and paperbark woodlands in sandy soils and often seasonally inundated areas, in the Gladstone-Bundaberg region of CE QLD and Torres Strait Islands in N QLD ²⁶ .	Unlikely. Highly restricted species with disjoint populations in the Agnes Waters area south of the proposed Gladstone port master planned area and the Torres Strait.
<i>Graptophyllum excelsum</i> Scarlet Fuchsia Acanthaceae	NL	NT	Semi-evergreen vine thickets in soil pockets among rocks and in rock crevices on quite steep, rough, rocky, eroded hillsides. Found in tropical and subtropical coastal regions of CE and NE QLD, from Cape York to Port Curtis, in soils derived from limestone, sandstone and igneous rock ²⁷ .	Known. Suitable habitat present within the proposed Gladstone port master planned area and species is known from within the proposed Gladstone port master planned area (Targinie area) and surrounding area.

²⁴ Harden, G., McDonald, B. and Williams, J. 2006. *Rainforest Trees and Shrubs: A field guide to their identification*. Gwen Harden Publishing, Nambucca Heads.

²⁵ Threatened Species Scientific Committee. 2008a. *Commonwealth Conservation Advice on *Dichanthium setosum**. DEWHA, Canberra.

²⁶ Threatened Species Scientific Committee. 2008b. *Approved Conservation Advice for *Germainia capitata**. DEWHA, Canberra.

²⁷ Department of Natural Resources. 1999. *Species Management Profiles: Flora and Fauna Information System 2*. DNR, Brisbane.

Botanical Name Common Name Family Name	Status*		Preferred Habitat	Likelihood of Occurrence ¹³
	CTH	QLD		
<i>Grevillea venusta</i> Byfield Spider Flower Proteaceae	VU	VU	Mixed sclerophyll forests and woodlands and rainforests of the Port Curtis area in C QLD in a range of soil types from deep sands to shallow granitic sands and along creekbanks or ridges and often at the base of mountains ²⁸ .	Possible. Suitable habitat present within the proposed Gladstone port master planned area and this species is known to the south of the proposed Gladstone port master planned area at Mount Castletower and to the north at Shoalwater Bay.
<i>Hernandia bivalvis</i> Grease Nut Hernandiaceae	NL	NT	Rainforests, vine thickets and microphyll vine forests to 620 m altitude on coastal ranges on rock pavements and outcrops in shallow soils in SE QLD ²⁹ .	Known. Suitable habitat present within the area and this species is known from the Targinie area.
<i>Macropteranthes leiocaulis</i> Smooth-barked Bonewood Combretaceae	NL	NT	Deciduous vine thickets, semi-evergreen vine thickets and araucarian microphyll vine forests and occasionally forest and woodland habitats in red eucrozems (red, strongly structured clay soils) or sandstone talus in E QLD ³⁰ .	Known. Suitable habitat present within the proposed Gladstone port master planned area and this species is known from the Targinie area.
<i>Parsonia larcomensis</i> Mount Larcum Monkey-rope Apocynaceae	VU	VU	Open heathlands and shrublands at or near the summits of mountain peaks on cliffs or among outcrops of acid volcanic rocks and serpentinite and in shallow, loamy soils in association with Narrow-leaved Red Ironbark, <i>Xanthorrhoea</i> spp. and Serpentinite Rice Flower (<i>Pimelea leptospermoides</i>) at 350 – 750 m altitude in the Rockhampton - Mt Perry region of C QLD ³¹ .	Known. Suitable habitat present within the proposed Gladstone port master planned area and this species is known from the Targinie area.

²⁸ Department of Natural Resources. 1999. *Species Management Profiles: Flora and Fauna Information System 2*. DNR, Brisbane.

²⁹ Department of Natural Resources. 1999. *Species Management Profiles: Flora and Fauna Information System 2*. DNR, Brisbane.

³⁰ Department of Natural Resources. 1999. *Species Management Profiles: Flora and Fauna Information System 2*. DNR, Brisbane.

³¹ Department of Natural Resources. 1999. *Species Management Profiles: Flora and Fauna Information System 2*. DNR, Brisbane.

Botanical Name Common Name Family Name	Status*		Preferred Habitat	Likelihood of Occurrence ¹³
	CTH	QLD		
<i>Parsonia kroombitensis</i> Kroombit Tops Monkey Rope Apocynaceae	NL	VU	Low shrubby eucalypt woodlands and open shrublands and lithophytic ferns, at the edges of deep valleys and among outcrops of acidic volcanic rocks of CE QLD ³² .	Unlikely. Species is highly restricted to Kroombit Tops with one outlier recorded near Lake Awoonga.
<i>Phaius australis</i> Lesser Swamp-orchid Orchidaceae	EN	EN	Ecotones of swamps and forests including swampy sclerophyll forests dominated by paperbarks, swamp forests with sclerophyll emergents or fringing open forests and paperbark swamp forests associated with rainforest species and occasionally wallum, seagelands, rainforests and closed forests. Occurs in densely shaded areas in permanently damp, sandy soils (and at higher altitudes farther north) in coastal regions of SE QLD and NE NSW ³³ .	Unlikely. Broad distributional range however, preferred habitat not present within the area.
<i>Samadera bidwillii</i> Quassia Simaroubaceae	VU	VU	Lowland rainforests or rainforest margins and occasionally open forests, woodlands and mangroves in lithosols, skeletal soils, loamy sands, sands, silts and sands with clay subsoils at 1 - 617 m altitude in coastal regions ³⁴ .	Known. Suitable habitat present within the proposed Gladstone port master planned area and this species is known from the Targinie area.
<i>Sophora fraseri</i> Brush Sophora Fabaceae	VU	VU	Margins and large gaps of wet sclerophyll forests, rainforests, dry open forests, araucarian notophyll vine forests, araucarian microphyll vine forests and thickets, semi-evergreen vine thickets and riverine vine scrub in shallow soils in hilly terrain at 60 – 660 m altitude in subtropical coastal regions of S QLD and N NSW ³⁵ .	Unlikely. This species is largely restricted to SE QLD and NE NSW with northernmost extent recorded at Boyne Valley, approximately 40 km south of the area.
<i>Xylosma ovata</i>	NL	NT	Littoral rainforests in CE QLD ³⁶ .	Possible. Small areas of suitable habitat

³² Department of Natural Resources. 1999. *Species Management Profiles: Flora and Fauna Information System 2*. DNR, Brisbane.

³³ Threatened Species Scientific Committee. 2008c. *Commonwealth Conservation Advice on Phaius australis*. DEWHA, Canberra.

³⁴ Department of Natural Resources. 1999. *Species Management Profiles: Flora and Fauna Information System 2*. DNR, Brisbane.

³⁵ Department of Natural Resources. 1999. *Species Management Profiles: Flora and Fauna Information System 2*. DNR, Brisbane.

³⁶ Atlas of Living Australia. 2015. *Atlas of Living Australia*. <http://www.ala.org.au/> viewed 27th October 2015.

Botanical Name Common Name Family Name	Status*		Preferred Habitat	Likelihood of Occurrence ¹³
	CTH	QLD		
Coastal Xylosma Flacourtiaceae				are present within the proposed Gladstone port master planned area and this species is known from areas north and south of the area.
<i>Zieria acities</i> Mount Larcom Zieria Rutaceae	NL	EN	Open woodlands and shrublands, in crevices and clefts on exposed outcrops and cliff lines on the Targinie Quartz Monzonite at 630 m altitude and in association with Mount Larcom Monkey Rope, on an isolated peak of Mount Larcom, WNW of Gladstone in C QLD ³⁷ .	Known. Suitable habitat present within proposed Gladstone port master planned area and species known to the Targinie area.

³⁷ Threatened Species Scientific Committee. 2008d. *Commonwealth Conservation Advice on Zieria sp. Brolga Park (A.R. Bean 1002)*. DEWHA, Canberra.

7.4.1.2 Threatened Ecological Communities

Description and Context

Five threatened ecological communities as defined under the EPBC Act were identified as potential significant environmental values within the proposed Gladstone port master planned area, based on current state vegetation mapping.

Table 10 provides a list of threatened ecological communities potentially occurring within the proposed Gladstone port master planned area including their conservation status and corresponding regional ecosystems (REs) currently mapped on the DNRM vegetation management mapping system (Figure 14).

Table 10 Threatened Ecological Communities Potentially Occurring within the proposed Gladstone port master planned area

Threatened Ecological Community	Status*	REs Identified as Potentially Containing TEC	REs Currently Mapped within the Area	Total Area Mapped (ha)
Littoral Rainforests and Coastal Vine Thickets of Eastern Australia ³⁸	CE	3.2.1a, 3.2.1b, 3.2.12, 3.2.13, 3.2.28, 3.2.29, 3.2.31, 3.2.11, 3.12.20, 7.2.1a-l, 7.2.2.a-h, 7.2.5a, 7.2.6b, 7.11.3b, 7.12.11d, 8.2.2 and 12.2.2 (TSSC, 2008e).	12.2.2	529.0
Lowland Rainforests of Subtropical Australia ³⁹	CE	12.3.1, 12.5.13, 12.8.3, 12.8.4, 12.8.13, 12.11.1, 12.11.10, 12.12.1, 12.12.16 (TSSC, 2011b).	12.3.1	53.3
Brigalow (<i>Acacia harpophylla</i> dominant and codominant) ⁴⁰	EN	11.3.11, 11.4.3, 11.4.7, 11.4.8, 11.4.9, 11.4.10, 11.5.16, 11.9.1, 11.9.5, 11.9.6, 11.11.14, 11.12.21, 12.8.23, 12.9-10.6, 12.12.26 (TSSC, 2013a).	11.11.14	7.7
Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions ⁴¹	EN	11.3.11, 11.4.1, 11.5.15, 11.8.13, 11.9.4, 11.11.18, 11.2.3, 11.8.3, 11.8.6, 11.9.8 (TSSC, 2001).	11.11.18, 11.3.11, 11.8.3	1768.1
Subtropical and Temperate Coastal Saltmarsh ⁴²	VU	12.1.2 (TSSC, 2013b).	12.1.2	3454.2

³⁸ Threatened Species Scientific Committee. 2008d. *Commonwealth Listing Advice on Littoral Rainforest and Coastal Vine Thickets of Eastern Australia*. TSSC, Canberra.

³⁹ Threatened Species Scientific Committee. 2011b. *Commonwealth Listing Advice on Lowland Rainforest of Subtropical Australia*. TSSC, Canberra.

⁴⁰ Threatened Species Scientific Committee. 2013a. *Commonwealth Conservation Advice for Brigalow Ecological Community*. TSSC, Canberra.

⁴¹ Threatened Species Scientific Committee. 2001. *Commonwealth Listing Advice on Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions*. TSSC, Canberra.

⁴² Threatened Species Scientific Committee. 2013b. *Commonwealth Conservation Advice for Subtropical and Temperate Coastal Saltmarsh*. TSSC, Canberra.

*Status (CTH under the EPBC Act): CE = Critically Endangered, EN = Endangered, VU = Vulnerable. **based on current regulated vegetation mapping of regional ecosystems.

Potential Threats, Pressures and Impacts

Direct threats to threatened ecological communities in the proposed Gladstone port master planned area include:

- clearing and associated fragmentation / edge effects.

Indirect threats are also present in the master planned area including:

- invasive species
- inappropriate fire regimes
- disturbance from pest animals
- inappropriate grazing regimes and agricultural practices
- changes to hydrological regimes and tidal restriction
- mangrove encroachment
- inappropriate vector control practices
- pollution and litter
- eutrophication
- acid sulphate soils
- tourism and recreational disturbance
- pathogens
- climate change.

7.4.1.3 Listed Regional Ecosystems

Description and Context

The Regional Ecosystem Description Database lists the biodiversity status (BD Status) and the vegetation management class (VM class) of each regional ecosystem. The biodiversity status is based on an assessment of the condition of remnant vegetation in addition to the criteria used to determine the class under the *Vegetation Management Act 1999* (the Act). The VM class is listed in the Vegetation Management Regulation under the Act.

Regional Ecosystems (REs) are vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. They are used to describe and categorise vegetation under the Queensland *Vegetation Management Act 1999* (VM Act) and are mapped by DNRM.

Regulated vegetation includes:

- Regulated vegetation under the VMA that is mapped as 'endangered' or 'of concern' or least concern regional ecosystems
- Essential habitat area for wildlife declared as endangered or vulnerable under the NCA
- Regional ecosystems that intersect with watercourses on vegetation management watercourse mapping or with wetlands on the vegetation management wetland map.

The proposed Gladstone port master planned area is mapped as containing 65 REs including six listed as endangered, 17 listed as of concern and 42 listed as least concern

under the VM Act and constitute significant environmental values within the proposed master planned area.

The names and conservation listing status of these REs are given in Table 11 and the extent of endangered and of concern REs is illustrated in Figure 14. Least concern REs are mapped in Figure 15.

A key gap in relation to these communities is site-specific survey information within the proposed Gladstone port master planned area to confirm their presence and condition.

Table 11 Regional Ecosystems Mapped within the proposed Gladstone port master planned area

*Status: VM Class = Vegetation Management Class as listed under the VM Act, Biodiversity = Biodiversity Status under the provisions of the Queensland VM Act 1999, EN = Endangered, OC = Of Concern, LC = Least Concern, NC = No Concern at Present.

RE Code	Community Description	Status*	
		VM Act	Biodiversity Status
11.1.1	Salt Couch (<i>Sporobolus virginicus</i>) grassland on marine clay plains	LC	NC
11.1.2a	Bare mud flats on Quaternary estuarine deposits with very isolated individual stunted mangroves	LC	NC
11.1.4a	<i>Rhizophora</i> open forest on Quaternary estuarine deposits	LC	NC
11.1.4c	Yellow Mangrove (<i>Ceriops tagal</i>) +/- Grey Mangrove (<i>Avicennia marina</i>) open forest on Quaternary estuarine deposits	LC	NC
11.1.4d	Mangrove closed forest on landward edge of tidal flats and upper tidal reaches of creeks	LC	NC
11.3.4	Queensland Blue Gum (<i>E. tereticornis</i>) and / or <i>Eucalyptus</i> spp. woodland on alluvial plains	OC	OC
11.3.11	Semi-evergreen vine thicket on alluvial plains	EN	EN
11.3.25	Queensland Blue Gum or River Red Gum (<i>E. camaldulensis</i>) woodland fringing drainage lines	LC	OC
11.3.26	Gum-topped Box (<i>E. moluccana</i>) or Grey Box (<i>E. microcarpa</i>) woodland to open forest on margins of alluvial plains	LC	NC
11.3.29	Narrow-leaved Ironbark, Queensland Peppermint, <i>Melaleuca</i> spp. woodland on alluvial plains	LC	NC
11.5.2	Narrow-leaved Ironbark, <i>Corymbia</i> spp. with Gum-topped Box on lower slopes of Cainozoic sand plains and / or remnant surfaces	LC	NC
11.5.8a	Poplar Gum (<i>E. platyphylla</i>), Pink Bloodwood, Swamp Box (<i>Lophostemon suaveolens</i>) +/- Queensland Blue Gum woodland on Cainozoic sand plains and / or remnant surfaces	LC	NC
11.5.9d	Lemon-scented Spotted Gum and / or Narrow-leaved Ironbark woodland on Cainozoic sand plains and / or remnant surfaces	LC	NC
11.7.6	Lemon-scented Spotted Gum and / or Narrow-leaved Ironbark woodland on Cainozoic lateritic duricrust	LC	NC
11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks	OC	OC
11.8.4	Silver-leaved Ironbark open woodland on Cainozoic igneous rocks	LC	NC

RE Code	Community Description	Status*	
		VM Act	Biodiversity Status
11.11.3	Lemon-scented Spotted Gum, Narrow-leaved Ironbark, Yellow Stringybark (<i>E. acmenoides</i>) open forest on old sedimentary rocks with varying degrees of metamorphism and folding	LC	NC
11.11.3c	Gum-topped Box woodland on lower slopes	LC	NC
11.11.4	Narrow-leaved Ironbark woodland on old sedimentary rocks with varying degrees of metamorphism and folding	LC	NC
11.11.4a	Queensland Blue Gum woodland on old sedimentary rocks with varying degrees of metamorphism and folding	LC	NC
11.11.4b	Brown Bloodwood (<i>Corymbia trachyphloia</i>) or Yellow Stringybark, Narrow-leaved Ironbark woodland +/- Black Wattle (<i>Acacia leiocalyx</i>) on old sedimentary rocks with varying degrees of metamorphism and folding	LC	NC
11.11.4c	Gum-topped Box woodland on old sedimentary rocks with varying degrees of metamorphism and folding	LC	NC
11.11.5	Microphyll vine forest +/- Hoop Pine on old sedimentary rocks with varying degrees of metamorphism and folding	LC	NC
11.11.5a	Vine thicket, usually no Hoop Pine emergents, on old sedimentary rocks with varying degrees of metamorphism and folding	LC	NC
11.11.14	Brigalow open forest on deformed and metamorphosed sediments and interbedded volcanics	EN	EN
11.11.15	Narrow-leaved Ironbark woodland on deformed and metamorphosed sediments and interbedded volcanics	LC	NC
11.11.15a	Narrow-leaved Ironbark, Queensland Peppermint woodland on deformed and metamorphosed sediments and interbedded volcanics	LC	NC
11.11.18	Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding	EN	EN
11.12.1	Narrow-leaved Ironbark woodland on igneous rocks	LC	NC
11.12.3	Narrow-leaved Ironbark, Queensland Blue Gum, Smooth-barked Apple (<i>Angophora leiocarpa</i>) woodland on igneous rocks especially granite	LC	OC
11.12.4	Semi-evergreen vine thicket and microphyll vine forest on igneous rocks	LC	NC
11.12.6	Lemon-scented Spotted Gum open forest on igneous rocks	LC	NC
11.12.14	<i>Lophostemon</i> spp. woodland on igneous rocks	OC	OC
11.12.15	Forest Sheoak (<i>Allocasuarina torulosa</i>), Weeping Cabbage Palm (<i>Livistona decora</i>) woodland on igneous rocks	OC	OC
11.12.18	Montane shrubland on igneous rocks	OC	OC
12.1.1	Swamp Sheoak (<i>Casuarina glauca</i>) woodland on margins of marine clay plains	OC	EN
12.1.2	Saltpan vegetation including grassland, hermland and sedgeland on marine clay plains	LC	NC

RE Code	Community Description	Status*	
		VM Act	Biodiversity Status
12.1.3	Mangrove shrubland to low closed forest on marine clay plains and estuaries	LC	NC
12.2.2	Microphyll / notophyll vine forest on beach ridges	OC	EN
12.2.11	Moreton Bay Ash (<i>C. tessellaris</i>) +/- Queensland Blue Gum, Pink Bloodwood and Weeping Cabbage Palm woodland on beach ridges in northern half of bioregion	LC	NC
12.2.14	Foredune complex	LC	NC
12.2.15	Red-fruit Sawsedge (<i>Gahnia sieberiana</i>), Spreading Roperush (<i>Empodisma minus</i>), <i>Gleichenia</i> spp. closed sedgeland in coastal swamps	LC	NC
12.2.16	Sand blows largely devoid of vegetation	OC	OC
12.3.1	Gallery rainforest (notophyll vine forest) on alluvial plains	EN	EN
12.3.3	Queensland Blue Gum woodland on Quaternary alluvium	EN	EN
12.3.3d	Gum-topped Box woodland on Quaternary alluvium	EN	EN
12.3.5	Broad-leaved Paperbark (<i>Melaleuca quinquenervia</i>) open forest on coastal alluvium	LC	OC
12.3.6	Broad-leaved Paperbark +/- Queensland Blue Gum, Swamp Box open forest on coastal alluvial plains	LC	NC
12.3.7	Queensland Blue Gum, River Sheoak (<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>) +/- <i>Melaleuca</i> spp. fringing woodland	LC	NC
12.3.11	Queensland Blue Gum +/- Grey Ironbark (<i>E. siderophloia</i>), Pink Bloodwood open forest on alluvial plains usually near coast	OC	OC
12.3.12	Broad-leaved White Mahogany (<i>E. latisinensis</i>) or Queensland Peppermint, Broad-leaved Tea-tree (<i>M. viridiflora</i> var. <i>viridiflora</i>) woodland on alluvial plains	LC	OC
12.5.1	Open forest complex with Lemon-scented Spotted Gum on subcoastal remnant Tertiary surfaces	LC	NC
12.5.4	Broad-leaved White Mahogany +/- Pink Bloodwood, Brown Bloodwood, Smooth-barked Apple, Queensland Peppermint woodland on complex of remnant Tertiary surfaces and Cainozoic and Mesozoic sediments	LC	NC
12.11.4	Semi-evergreen vine thicket on metamorphics +/- interbedded volcanics	OC	OC
12.11.6	Lemon-scented Spotted Gum, Narrow-leaved Ironbark woodland on metamorphics +/- interbedded volcanics	LC	NC
12.11.7	Narrow-leaved Ironbark woodland on metamorphics +/- interbedded volcanics	LC	NC
12.11.12	Araucarian complex microphyll vine forest on metamorphics +/- interbedded volcanics	OC	OC
12.11.14	Narrow-leaved Ironbark, Queensland Blue Gum, Pink Bloodwood woodland on metamorphics +/- interbedded volcanics	OC	OC

RE Code	Community Description	Status*	
		VM Act	Biodiversity Status
12.11.17	Yellow Stringybark or White Mahogany (<i>E. portuensis</i>) open forest on metamorphics +/- interbedded volcanics	OC	OC
12.11.18	Gum-topped Box woodland on metamorphics +/- interbedded volcanics	LC	NC
12.11.19	Broad-leaved Red Ironbark woodland on metamorphics +/- interbedded volcanics	OC	OC
12.11.20	Pink Bloodwood, Swamp Box woodland on metamorphics +/- interbedded volcanics	OC	OC
12.11.21	Buloke (<i>Allocasuarina leuhmannii</i>), Fibrebark (<i>Melaleuca nervosa</i>) woodland on metamorphics +/- interbedded volcanics	OC	OC
12.12.5	Lemon-scented Spotted Gum, Narrow-leaved Ironbark woodland on Mesozoic to Proterozoic igneous rocks	LC	NC
12.12.19	Vegetation complex of rocky headlands on Mesozoic to Proterozoic igneous rocks	OC	OC

Under the Queensland *Vegetation Management Act 1999* (VM Act), a permit may be required to clear endangered, of concern or least concern vegetation (Figure 14) unless the clearing is for an exempt activity.

Potential Threats, Pressures and Impacts

Direct threats to regional ecosystems in the proposed Gladstone port master planned area include:

- clearing and associated fragmentation / edge effects.

Indirect threats are also present in the master planned area including:

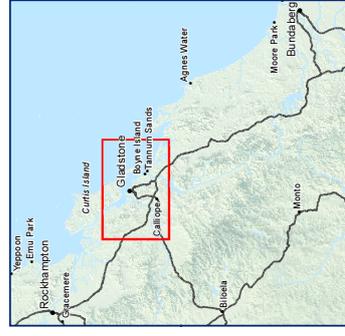
- invasive species
- inappropriate fire regimes
- changes to groundwater
- changes to hydrological regimes and tidal restriction
- tourism and recreational disturbance
- disturbance from pest animals
- inappropriate grazing regimes and agricultural practices
- mangrove encroachment
- inappropriate vector control practices
- pollution and litter
- eutrophication
- acid sulphate soils
- pathogens
- climate change.

Figure 14

Regulated vegetation

Legend

- Cities
- Urban centres
- Local centres
- Localities
- Railway
- Highways
- Secondary Roads
- Property boundaries
- Port limits
- Proposed Gladstone port master planned area boundary
- Great Barrier Reef Marine Park
- Great Barrier Reef Coast Marine Park
- Essential Habitat
- Regional Ecosystems v8.0
 - Endangered (Dominant)
 - Endangered (Sub Dominant)
 - Of Concern (Dominant)
 - Of Concern (Sub Dominant)



10 November 2015



Coordinate System: GCS GDA 1984
Datum: GDA 1984
Units: Degree

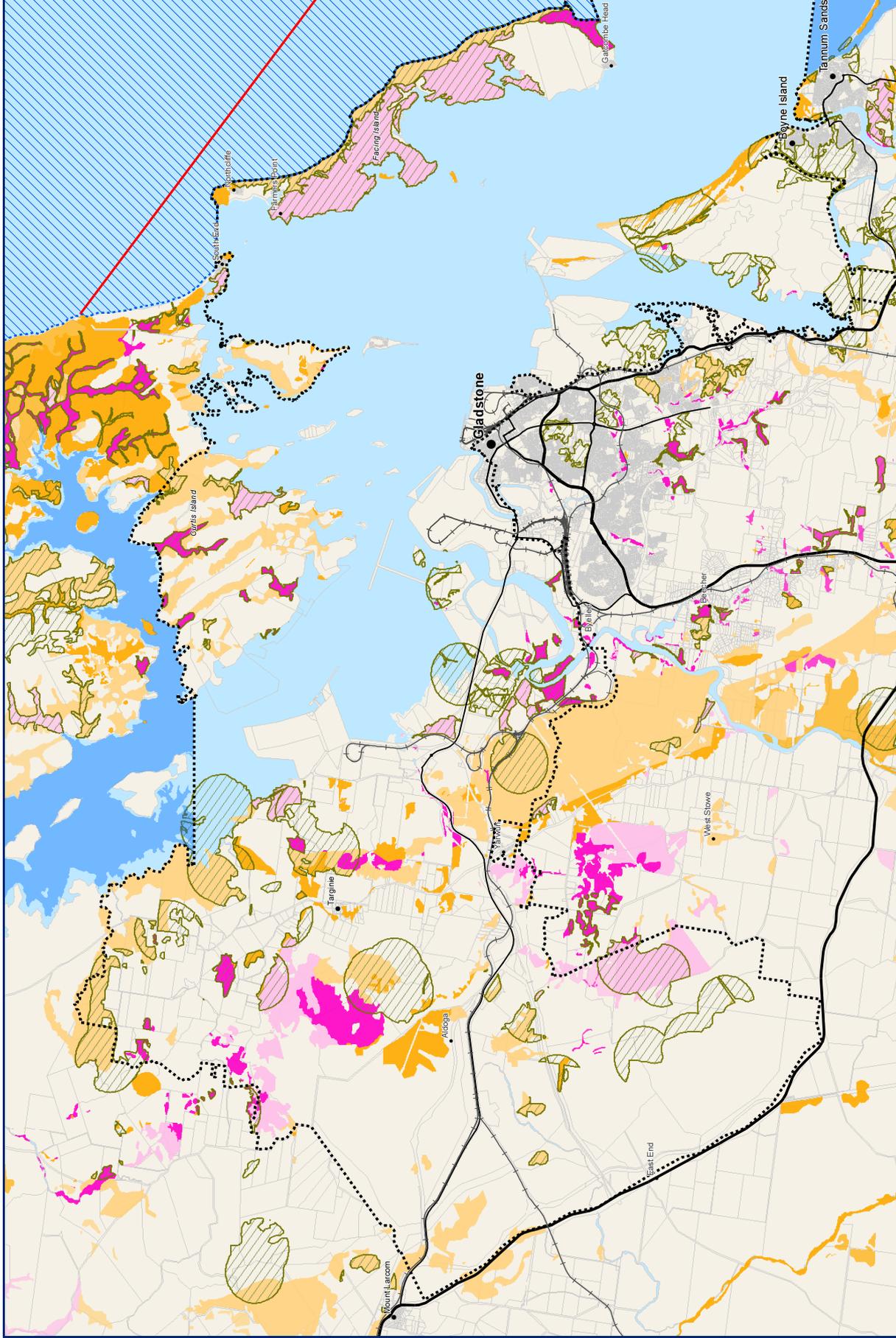
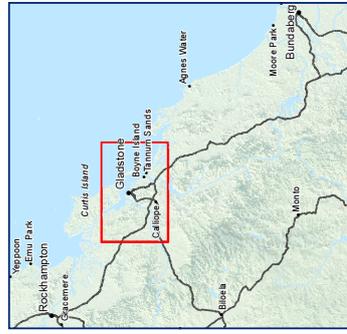
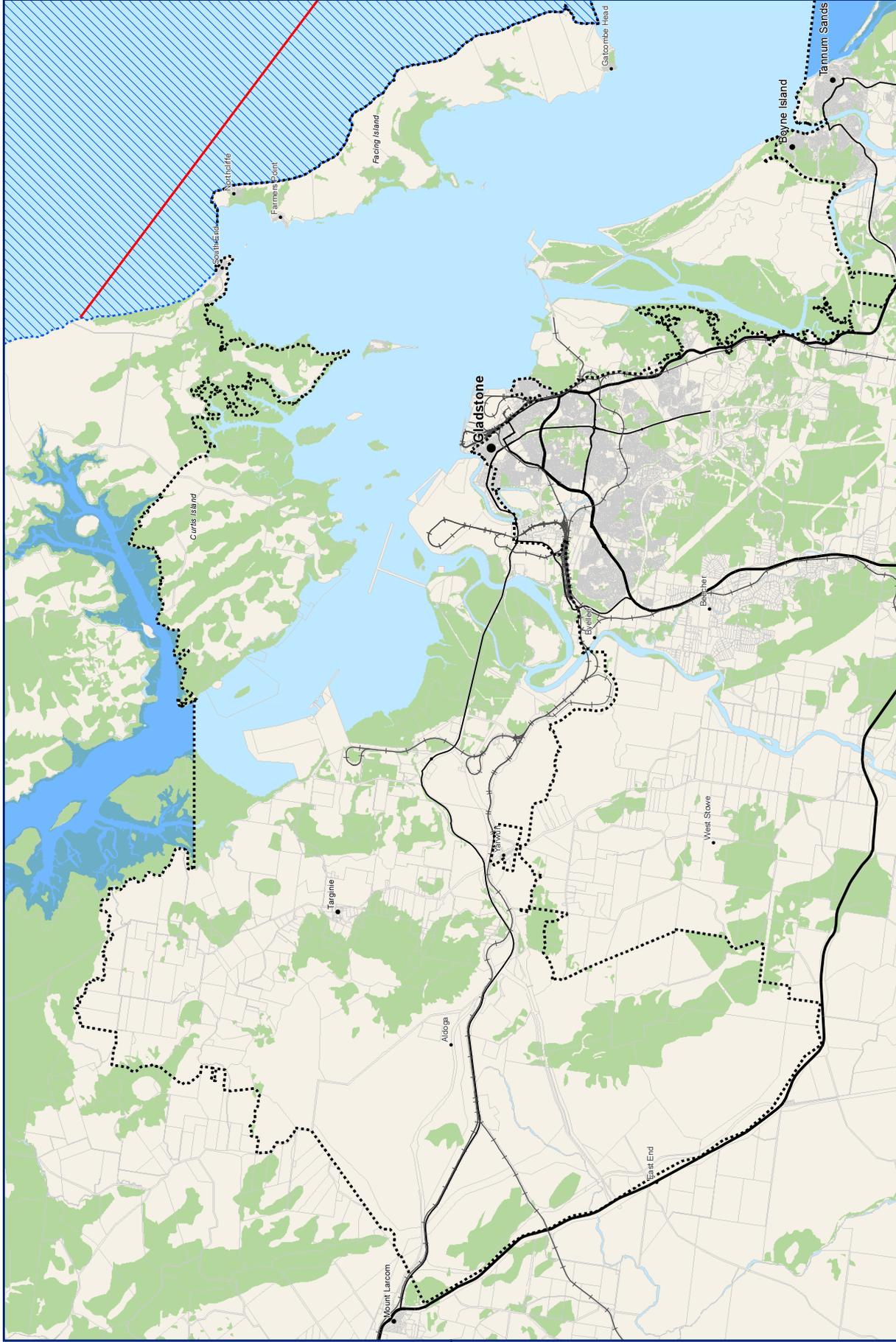


Figure 15

Least Concern vegetation

Legend

- Cities
- Urban centres
- Local centres
- Localities
- Railway
- Highways
- Secondary Roads
- Property boundaries
- Port limits
- ⋯ Proposed Gladstone port master planned area boundary
- ⋯ Great Barrier Reef Marine Park
- ⋯ Great Barrier Reef Coast Marine Park
- Regional Ecosystems v8.0
- Least concern



10 November 2015



0 0.5 1 2 3 4 5
Kilometres
Coordinate System: GCS GDA 1984
Datum: GDA 1984
Units: Degree

7.4.1.4 Invasive Species

Table 12 summarises the invasive weed species identified as potentially occurring with the proposed Gladstone port master planned area. Thirty two Weeds of National Significance (WoNS) have been identified by the Australian government based on an assessment process that prioritised these weeds based on their invasiveness, potential for spread and environmental, social and economic impact⁴³.

There are three classes of declared weeds under the *Land Protection (Pest and Stock Route Management) Act 2002*. Class 1 declared weeds are not commonly present in Queensland and if found in Queensland are subject to eradication. Class 2 declared weeds are established in Queensland and must be controlled by landowners on their property. Class 3 declared weeds are established in Queensland and must be controlled by landowners whose property is adjacent to an environmentally significant area⁴⁴.

Table 12 Likelihood of occurrence of significant weeds in the proposed Gladstone port master planned area

Botanical Name	Common Name	WoNS (Cth)	Declared (QLD)
<i>Alternanthera philoxeroides</i>	Alligator Weed	Yes	Class 1
<i>Anredera cordifolia</i>	Madeira Vine	Yes	Class 3
<i>Asparagus aethiopicus</i>	Asparagus Fern	Yes	Class 3
<i>Asparagus aethiopicus</i> cv. Sprengeri	Basket asparagus Fern	No	Class 3
<i>Asparagus africanus</i>	Climbing Asparagus	Yes	Class 3
<i>Asparagus plumosus</i> , <i>Protasparagus plumosuss</i>	Climbing Asparagus-Fern	Yes	Class 3
<i>Baccharis halimifolia</i>	Groundsel Bush	Yes	Class 2
<i>Bryophyllum delagoense</i>	Mother-of-Millions	No	Class 2
<i>Bryophyllum x houghtonii</i>	Hybrid Mother of Millions	No	Class 2
<i>Cabomba caroliniana</i>	Cabomba	Yes	Class 2
<i>Cascabela thevetia</i>	Yellow	No	Class 3

⁴³ Australian Government 2014. *Weeds of National Significance*, <http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html>.

⁴⁴ Queensland Government 2015. *Business and industry portal - Weed control laws*, <https://www.business.qld.gov.au/industry/agriculture/land-management/health-pests-weeds-diseases/weeds-and-diseases/controlling-weeds-property/weed-control-laws>.

Botanical Name	Common Name	WoNS (Cth)	Declared (QLD)
	oleander		
<i>Celtis sinensis</i>	Chinese elm	No	Class 3
<i>Chrysanthemoides monilifera</i>	Bitou Bush	Yes	Class 1
<i>Cryptostegia grandiflora</i>	Rubber Vine	Yes	Class 2
<i>Dolichandra unguis-cati</i>	Cats Claw	Yes	Class 3
<i>Eichhornia crassipes</i>	Water Hyacinth	Yes	Class 2
<i>Hymenachne amplexicaulis</i>	Hymenachne	Yes	Class 2
<i>Hymenachne amplexicaulis</i> cv. Olive	Olive Hymenachne	No	Class 2
<i>Jatropha gossypifolia</i>	Bellyache Bush	Yes	Class 2
<i>Lantana camara</i>	Lantana	Yes	Class 2
<i>Lantana montevidensis</i>	Creeping Lantana	No	Class 2
<i>Opuntia</i> spp.	Prickly Pears	Yes	Class 1
<i>Parkinsonia aculeata</i>	Parkinsonia	Yes	Class 2
<i>Parthenium hysterophorus</i>	Parthenium Weed	Yes	Class 2
<i>Prosopis</i> spp.	Mesquite	Yes	Class 1
<i>Protasparagus densiflorus</i>	Asparagus Fern	Yes	Class 3
<i>Rubus fruticosus aggregata</i>	Blackberry	Yes	Class 3
<i>Salix</i> spp.	Willows	Yes	Class 1
<i>Salvinia molesta</i>	Salvinia	Yes	Class 2
<i>Schinus terebinthifolius</i>	Broadleaf Paper Tree	No	Class 3
<i>Spathodea campanulata</i> subsp. <i>nilotica</i>	Bidgood	No	Class 2
<i>Sphagneticola trilobata</i>	Creeping Ox-eye	No	Class 3
<i>Sporobolus africanus</i>	Parramatta grass	No	Class 2
<i>Sporobolus fertilis</i>	Giant Parramatta grass	No	Class 2
<i>Sporobolus jacquemontii</i>	American	No	Class 2

Botanical Name	Common Name	WoNS (Cth)	Declared (QLD)
	Ratstail Grass		
<i>Sporobolus natalensis</i> , <i>Sporobolus pyramidalis</i>	Giant Ratstail Grass	No	Class 2
<i>Tecoma stans</i> var. <i>stans</i>	Yellow Tecoma	No	Class 3
<i>Vachellia nilotica</i>	Prickly Acacia	Yes	Class 2

7.4.2 Fauna

7.4.2.1 Threatened Terrestrial Birds

Description and Context

Fifteen conservation significant terrestrial bird species, listed under the provisions of the EPBC Act and/or NC Act, were identified from the desktop assessment as potentially occurring within the proposed Gladstone port master planned area (Table 13).

Refinement of the potential occurrence of each species, based on the likelihood of occurrence assessment, identified seven conservation significant terrestrial bird species that are known to occur within the proposed Gladstone port master planned area. In addition, six other species are considered to have a possible likelihood of occurrence within the proposed Gladstone port master planned area based on their known range and the presence of suitable habitat within the study. The remaining two species are considered unlikely to occur within the proposed Gladstone port master planned area.

The proposed Gladstone port master planned area supports suitable habitat for the species with a number of these previously recorded in the area. A key gap in relation to these species is site-specific survey information within the proposed Gladstone port master planned area in areas of potential habitat.

Potential Threats, Pressures and Impacts

Potential threats (direct and indirect) to conservation significant terrestrial bird species in the proposed Gladstone port master planned area have been identified.

Potential direct threats to these species include:

- the loss of suitable foraging and nesting habitat from vegetation clearing
- the mortality and/or injury of fauna resulting from vehicles and machine interactions.

Potential indirect threats to these species include:

- fragmentation of habitat and habitat degradation from increased edge effects
- exacerbation of weeds and pest animals
- noise, light and vehicle movements disturbing breeding periods
- alterations to freshwater hydrology and surface water quality

- fire and altered fire regimes.

Table 13 Likelihood of occurrence of listed bird species within the proposed Gladstone port master planned area

*Conservation Status: CTH = Commonwealth (listed under the EPBC Act), QLD = Queensland (listed under the NC Act), EX = Extinct, CE = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, SL = Special Least Concern, NL = Not Listed

Scientific Name Common Name	Status*		Preferred habitat	Likelihood of occurrence ⁴⁵
	CTH	QLD		
<i>Botaurus poiciloptilus</i> Australasian Bittern	EN	LC	The Australasian Bittern occurs in terrestrial wetlands and, rarely, estuarine habitats, mainly in the temperate southeast and southwest. It favours wetlands with tall dense vegetation ⁴⁶ .	Possible. Suitable habitat areas including estuarine habitats are present within the proposed Gladstone port master planned area. As such this species is considered a possible occurrence.
<i>Calidris ferruginea</i> Curlew Sandpiper	CE	SL	Species utilises the intertidal zone for foraging and roosting purposes. Habitat types within the intertidal zone include mudflats, mangrove communities, rocky shores, saltflats and salt marshes and sandy beaches ⁴⁷ .	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area near Yarwun and Southend, Curtis Island ⁴⁸ .
<i>Calyptorhynchus lathamii erebus</i> Glossy Black-cockatoo (northern)	NL	VU	The Glossy Black-cockatoo is reliant on casuarina seeds and requires habitats that include these trees. Inhabits forest and woodland with abundant casuarina trees ⁴⁹ .	Possible. Suitable habitat areas are present within the proposed Gladstone port master planned area. As such this species is considered a possible occurrence.

⁴⁵ Atlas of Living Australia. 2015. *Atlas of Living Australia*. <http://www.ala.org.au/> viewed 24th September 2015.

⁴⁶ Department of the Environment. 2015. *Species Profile and Threats Database*. Department of the Environment, Canberra.

⁴⁷ URS. 2009. *GLNG EIS Marine Ecology Technical Report*. Report prepared for Santos Ltd.

⁴⁸ ALA. 2015. *Species profile occurrence search results*. Atlas of Living Australia.

⁴⁹ Morcombe. 2004. *Field guide to Australian Birds*. Steve Parish Publishing, Archerfield, Australia.

Scientific Name Common Name	Status*		Preferred habitat	Likelihood of occurrence ⁴⁵
	CTH	QLD		
<i>Cyclopsitta diophthalma coxeni</i> Coxen's Fig-Parrot	EN	EN	Core habitat is rainforest but ventures out short distances to into woodland.	Unlikely. Core habitat unlikely to be present in large areas and therefore species unlikely to be present.
<i>Epthianura crocea macgregori</i> Yellow Chat (Dawson)	VU	EN	Occurs within coastal grassy swamps and lagoon margins in vegetation of reeds and saltbush.	Possible. Suitable habitat areas are present within the proposed Gladstone port master planned area. As such this species is considered a possible occurrence.
<i>Erythrotriorchis radiatus</i> Red Goshawk	VU	EN	The Red Goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia ⁵⁰ . The red goshawk requires woodland habitat for nesting and foraging purposes. Nest trees are invariably within 1 km of permanent water (river, swamp, pool).	Unlikely. Core habitat unlikely to be present in large areas and therefore species unlikely to be present.
<i>Esacus magnirostris</i> Beach Stone-curlew	NL	VU	The Beach Stone-curlew is confined to marine tidal habitat such as mudflats, mangroves and sandy, stony or rocky shores ⁵¹ .	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area near Targinie and Southend, Curtis Island.
<i>Falco hypoleucos</i> Grey Falcon	NL	VU	The Grey Falcon occurs within shrubland, grassland and wooded watercourses of arid and semi-arid regions ⁵² .	Possible. Suitable habitat areas are present within the proposed Gladstone port master planned area. As such this species is considered a possible occurrence.

⁵⁰ Department of the Environment (2015). *Species Profile and Threats Database*, Department of the Environment, Canberra.

⁵¹ Morcombe, M. 2004. *Field Guide to Australian Birds*. Steve Parish Publishing. Archerfield, Australia

⁵² Morcombe, M. 2004. *Field Guide to Australian Birds*. Steve Parish Publishing. Archerfield, Australia

Scientific Name Common Name	Status*		Preferred habitat	Likelihood of occurrence ⁴⁵
	CTH	QLD		
<i>Geophaps scripta scripta</i> Squatter Pigeon (southern subspecies)	VU	VU	The Squatter Pigeon (southern) occurs mainly in grassy woodlands and open eucalypt forests. The species also inhabits sown grasslands with scattered remnant trees, disturbed areas (such as roads, railways, settlements and stockyards), scrubland, Acacia regrowth and is commonly found in heavily-grazed areas north of the Tropic of Capricorn. However, it is noted that this species is considered more common in ungrazed land ⁵³ .	Known. This species was recorded within the proposed Gladstone port master planned area.
<i>Neochmia ruficauda ruficauda</i> Star Finch	EN	EN	Inhabits tall grass besides swamps and rivers, and grassy eucalypt open woodlands near watercourses ⁵⁴ .	Possible. Suitable habitat areas are present within the proposed Gladstone port master planned area. As such this species is considered a possible occurrence.
<i>Ninox strenua</i> Powerful Owl	NL	VU	The Powerful Owl is found in open forests and woodlands, as well as along sheltered gullies in wet forests with dense understoreys, especially along watercourses ⁵⁵ .	Known. This species was recorded within the proposed Gladstone port master planned area.
<i>Numenius madagascariensis</i> Eastern Curlew	CE	VU	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass ⁵⁶ .	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area in suitable habitat near Curtis Island and Barney Point (ALA, 2015).
<i>Poephila cincta cincta</i>	EN	EN	The Black-throated Finch (southern) occurs mainly in grassy, open	Known. Suitable habitat present within

⁵³ Department of the Environment. 2015. *Species Profile and Threats Database*. Department of the Environment, Canberra.

⁵⁴ Morcombe, M. 2004. *Field Guide to Australian Birds*. Steve Parish Publishing. Archerfield, Australia

⁵⁵ Morcombe, M. 2004. *Field Guide to Australian Birds*. Steve Parish Publishing. Archerfield, Australia

⁵⁶ Department of the Environment. 2015. *Species Profile and Threats Database*. Department of the Environment, Canberra.

Scientific Name Common Name	Status*		Preferred habitat	Likelihood of occurrence ⁴⁵
	CTH	QLD		
Black-throated Finch (southern)			woodlands and forests, typically dominated by Eucalyptus, Corymbia and Melaleuca, and occasionally in tussock grasslands or other habitats (for example freshwater wetlands), often along or near watercourses, or in the vicinity of water. Eucalypts commonly associated with this species include Narrow-leaved Ironbark, River Red Gum and Silver-leaved Ironbark ⁵⁷ .	the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area along the margins of South Trees Inlet east of Glen Eden.
<i>Rostratula australis</i> Australian Painted Snipe	VU	VU	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans.	Possible. Suitable habitat areas are present within the proposed Gladstone port master planned area. As such this species is considered a possible occurrence.
<i>Turnix melanogaster</i> Black-breasted Button-quail	VU	VU	The black-breasted button-quail is restricted to rainforests and forests, mostly in areas with 770-1,200 mm rainfall per annum. They prefer drier low closed forests, particularly semi-evergreen vine thicket, low microphyll vine forest, Araucarian microphyll vine forest and Araucarian notophyll vine forest.	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area along the margins of South Trees Inlet east of Glen Eden.

⁵⁷ Department of the Environment. 2015. *Species Profile and Threats Database*. Department of the Environment, Canberra.

7.4.2.2 Migratory Species

Description and Context

The desktop assessment identified 56 migratory bird species listed under the provisions of the EPBC Act were identified as potentially occurring within the proposed Gladstone port master planned area. This includes 15 migratory marine birds, 10 migratory terrestrial birds and 31 migratory wetland birds. Refinement of the potential occurrence of each species based on the likelihood of occurrence assessment identified 45 migratory species that are known to occur within the proposed Gladstone port master planned area (refer Table 14).

In addition, seven additional migratory species are considered to have a possible likelihood of occurrence within the proposed Gladstone port master planned area based on their known range and the presence of suitable habitat within the study. The remaining four migratory species are considered to have an unlikely likelihood of occurrence.

Shorebird surveys have been undertaken annually since 2011 along the Curtis Coast⁵⁸. A total of 13,752 migratory shorebirds consisting of 21 species were recorded during the survey in 2015 which found increases in Red-necked Stints, Great Knots, Bar-tailed Godwits, Greater Sand Plover and Whimbrels and decreases in numbers of Lesser Sand Plovers, Terek Sandpipers Eastern Curlew and Grey Tattlers over the 144 roost sites surveyed. Two rarely recorded species, Latham's Snipe and Little Curlew were also seen during this survey.

Counts of Eastern Curlew, now considered critically endangered, Terek Sandpiper and Grey-tailed Tattler, indicate that the Curtis Coast population may be considered a site of national significance for these species as they support 0.1 per cent of the population threshold⁵⁹.

During the 2015 survey around 100 Curlew Sandpiper were recorded on the Port Curtis coast⁶⁰.

The proposed Gladstone port master planned area supports suitable habitat for the species with a number of these previously recorded in the area. A key gap in relation to these species is site-specific survey information within the proposed Gladstone port master planned area in areas of potential habitat.

Potential Threats, Pressures and Impacts

Potential threats (direct and indirect) to migratory bird species in the proposed Gladstone port master planned area have been identified.

Potential direct threats to these species include:

- loss and disturbance of shorebird roost sites
- the loss of suitable foraging and nesting habitat from vegetation clearing

⁵⁸ Wildlife Unlimited. 2015. Gladstone Ports Corporation Report for Migratory Shorebird Monitoring Port Curtis and the Curtis Coast Annual Summer Survey – 2015.

⁵⁹ DEWHA. 2009. Significant impact guidelines for 36 migratory shorebirds – Background paper to EPBC Act policy statement 3.21. Commonwealth of Australia.

⁶⁰ Wildlife Unlimited. 2015. Gladstone Ports Corporation Report for Migratory Shorebird Monitoring Port Curtis and the Curtis Coast Annual Summer Survey – 2015.

- the mortality and/or injury of fauna resulting from vehicles and machine interactions
- disruption of migratory shorebird foraging and roosting areas

Potential indirect threats to these species include:

- fragmentation of habitat and habitat degradation from increased edge effects
- exacerbation of weeds and pest animals
- noise, light and vehicle movements disturbing breeding periods and foraging
- alterations to freshwater hydrology and surface water quality
- fire and altered fire regimes.

Table 14 Likelihood of occurrence of migratory species within the proposed Gladstone port master planned area

*Conservation Status: CTH = Commonwealth (listed under the EPBC Act), QLD = Queensland (listed under the NC Act), Mi = Migratory, SL = Special Least Concern.

Scientific Name Common Name	Status*		Likelihood of occurrence ⁶¹
	CTH	QLD	
<i>Acrocephalus australis</i> Australian Reed-warbler	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Auckland Inlet and Boyne River, Tannum Sands.
<i>Actitis hypoleucos</i> Common sandpiper	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Yarwun, Tannum Sands and Auckland Inlet.
<i>Anous stolidus</i> Common noddy	Mi	SL	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area near Tannum Sands.
<i>Apus pacificus</i> Fork-tailed swift	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Tannum Sands.
<i>Ardea alba modesta</i> Eastern Great Egret	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Mt Larcom.
<i>Ardea ibis</i> Cattle Egret	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Targinie and Boyne Island.
<i>Arenaria interpres</i> Ruddy Turnstone	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Southend, Curtis Island.
<i>Ardenna pacifica</i> Wedge-tailed shearwater	Mi	SL	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area over waters east of Tannum Sands.
<i>Ardenna tenuirostris</i> Short-tailed shearwater	Mi	SL	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area over waters near of Facing Island.

⁶¹ Atlas of Living Australia. 2015. *Atlas of Living Australia*. <http://www.ala.org.au/> viewed 24th September 2015.

Scientific Name Common Name	Status*		Likelihood of occurrence ⁶¹
	CTH	QLD	
<i>Calidris alba</i> Sanderling	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Yarwun.
<i>Calidris acuminata</i> Sharp-tailed Sandpiper	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area in Port Curtis.
<i>Calidris canutus</i> Red Knot	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Yarwun.
<i>Calidris ruficollis</i> Red-necked Stint	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Yarwun, Port Curtis and Southend, Curtis Island.
<i>Calidris subminuta</i> Long-toed Stint	Mi	SL	Possible. No records for the species are found within the area. However suitable habitat is present within the area, and thus is a possible occurrence.
<i>Calidris tenuirostris</i> Great Knot	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Southend, Curtis Island .
<i>Charadrius bicinctus</i> Double-banded Plover	Mi	SL	Possible. No records for the species are found within the area. However suitable habitat is present within the area, and thus is a possible occurrence.
<i>Charadrius leschenaultii</i> Greater Sand Plover	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Southend, Curtis Island.
<i>Charadrius mongolus</i> Lesser Sand Plover	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Southend, Curtis Island and Boyne Island.
<i>Charadrius veredus</i> Oriental Plover	Mi	SL	Unlikely. No records within the proposed Gladstone port master planned area or region. Species has a preference toward semi-arid regions such as claypans and gibberstone plains. Marine areas such as tidal mudflats are used less frequently.
<i>Coracina tenuirostris</i> Cicadabird	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Clinton and Tannum Sands.
<i>Cuculus optatus</i> Oriental Cuckoo	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Clinton and Tannum Sands.
<i>Fregata ariel</i> Lesser frigatebird	Mi	SL	Possible. Records exist for the species on offshore islands and oceanic waters adjacent to the proposed Gladstone port master planned area.
<i>Fregata minor</i> Great frigatebird	Mi	SL	Possible. Records exist for the species on offshore islands and oceanic waters near Heron Reef. Species could be a visitor to the area.
<i>Gallinago hardwickii</i> Latham's Snipe	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Yarwun and Clinton.

Scientific Name Common Name	Status*		Likelihood of occurrence ⁶¹
	CTH	QLD	
<i>Gallinago megala</i> Swinhoe's Snipe	Mi	SL	Unlikely. No records within the area. National records indicate that this species occurs across northern Australia.
<i>Gallinago stenura</i> Pin-tailed Snipe	Mi	SL	Unlikely. No records within the area. National records indicate that this species occurs across northern Australia.
<i>Gelochelidon nilotica</i> Gull-billed tern	Mi	SL	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area within Port Curtis.
<i>Hirundapus caudacutus</i> White-throated Needletail	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Mt Larcom.
<i>Hydroprogne caspia</i> Caspian tern	Mi	SL	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area throughout Port Curtis.
<i>Limicola falcinellus</i> Broad-billed Sandpiper	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Auckland Inlet and Clinton.
<i>Limosa lapponica</i> Bar-tailed Godwit	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Southend, Curtis Island and throughout Port Curtis.
<i>Limosa limosa</i> Black-tailed Godwit	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Clinton.
<i>Merops ornatus</i> Rainbow Bee-eater	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the study near Mt Larcom, Yarwun, Clinton, Camp Island and Targinie.
<i>Monarcha melanopsis</i> Black-faced Monarch	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Curtis Island.
<i>Myiagra cyanoleuca</i> Satin Flycatcher	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Yarwun and Curtis Island.
<i>Oceanites oceanicus</i> Wilson's storm-petrel	Mi	SL	Possible. Records exist for the species on offshore islands and oceanic waters near Heron Reef. Record exists within Gladstone from 130. As such, species considered a potential visitor to the area.
<i>Onychoprion anaethetus</i> Bridled tern	Mi	SL	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area near Kirkwood.
<i>Plegadis falcinellus</i> Glossy Ibis	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Barney Point.

Scientific Name Common Name	Status*		Likelihood of occurrence ⁶¹
	CTH	QLD	
<i>Pluvialis fulva</i> Pacific Golden Plover	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Clinton.
<i>Pluvialis squatarola</i> Grey Plover	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area south of Yarwun.
<i>Rhipidura rufifrons</i> Rufous Fantail	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Camp Island.
<i>Stercorarius maccormicki</i> South Polar skua	Mi	SL	Unlikely. Offshore species with records south east of Brisbane. Unlikely occurrence within area.
<i>Sterna albifrons</i> Little tern	Mi	SL	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the area near Yarwun, and waters south of Quoin Island and Southend.
<i>Sterna dougallii</i> Roseate tern	Mi	SL	Possible. Known nesting habitat east of the proposed Gladstone port master planned area on Wilson Island. Possible visitor to area.
<i>Sterna hirundo</i> Common Tern	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Parsons Point.
<i>Sterna sumatrana</i> Black-naped Tern	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area south of Quoin Island.
<i>Sula leucogaster</i> Brown Booby	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area in waters south of Quoin Island.
<i>Symposiachrus trivirgatus</i> Spectacled Monarch	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Canoe Point.
<i>Numenius minutus</i> Little Curlew	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Clinton.
<i>Numenius phaeopus</i> Whimbrel	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area in suitable habitat near Curtis Island, Barney Point and Tannum Sands.
<i>Pandion cristatus</i> Eastern Osprey	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Curtis Island, Wiggins Island, Barney Point and Tannum Sands.
<i>Tringa brevipes</i> Grey-tailed Tattler	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Targinie, Southend and Canoe Point.
<i>Tringa incana</i> Wandering Tattler	Mi	SL	Possible. No records for the species are found within the area. However suitable habitat is present within the area, and thus is a possible occurrence.

Scientific Name Common Name	Status*		Likelihood of occurrence ⁶¹
	CTH	QLD	
<i>Tringa nebularia</i> Common Greenshank	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Southend and Hay Island.
<i>Tringa stagnatilis</i> Marsh Sandpiper	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Hay Island.
<i>Xenus cinereus</i> Terek Sandpiper	Mi	SL	Known. Suitable habitat present within the area and species has been recorded from within the area near Passage Islands.

7.4.2.3 Other Listed Threatened Fauna

Description and Context

Eleven conservation significant fauna species listed under the provisions of the EPBC Act and/or NC Act were identified from the desktop assessment as potentially occurring within the proposed Gladstone port master planned area (Table 16).

Refinement of the potential occurrence of each species based on the likelihood of occurrence assessment identified one species that is known to occur within the proposed Gladstone port master planned area (Table 15). In addition, ten other fauna species are considered to have a possible likelihood of occurrence within the proposed Gladstone port master planned area based on their known range and the presence of suitable habitat within the area.

The proposed Gladstone port master planned area supports suitable habitat for these species with a number of these previously recorded in the area. A key gap in relation to these species is site-specific survey information within the proposed Gladstone port master planned area in areas of potential habitat.

Table 15 Likelihood of occurrence of other listed fauna species within the proposed Gladstone port master planned area

*Conservation Status: CTH = Commonwealth (listed under the EPBC Act), QLD = Queensland (listed under the NC Act), EX = Extinct, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, SL = Special Least Concern, NL = Not Listed.

Scientific Name Common Name	Status*		Preferred habitat	Likelihood of occurrence ⁶²
	CTH	QLD		
Mammals				
<i>Taphozous australis</i> Coastal Sheath-tail Bat	NL	NT	This species prefers to roost in sea caves and rocky clefts although it is also known to roost in boulder piles ⁶³ .	Possible. Suitable habitat areas are present within the area. As such this species is considered a possible occurrence.
<i>Xeromys myoides</i> Water Mouse	VU	VU	In south-east Queensland, Water Mouse habitat includes mangrove communities and adjacent sedgeland, grasslands and freshwater wetlands ⁶⁴ .	Possible. Suitable habitat areas are present within the area. As such this species is considered a possible occurrence.
<i>Ornithorhynchus anatinus</i> Platypus	NL	SL	Inhabits freshwater streams, lakes, shallow reservoirs and farm dams. Prefers areas with steep, vegetated banks in which to burrow ⁶⁵ .	Possible. Suitable habitat areas are present within the area. As such this species is considered a possible occurrence.
<i>Phascolarctos cinereus</i> Koala	VU	VU	Koalas occur within open woodland habitat comprising a range of Eucalypt species.	Known. Suitable habitat areas are present within the area, including essential habitat mapping.
<i>Tachyglossus aculeatus</i> Short-beaked Echidna	NL	SL	Species occurs in a variety of terrestrial habitats including desert, rainforest, open forest and farmland ⁶⁶ .	Known. Suitable habitat present within the GSDA and species has been

⁶² Atlas of Living Australia. 2015. *Atlas of Living Australia*. <http://www.ala.org.au/> viewed 27th October 2015.

⁶³ Department of the Environment. 2015. *Species Profile and Threats Database*. Department of the Environment, Canberra.

⁶⁴ Department of the Environment. 2015. *Species Profile and Threats Database*. Department of the Environment, Canberra.

⁶⁵ Menkhorst, P. and Knight, F. 2004. *A Field Guide to the Mammals of Australia*. Oxford University Press, Australia.

⁶⁶ Menkhorst, P. and Knight, F. 2004. *A Field Guide to the Mammals of Australia*. Oxford University Press, Australia.

Scientific Name Common Name	Status*		Preferred habitat	Likelihood of occurrence ⁶²
	CTH	QLD		
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	VU	VU	Roosting habitat for this species includes overhangs, caves, mine shafts and abandoned fairy martin nests which this species depends ⁶⁷ .	recorded from within the GSDA east of Mount Larcom. Possible. Suitable habitat areas are present within the GSDA. As such this species is considered a possible occurrence.
<i>Dasyurus hallucatus</i> Northern Quoll	EN	LC	The Northern Quoll occurs within rocky areas and eucalypt forests which support hollow logs, rock crevices, caves and hollow trees ⁶⁸ .	Possible. Suitable habitat areas are present within the GSDA. As such this species is considered a possible occurrence.
<i>Nyctophilus corbeni</i> Corben's Long-eared Bat	VU	VU	Occurs in a range of inland woodland vegetation types, including box, ironbark and cypress pine woodlands.	Possible. Suitable habitat areas are present within the GSDA. As such this species is considered a possible occurrence.
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	VU	LC	The Grey-headed Flying-fox requires foraging resources and roosting sites. It is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands. The Grey-headed Flying-fox roosts in aggregations of various sizes on exposed branches. Roost sites are typically located near water, such as lakes, rivers or the coast ⁶⁹ .	Possible. Suitable habitat areas are present within the GSDA. As such this species is considered a possible occurrence.

⁶⁷ Department of the Environment. 2015. *Species Profile and Threats Database*. Department of the Environment, Canberra.⁶⁸ Department of the Environment. 2015. *Species Profile and Threats Database*. Department of the Environment, Canberra.⁶⁹ Department of the Environment. 2015. *Species Profile and Threats Database*. Department of the Environment, Canberra.

Scientific Name Common Name	Status*		Preferred habitat	Likelihood of occurrence ⁶²
	CTH	QLD		
Reptiles				
<i>Egernia rugosa</i> Yakka Skink	VU	VU	The Yakka Skink occurs within woodland habitat including the species: Brigalow (<i>Acacia harpophylla</i>), Mulga (<i>A. aneura</i>), Bendee (<i>A. catenulata</i>), Lancewood (<i>A. shirleyi</i>), Belah (<i>Casuarina cristata</i>), Poplar Box (<i>Eucalyptus populnea</i>), Ironbark (<i>Eucalyptus</i> spp.) and White Cypress Pine (<i>Callitris glaucophylla</i>). Microhabitat for this species includes cavities under and between partly buried rocks, logs or tree stumps, root cavities and abandoned animal burrows ⁷⁰ .	Possible. Suitable habitat areas are present within the GSDA. As such this species is considered a possible occurrence.
<i>Furina dunmali</i> Dunmall's Snake	VU	VU	Dunmall's Snake has been found in a range of habitats including various Spotted Gum (<i>Corymbia citriodora</i>), Ironbark (<i>Eucalyptus crebra</i>) and <i>E. melanophloia</i> , White Cypress Pine (<i>Callitris glaucophylla</i>) and Bullock open forest and woodland associations on sandstone derived soils. Little is known about the microhabitat requirements of this species ⁷¹ .	Possible. Suitable habitat areas are present within the GSDA. As such this species is considered a possible occurrence.

⁷⁰ Department of the Environment. 2015. *Species Profile and Threats Database*. Department of the Environment, Canberra.

⁷¹ Department of the Environment. 2015. *Species Profile and Threats Database*. Department of the Environment, Canberra.

7.4.3 Pests

Table 16 outlines the potential faunal pest species that could occur within the proposed Gladstone port master planned area.

Table 16 Possible animal pest species in the proposed Gladstone port master planned area⁷²

Scientific Name	Common Name	Known to be present
Invertebrates		
<i>Solenopsis invicta</i>	Fire Ant	Yes, Curtis Island, Yarwun ⁷³
Birds		
<i>Acridotheres tristis</i>	Indian Myna	No
<i>Anas platyrhynchos</i>	Mallard	No
<i>Columba livia</i>	Rock Pigeon	Yes
<i>Lonchura punctulata</i>	Nutmeg Mannikin	No
<i>Passer domesticus</i>	House Sparrow	Yes
<i>Streptopelia chinensis</i>	Spotted Turtle-Dove	No
<i>Sturnus vulgaris</i>	Common Starling	No
Frogs		
<i>Rhinella marina</i>	Cane Toad	Yes
Mammals		
<i>Bos taurus</i>	Domestic Cattle	Yes
<i>Canis lupus familiaris</i>	Domestic Dog	Yes
<i>Capra hircus</i>	Goat	No
<i>Equus caballus</i>	Horse	No
<i>Felis catus</i>	Domestic Cat	Yes
<i>Lepus europeaus</i>	Brown Hare	Yes

⁷² DAF 2015. *Photo guide to pest animals*. Source: <https://www.daf.qld.gov.au/plants/weeds-pest-animals-ants/pest-animals/a-z-listing-of-pest-animals/photo-guide-to-pest-animals>.

⁷³ DAF 2015. Fire ant restricted area map and declaration notice within Gladstone. Source: https://www.daf.qld.gov.au/_data/assets/pdf_file/0015/147030/RIFA-gladstone-restricted-area.pdf.

Scientific Name	Common Name	Known to be present
<i>Mus musculus</i>	House Mouse	Yes
<i>Oryctolagus cuniculus</i>	European Rabbit	Yes
<i>Rattus rattus</i>	Black Rat	Yes
<i>Sus scrofa</i>	Pig	Yes
<i>Vulpes vulpes</i>	Red Fox	Yes
Fish		
<i>Gambusia holbrooki</i>	Mosquito fish	Yes
<i>Poecilia reticulata</i>	Guppy	Yes

It is noted that there are many environmental management programs in place in the Gladstone area, which may be active within the proposed Gladstone port master planned area. These groups and some of their activities are identified below.

- Fitzroy Basin Association, (Grazing Best Management Practice Programs, support feral animal and weed control programs, rubbish removal in waterways and beaches, tree and shrub planting, installation of cattle watering points (away from waterways)⁷⁴
- Conservation Volunteers Australia (with CQ University, quarterly surveys of marine debris)⁷⁵
- Capricorn Coast Landcare Group (land and creek rehabilitation, seed collection and plant propagation, water quality monitoring, weed buster workshops)
- Port Curtis Harbour Watch (school and community based program monitoring marine and estuarine water and substrate in Gladstone Harbour and surrounds)
- Society for Growing Australian Plants Queensland, Gladstone Branch (support the Tondoon Botanic Gardens Herbarium, advice for bush tucker school gardens, community tree planting)
- Green Army (environmental conservation, community engagement, participation and experience, skills, training and accreditation in a range of conservation management areas).

Potential Threats, Pressures and Impacts

Potential threats (direct and indirect) to conservation significant fauna species in the proposed Gladstone port master planned area have been identified.

⁷⁴ Fitzroy Basin Association. 2015. Annual Report 2014-2015. Source: <http://www.fba.org.au/wordpress/wp-content/uploads/2015/10/Fitzroy-Basin-Association-Inc-Annual-Report-2014-15.pdf>

⁷⁵ Since 2011 quarterly surveys of marine debris have collected 20,999 items, commonly plastic fragments and rope. CQU, 2015, *Ocean Rubbish is Harming Our Marine Animals*. Source: <https://www.cqu.edu.au/cquinews/stories/general-category/2015/ocean-rubbish-is-harming-our-marine-animals>

Direct threats to these species in the master planned area include:

- habitat loss
- loss of fauna movement corridors (local and regional)
- fauna mortality through collision with vehicles.

Indirect threats vary as these species have a wide range of behaviours and habitats, and include:

- fragmentation and edge effects
- fire or altered fire regimes
- pests, in particular cane toads that are ingested by northern quolls
- exacerbation of weeds
- artificial lighting, in particular lighting that disturbs foraging or roosting for bats
- disturbance from people and vehicle activity.

7.4.4 Physiography and Topography

Much of the proposed Gladstone port master planned area is a low coastal plain. Mount Larcom Range forms a prominent mountain feature, trending south to south-easterly, borders the coastal plain. Calliope and Boyne rivers flow north-north easterly through deep gorges in this coast-range barrier. Gladstone Harbour, bounded by the mainland and on the north and east by the outer continental islands of Curtis and Facing islands, contains a complex array of inlets, channels, shoals, tidal marshes, river and stream mouths, small islands and shorelines.

Figure 16 shows the prevailing topography within the proposed Gladstone port master planned area using 50m contour intervals. The land areas immediately adjacent to the port and Calliope River are predominantly flat whilst the undeveloped areas surrounding Mount Larcom and to the south east of Yarwun are characterised by undulating topography.

7.4.4.1 Description and context

The following soil types are present in the terrestrial component of the proposed Gladstone port master planned area⁷⁶:

- Hydrosols, commonly associated with acid sulphate soils, are located within the intertidal and supratidal flats
- Vertosols and sodosols are located within the alluvial systems such as swamps, channels and flat
- Rudosols, tenosols, chromosols and some sodosols associated with the higher sloping areas.

Mapping of soil types show that the yellow duplex soil category dominates the proposed Gladstone port master planned area, with non-cracking clays fringing Port Curtis⁷⁷. Soils on Curtis Island are generally shallow acid yellow –mottled duplex soils⁷⁸.

⁷⁶ Australia Pacific LNG. 2010. *Australia Pacific LNG Project: Environmental Impact Statement*. APLNG, Queensland.

Acid sulfate soils of the coastal land and tidal flat areas within the proposed Gladstone port master plan area are mapped by DNRM⁷⁹. The tidal flats are composed of fine sediment indicative of a low energy deposition of a marine dominated rather than fluvial depositional regime. Acid sulfate soils in the tidal lands or tidal zones are classified as hydrosols, with sulfidic and histic-sulfidic hydrosols typically occurring in the intertidal (mangrove) mudflats. Sulfuric hydrosols are mainly associated with saltpans (supratidal flats) or extratidal (slightly elevated marine couch) flats). Soils of the beach ridge sands are either Rudosols or Tenosols⁸⁰.

Sediments and sedimentology of the Gladstone Harbour was first described by Conaghan in 1966⁸¹. Conaghan broadly described the harbour's regional physiography and geology as a drowned river valley, with the harbour containing deep tidal channels and linear sandbanks flanked on both sides with zones of tidal flats and mangrove swamp. Textural variation of the bottom sediments were considered by Conaghan as controlled by differences in hydrography, where coarse sediments characterise the deeper channels influenced by swift tidal currents on ebb and flood tides. Finer sediment winnowed by currents are deposited on shoals, with tidal concentration of muddy sediment towards the peripheral shoals, muds deposited in sheltered areas not subject to strong currents and waves. Four broad sediment facies were found to occur; sandy, muddy, intermediate and carbonate associated with fringing coral-algal reefs. In deeper channel areas, modern marine sands are underlain with fluvial sediments probably deposited during later Pleistocene glacial periods. More recent work on Port Curtis estuary sediments state that they consist of primarily silts and clays within the shallow intertidal banks, while fine and coarse sand dominate in the more energetic deeper regions of the estuary. The estuary maintains a highly turbid character as the large tides cause significant resuspension of fine sediment and large deposits of silt from the hinterland occur in times of flood.⁸² Surface sediment median grain size (um) is mapped for the surface sediments of the inner Gladstone Harbour and used in a three dimensional sediment transport and fates model (Plate 1).

⁷⁷ Gladstone Area Water Board. 2008. Gladstone-Fitzroy Pipeline Project Environmental Impact Statement. Chapter 5. Soils and Contaminated Land (Figure 5.2).

⁷⁸ Department of Environment. 1994. Curtis Coast Study Resource Report.

⁷⁹ Queensland Government Natural Resources, Mines and Energy. 2004. Acid Sulfate Soils Tannum Sands-Gladstone, Scale 1:50,000.

⁸⁰ Ross, D.J. 2004. Acid Sulfate Soils Tannum Sands- Gladstone Area Central Queensland Coast. Department of Natural Resources & Mines.

⁸¹ Conaghan, P.J. 1966. Sediments and Sedimentary Processes in Gladstone Harbour, Queensland. University of Queensland Press.

⁸² Dunn, Ryan, Zigic, Sasha, Burling, Murray and Hsin Hui Lin. 2015. Hydrodynamic and Sediment Modelling within a Macro Tidal Estuary: Port Curtis Estuary, Australia. *Journal of Marine Science and Engineering*, 3 pp720-744.

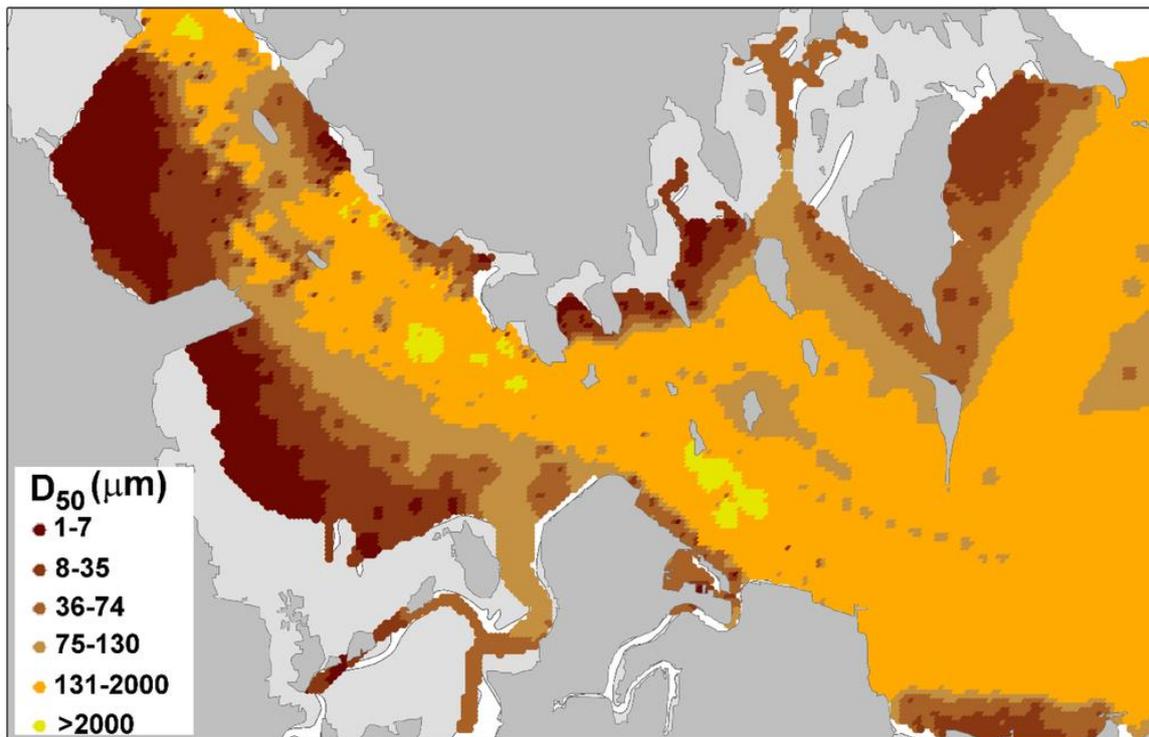


Plate 1 Surface sediment median grain size (D_{50}) map of Port Curtis Estuary⁷⁵

Marine sediment quality has been extensively examined in Port Curtis and as at 2012, 462 sample sites investigated⁸³. DEHP's 2012 reporting was undertaken after speculation that sediment bound toxicants released during dredging was related to fish health issues at Port Curtis. Findings of sediment sampling indicate that there are no conspicuous 'above guideline'⁸⁴ concentrations of elements and compounds suggestive of point sources of sediment contaminants. Specific findings from the DEHP study were that:

- No metal exceeded the ISQG guideline except for mercury taken at the mouth of the Boyne River, although all follow up sampling found less than ISQG guidelines levels at this site.
- The metalloid arsenic exceeded the ISQG low value at four sites (out of 31 sites in Port Curtis) and it is likely that arsenic and barium are present in the sediments of Port Curtis.
- Sulfur, sulphides and sulfates (naturally occurring components of marine sediments) occur at the expected range, suggesting that they are not of concern.
- Fluoride measurements (a common constituent of rock and marine sediments) are relatively low.
- No pesticides were detected in the Port Curtis sediments.

⁸³ Department of Environment and Heritage Protection. 2012. Update on the Quality of Sediment from Port Curtis and Tributaries. Water Science Technical Report Volume 2012 Number 6. State of Queensland.

⁸⁴ Australian Interim Sediment Quality Guidelines (ISQGs) 2000

- Dioxins were detected within the typical range of Australian sediments adjacent to urban and industrial environments. Arclors (commercial mixtures of PCBs which are being progressively withdrawn from sale) were not detected however.
- Tributyltin (TBT) (now banned but persists in the environment) was detected in a small number of samples but did not exceed ISQG values.
- Petroleum hydrocarbons are at low relative levels and less than NEMP ecological investigation levels in soils. Further no BTEX was detected and PAH levels did not exceed ISQG values.

A key gap in relation to soil quality on land is site-specific information within the proposed Gladstone port master planned area in undeveloped areas.

7.4.4.2 Potential threats, pressures and impacts

Direct threats to soil and marine sediment quality within the proposed Gladstone port master planned area include:

- vegetation clearing and other land use practises leading to destabilisation, sediment runoff, loss of top soil, dust creation or compaction
- construction activities leading to contamination of soil by hazardous substances.

Indirect threats to soil and marine sediment quality within the proposed Gladstone port master planned area include:

- alterations to groundwater leading to activation of potential acid sulphate soils
- increased sedimentation leading to smothering of marine communities and burial of coral, mangrove and seagrass; decreases in available sunlight and subsequent limiting of production of algae and macrophytes, increased water temperature; damage to fish (irrigation or scour of gills) or damage to fish habitat by reduction of available oxygen; reduce the success of visual predators; release of toxic organic chemicals which have been absorbed into sediment into the marine environment⁸⁵
- alterations to biogeochemical process in marine sediments such as nutrient recycling, carbon re-mineralisation and carbon burial and subsequent changes in community structure⁸⁶
- changes to marine sediment pH, ambient carbonate systems and oxygen concentrations which can affect metal mobilisation⁸⁷
- changes to nutrient status from soil management activities
- soil pollution from industrial & agricultural activities, waste disposal, and accidental oil spills.

⁸⁵ UNEP. The Caribbean Environment Program. Sedimentation and Erosion Program.

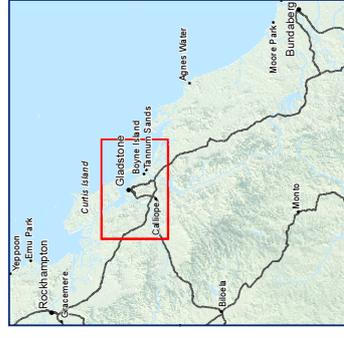
⁸⁶ Taylor, P., Lichschlag, A., Toberman, M, Sayer, M, Reynolds, A., Sato, T and H Stahl. 2015. Impact and recovery of pH in marine sediments subject to a temporary carbon dioxide leak. International Journal of Greenhouse Gas Control. Vol 38. 93-101

⁸⁷ Australian Interim Sediment Quality Guidelines (ISQGs)

Figure 16

Topography

- Legend**
- Cities
 - Urban centres
 - Local centres
 - Localities
 - Railway
 - Highways
 - Secondary Roads
 - Local Connector Roads
 - Property boundaries
 - Port limits
 - Proposed Gladstone port master planned area boundary
 - Great Barrier Reef Marine Park
 - Great Barrier Reef Coast Marine Park
 - 50m contour intervals

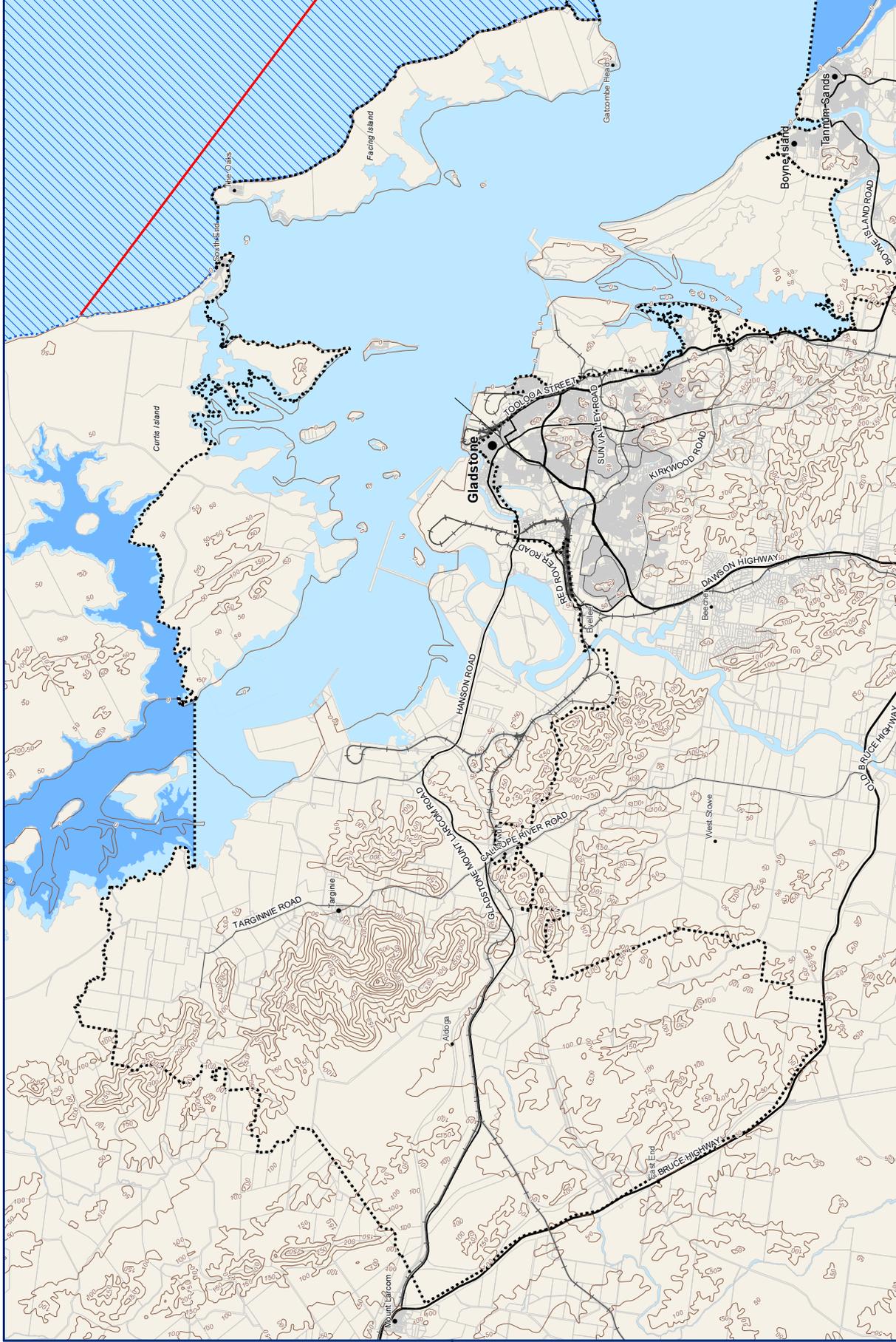


10 November 2015



0 0.5 1 2 3 4 5
Kilometres

Coordinate System: GCS GDA 1984
Datum: GDA 1984
Units: Degree



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7.5 Water Ecosystem (Marine and Estuarine)

The proposed Gladstone port master planned area is dominated by the Gladstone Harbour and port operational area. A number of reclaimed areas and berths are present along coastal areas of the mainland and channel side of Curtis Island.

For the purposes of this section, the marine water ecosystem refers to waters within and adjacent to the proposed Gladstone port master planned area. A range of species and habitats have been identified as significant environmental values of the marine water ecosystems of the proposed Gladstone port master planned area and are described in the sections below.

7.5.1 Flora

7.5.1.1 Description and Context

Mangroves

A number of mangrove species are present within the proposed Gladstone port master planned area and of which, some are considered at or near their known geographical distribution⁸⁸. Mangroves provide structurally complex habitat for juvenile fish and invertebrates.

Broad scale mapping of mangrove habitat within Port Curtis was undertaken in 2004 and to Colosseum Island in 2009, finding seventeen different types of mangrove communities⁸⁹. Generally Rhizophora communities are found to the seaward edge, backed with a narrow mixed band of Avicenna / Ceriops. Landward of these communities, extensive salt pans tended to occur with samphires and saline grass communities. Along watercourses with freshwater the mangrove species of Aegiceras and Xylocarpus are often found⁹⁰. Port Curtis contains an unusual mix of mangrove species as the region marks an overlap between the southernmost reaches of tropical mangrove species and also supports a diverse array of sub-tropical species⁹¹. The Port Curtis area also marks the southern distribution of Cedar mangrove (*Xylocarpus moluccensis*), Holly mangrove (*Acanthus ilicifolius*) and Rib fruited orange mangrove (*Bruguiera exaristata*)⁹². Twelve species of mangrove are known to occur in the Calliope River^{93&94}.

Mangroves also form remnant vegetation as discussed in Section 7.4 (Landform and Biota). Five regional ecosystems containing mangroves as identified in Table 17 are mapped in the

⁸⁸ Australia Pacific LNG. 2010. *Australia Pacific LNG Project – Environmental Impact Statement*. APLNG, Queensland.

⁸⁹ Danaher, K.F.M., Rasheed, M.A., and R. Thomas 2005. The intertidal wetlands of Port Curtis. Queensland Department of Primary Industries and Fisheries, 55

⁹⁰ Port Curtis Integrated Monitoring Program. 2011. Port Curtis Ecosystem Health Report 2008-2010, Gladstone.

⁹¹ Small, M. 1997. Fish communities of a subtropical mangrove forest, with comparison to adjacent mudflats and seagrass beds. Central Queensland University, Rockhampton Qld

⁹² Danaher, K.F.M., Rasheed, M.A., and R. Thomas 2005. The intertidal wetlands of Port Curtis. Queensland Department of Primary Industries and Fisheries, 55

⁹³ McKinnon, S, Lupton, C, Long, P. 1995. A fisheries Resource Assessment of the Calliope River System in Central Queensland 1994. Department of Primary Industries, Qld

⁹⁴ Queensland Parks and Wildlife Service. 2014. Fisheries Resources of Calliope River, Gladstone Central Queensland. State of Queensland

proposed Gladstone port master planned area as least concern regional ecosystems in Figure 15 and shown as wetlands in Figure 17.

Table 17 Regional Ecosystems containing mangroves within the proposed Gladstone port master planned area

RE	Description of vegetation communities ⁹⁵
11.1.2a	Estuarine wetlands (e.g. mangroves). Bare mud flats on Quaternary estuarine deposits, with very isolated individual stunted mangroves such as <i>Avicennia marina</i> and/or <i>Ceriops tagal</i> . May have obvious salt crusts on the soil surface.
11.1.4a	Estuarine wetlands (e.g. mangroves). <i>Rhizophora</i> spp. open forest on Quaternary estuarine deposits. This may include <i>Rhizophora stylosa</i> or <i>R. apiculata</i> as dominants, with occasional <i>Avicennia marina</i> as emergents, and subdominant <i>Bruguiera gymnorhiza</i> and/or <i>Ceriops tagal</i> . In northern areas, occasional <i>Xylocarpus moluccensis</i> may also occur. A shrub layer is usually not present. Occurs on fringing waterways low in intertidal zone, with roots submerged during high tides (Danaher 1995).
11.1.4c	Estuarine wetlands (e.g. mangroves). <i>Ceriops tagal</i> +/- <i>Avicennia marina</i> open forest on Quaternary estuarine deposits. Other mangrove species may be present as occasional individuals including <i>Rhizophora</i> spp., <i>Bruguiera</i> spp., <i>Lumnitzera</i> spp., and <i>Sonneratia</i> spp. A shrub layer is not usually present. Occurs on upstream creek edges, and toward the landward edge of the upper intertidal limit. Only inundated by spring tides (Bruinsma 2000).
11.1.4d	11.1.4d: Estuarine wetlands (e.g. mangroves). Dominated by a range of species from genera such as from <i>Avicennia</i> sp., <i>Ceriops</i> sp., <i>Rhizophora</i> sp. and <i>Bruguiera</i> sp. which form a closed forest. A low shrub layer composed of species such as <i>Acanthus ilicifolius</i> , <i>Acrostichum speciosum</i> , <i>Crinum pedunculatum</i> or juvenile canopy species is often present. Epiphytes on the canopy are common. Occurs on the landward edge of the tidal flats and in the upper tidal reaches of creeks and rivers where there is a high freshwater influence.
12.1.3	Mangrove shrubland to low closed forest. Occurs on Quaternary estuarine deposits. Six vegetation communities are included in this regional ecosystem including: 12.1.3a: <i>Aegiceras corniculatum</i> dominated low closed forest. 12.1.3b: <i>Avicennia marina</i> subsp. <i>australasica</i> dominated shrubland to low closed forest. 12.1.3c: <i>Bruguiera gymnorhiza</i> dominated shrubland to low closed forest. 12.1.3d: <i>Ceriops tagal</i> dominated shrubland to low closed forest. 12.1.3e: <i>Rhizophora stylosa</i> dominated shrubland to low closed forest. 12.1.3f: Estuarine water bodies with groundwater connectivity.

Seagrass

The seagrass beds of the Port Curtis region have been extensively investigated since 1988 and subject to extensive monitoring since 2002⁹⁶. Seagrass condition has been monitored and mapped at seven locations in Port Curtis and Rodd's Bay between from November 2009

⁹⁵ Queensland Herbarium 2014, Regional ecosystem database. Queensland Government.

⁹⁶ Bryant C, Davies, J, Sankey T, Jarvis, J and M Rasheed. 2014. Long Term Seagrass Monitoring in Port Curtis: Quarterly Seagrass Assessments & Permanent Transect Monitoring Progress Report 2009-2013. TropWater, James Cook University.

to December 2013⁹⁷, with further monitoring sites added more recently. Generally, beds and biomass peak late spring and summer and are at their lowest over winter. Seagrass beds within the proposed Gladstone port master planned area are an important food source for dugong and provide nursery habitat for many species of fish, crustacean and other marine invertebrates.

Seagrass species present within Gladstone harbour include:

- *Zostera capricorni*
- *Halophila ovalis*
- *H. decipiens*
- *H. uninervis*
- *H. spinulosa*.

Seagrass beds of the Port Curtis region are dynamic and susceptible to local climate conditions. Seagrass declines may occur as a result of high rainfall events and high inflows of freshwater leading to inputs from sediment, herbicides and reduced salinity. These inflows may also increase nutrient inputs which generally enhance seagrass growth. The most recently available mapping of the Gladstone Port's seagrass distribution is shown in Plate 2.



Plate 2 November 2013 Seagrass Distribution (Source Bryant *et al* 2014).

⁹⁷ Bryant, C. V. & Rasheed, M. A. 2013. Gladstone Permanent Transect Seagrass Monitoring – December 2013 Update report, Centre for Tropical Water & Aquatic Ecosystem Research Publication 13/50 James Cook University, Cairns.

Macro algae

PCIMP's Ecological Indicators Monitoring Program examined water macro algae (seaweeds and algae etc.) during 2008-2010 on settlement devices deployed in the Port Curtis area. Findings suggest that large seasonal effects were evident, with greater abundance and higher species diversity during winter⁹⁸. Overall diverse macro algal communities are found throughout the Port Curtis area.

Coral Communities

It is noted that whilst coral is faunal in its composition, it has a number of characteristics comparable to flora and as such has been included within Section 7.5.1. Coral and rocky reef communities occur around Port Curtis and those surveyed appear to be typical of fringing coral reefs on the southern inshore Great Barrier Reef. Around Port Curtis the reefs are composed of coral and other benthic organisms growing on rocks or boulders, as compared with true carbonate reefs⁹⁹. Coral species richness is relatively low compared to areas to the north and also low on inshore reefs compared with mid shelf and outer shelf reefs. Coral cover has been surveyed in the North Passage, the western and southern sides of Facing Island and the sheltered side of Curtis Islands. The location of reefs have been mapped and described by GBRMPA and BMT WBM for the Port of Gladstone Corporation (Figure 2.1 in¹⁰⁰) within the broader Port Curtis area. Known reefs within or on the boundary of the proposed Gladstone port master planned area include those at the following locations:

- North Entrance – Rat Island Reef, North Point, Oaks Reef (Facing Island No 2) and Farmers Reef
- South Channel – reefs around Seal Rocks (Reef No 1), Curtis Rock, East Banks and Gatcombe Head
- Inside Port Curtis – Manning Reef (inside of Facing Island), Bushy Island and Turtle Island.

The BMT WBM study on coral cover and condition found that:

- Most of the reefs surrounding Facing Island are similar in terms of broad community type that is they have moderate hard coral cover, moderate algal cover, low soft coral and other invertebrate cover except for Manning Reef and Farmers Reef
- Manning Reef has high cover of hard coral
- Farmers Reef has high cover of soft coral
- Reef communities at Turtle Island have little coral cover and extensive algal cover.

The Gladstone Harbour Report Card 2015 provides information on coral health around the harbour, through monitoring the health of the reefs and coral habitats between June 2014 and July 2015. Three indicators were assessed to ascertain the overall health of the coral; combined cover of hard and soft coral, macroalgal (algae) cover, and juvenile coral density.

⁹⁸ Port Curtis Integrated Monitoring Program 2011, Port Curtis Ecosystem Health Report 2008 – 2010, <<http://www.pcimp.com.au/PDFs/PCIMP%20Report%202008-2010.pdf>>.

⁹⁹ Sea Research. 2011. The impact of dredge spoil dumping on fringing coral reefs around Facing Island. Report for Gladstone Ports Corporation Limited.

¹⁰⁰ BMT WBM. 2014. Identification of Coral Reef Sites for Restoration and Enhancement in Port Curtis – Phase 1. Figure 2.1.

The overall grade for coral was very poor (E). This result was due to low cover of living corals, low abundance of juvenile corals, and high macroalgal cover at most of the surveyed reefs.

7.5.1.2 Potential Threats, Pressures and Impacts

Marine flora in the proposed Gladstone port master planned area are directly threatened by:

- clearance (particularly for mangroves)
- catchment runoff (generating nutrients or reducing salinity) and point source discharge (particularly for coral)
- capital dredging (for seagrass)
- crown of thorn starfish outbreaks (coral).

Indirect threats to marine flora in the proposed Gladstone port master planned area include:

- changes to hydrological regimes
- changes to water quality (herbicides impact on salt excreting mangroves particularly¹⁰¹)
- increased sediment loads (which can cause gains in mangrove distribution and through turbidity, losses in seagrass and coral)^{96 & 102}
- climate change, particularly extreme rainfall and river discharge events. Cyclonic events cause change in coral cover in a minor way by damaging tips or edges of coral through to severely damaging or removing coral and coral communities. After damage from such severe wind and wave events and underwater turbulence, further changes can occur on reef structures including extensive growth of algae over injured colonies which blanket damaged reef structure (possibly due to increases in available nutrients)¹⁰³.
- flood plumes, caused by intense rainfall can expose large areas to stressful changes in water quality. Seagrass can be ripped up by large waves, and deeper seagrass meadows can be scoured by strong currents. Mangroves and wetlands can be impacted by wind and prolonged inundation¹⁰⁴.

7.5.2 Fauna

Twenty-five conservation significant marine and estuarine fauna species listed under the provisions of the EPBC Act and/or NC Act were identified from the desktop assessment as potentially occurring within the proposed Gladstone port master planned area (Table 18).

Refinement of the potential occurrence of each species based on the likelihood of occurrence assessment identified four species that are known to occur within the proposed Gladstone port master planned area (Table 18). In addition, 17 other species are considered to have a possible likelihood of occurrence within the proposed Gladstone port master planned area based on their known range and the presence of suitable habitat within the study. The

¹⁰¹ Mangrove Watch Australia, a new monitoring program that partners mangrove scientists and community participants. http://www.mangrovetwatch.org.au/index.php?option=com_content&view=category&layout=blog&id=26&Itemid=300161

¹⁰² BMT WBM. 2014. Identification of Coral Reef Sites for Restoration and Enhancement in Port Curtis – Phase 1.

¹⁰³ Great Barrier Reef Marine Park Authority. 2011. Impacts of tropical cyclone Yasi on the Great Barrier Reef. A report on the findings of a rapid ecological impact assessment. Commonwealth of Australia

¹⁰⁴ Great Barrier Reef Marine Park Authority. 2011. Extreme weather and the Great Barrier Reef. Commonwealth of Australia

remaining four conservation significant fauna species are considered unlikely to occur within the proposed Gladstone port master planned area.

All of the Gladstone port area is broadly identified as an area of occupancy for Indo-Pacific humpback (*Sousa sahalensis*) and Australian snubfin dolphin (*Orcaella heinsohni*) by the Great Barrier Reef Marine Park Authority¹⁰⁵. Intensive survey during 2006 and 2008 indicates that the Indo Pacific dolphin tends to occur within the coastal waters of the proposed Gladstone port master planned area and Rodds Harbour, while the Australian snubfin has only been observed in the waters around Keppel Bay and Fitzroy estuary to the north of the master planned area¹⁰⁶ & ¹⁰⁷. Population estimates indicate that 84 snubfin dolphins live year round mostly in the Fitzroy River estuary, whereas about 200 humpback dolphins live in the Fitzroy River and Port Curtis area. A resident population of Indo-Pacific humpback dolphin occur within Auckland Creek¹⁰³.

Green turtle movement has been tracked around Wiggin Island and Pelican Banks during 2013 using acoustic and satellite tags. Findings indicate average home ranges between from 1.3 to 6.7 km² including seasonal and monthly variations due to movement between both locations and also with seagrass density¹⁰⁸.

Benthic macro-invertebrate communities are found in the deeper water section of the proposed Gladstone port master planned area with differences in communities found inside Facing Island where they are dominated by low density benthic macro-invertebrate communities and the inner port which is dominated with highly diverse and high density communities¹⁰⁹. These differences are likely a result of high tidal currents in the inner port channels.

Table 18 Likelihood of occurrence of listed marine fauna species within the proposed Gladstone port master planned area

*Conservation Status: CTH = Commonwealth (listed under the EPBC Act), QLD = Queensland (listed under the NC Act), EX = Extinct, CE = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, SL = Special Least Concern, NL = Not Listed, Mi = Migratory.

Scientific Name Common Name	Status*		Likelihood of occurrence ¹¹⁰
	CTH	QLD	
Sea Birds			
<i>Diomedea exulans</i> Wandering Albatross	VU	VU	Known. Suitable habitat present within the proposed Gladstone port master planned area and species has been recorded from within the proposed Gladstone port master planned area near Boyne Island.

¹⁰⁵ Great Barrier Reef Marine Park Authority. 2014. Great Barrier Reef Region Strategic Assessment: Strategic Assessment Report, GRMPA Townsville, Figure 7.5 in Chapter 7 Current condition and trend.

¹⁰⁶ Gladstone Port Corporation. No date. Dolphins Fact Sheet. www.gpcl.com.au/Big6

¹⁰⁷ Cagnazzi, D. 2013. Review of Coastal Dolphins in central Queensland, particularly Port Curtis and Port Alma regions. Gladstone Port Corporation

¹⁰⁸ Babcock, R. Baird, M., Pillans, R, Patterson, T, Clementson, L, Haywood, M, Rochester, W, Morello, E, Kelly, N, Ouberkheir K, Fry G, Dunbabin, M Perkins, S, Forecy K, Cooper, S, Adams, M, O'Brien, K, Donovan, A, Kenyon, R, Carlin, G, Wild-Allen, K, Limpus, C. 2015. An integrated study of Gladstone marine system. CSIRO Oceans and Atmosphere.

¹⁰⁹ Rasheed, M.A, Thomas R., Roelofs A.J., Niel, K.M and Kerville, S.P 2003. Port Curtis and Rodds Bay seagrass and benthic macro-invertebrate community baseline survey, November/December 2002. DPI Information Series Q103058, Cairns

¹¹⁰ Atlas of Living Australia. 2015. *Atlas of Living Australia*. <http://www.ala.org.au/> viewed 27th October 2015.

Scientific Name Common Name	Status*		Likelihood of occurrence ¹¹⁰
	CTH	QLD	
<i>Fregetta grallaria grallaria</i> White-bellied Storm-Petrel	VU	LC	Possible. Species may utilise coastal waters within and adjacent to the proposed Gladstone port master planned area.
<i>Pachyptila turtur subantarctica</i> Fairy Prion (southern)	VU	LC	Possible. Species may utilise coastal waters within and adjacent to the proposed Gladstone port master planned area.
<i>Phoebastria fusca</i> Sooty Albatross	VU	VU	Possible. Species may utilise coastal waters within and adjacent to the proposed Gladstone port master planned area.
<i>Pterodroma heraldica</i> Herald Petrel	CE	EN	Possible. Species may utilise coastal waters within and adjacent to the proposed Gladstone port master planned area.
<i>Pterodroma neglecta neglecta</i> Kermadec Petrel (western)	VU	LC	Possible. Species may utilise coastal waters within and adjacent to the proposed Gladstone port master planned area.
<i>Thalassarche cauta cauta</i> Shy Albatross	VU	VU	Possible. Species may utilise coastal waters within and adjacent to the proposed Gladstone port master planned area.
<i>Thalassarche cauta salvini</i> Salvin's Albatross	VU	LC	Possible. Species may utilise coastal waters within and adjacent to the proposed Gladstone port master planned area.
<i>Thalassarche cauta steadi</i> White-capped Albatross	VU	VU	Possible. Species may utilise coastal waters within and adjacent to the proposed Gladstone port master planned area.
<i>Thalassarche eremita</i> Chatham Albatross	EN	LC	Possible. Species may utilise coastal waters within and adjacent to the proposed Gladstone port master planned area.
<i>Thalassarche melanophris</i> Black-browed Albatross	VU	LC	Possible. Species may utilise coastal waters within and adjacent to the proposed Gladstone port master planned area.
<i>Thalassarche melanophris impavida</i> Campbell Albatross	VU	LC	Possible. Species may utilise coastal waters within and adjacent to the proposed Gladstone port master planned area.
Marine Turtles			
<i>Caretta caretta</i> Loggerhead Turtle	EN	EN	Possible. Records exist outside the proposed Gladstone port master planned area near Heron Reef. Species is a possible occurrence within the proposed Gladstone port master planned area.
<i>Chelonia mydas</i> Green Turtle	VU	VU	Known. Suitable habitat present within the proposed Gladstone port master planned area and this species has been recorded from within the proposed Gladstone port master planned area near Hamilton Point, Curtis Island.
<i>Dermochelys coriacea</i> Leatherback Turtle	EN	EN	Possible. Records exist south of Gladstone toward Seventeen Seventy. Species may disperse through the proposed Gladstone port master planned area and is as such a possible occurrence.

Scientific Name Common Name	Status*		Likelihood of occurrence ¹¹⁰
	CTH	QLD	
<i>Eretmochelys imbricata</i> Hawksbill Turtle	VU	VU	Possible. Nearest records exist north of the proposed Gladstone port master planned area near Yeppoon. Species may disperse through the proposed Gladstone port master planned area and is as such a possible occurrence.
<i>Lepidochelys olivacea</i> Olive Ridley Turtle	EN	EN	Possible. No records occur within the proposed Gladstone port master planned area. Distribution of the species suggests species may disperse through the proposed Gladstone port master planned area.
<i>Natator depressus</i> Flatback Turtle	EN	VU	Possible. Records exist immediately adjacent to the proposed Gladstone port master planned area on Curtis Island and east of Facing Island. As such, the flatback turtle is considered a possible occurrence.
Marine Mammals			
<i>Balaenoptera musculus</i> Blue Whale	VU	VU	Unlikely. The distribution and majority of records for the blue whale in Australia occurs primarily in the Southern Ocean ¹¹¹ .
<i>Megaptera novaeangliae</i> Humpback Whale	VU, Mi	VU	Possible. Humpback whales migrate along the continental shelf on the eastern coastline and the proposed Gladstone port master planned area is identified as an area of occupancy ¹¹² .
<i>Dugong dugon</i> Dugong	Mi	VU	Known. Dugongs are known to occur within the proposed Gladstone port master planned area, throughout Gladstone Harbour ¹¹³ .
Sharks			
<i>Carcharodon carcharias</i> Great White Shark	VU	LC	Unlikely. Known to occur in cooler waters found in southern portions of Australia. This species is an unlikely occurrence.
<i>Pristis zijsron</i> Green Sawfish	VU, Mi	LC	Unlikely. Records indicate that the Green Sawfish occurred along the east coast of Queensland and NSW prior to the 1960s, however, after this period there have been no reports of this species south of Cairns. As such, this species is an Unlikely occurrence.
<i>Rhincodon typus</i> Whale shark	VU, Mi	LC	Unlikely. No records for the whale shark occur within the proposed Gladstone port master planned area. The distribution of the species extends along the eastern coast, however, the species is unlikely to occur within the proposed Gladstone port master planned area.

¹¹¹ Menkhorst, P. and Knight, F. 2004. *A Field Guide to the Mammals of Australia*. Oxford University Press, Australia.

¹¹² GBRMPA. 2014. Great Barrier Reef Region Strategic Assessment – Strategic Assessment Report. Great Barrier Reef Marine Park Authority

¹¹³ Soltzick, S., Grech, A., Coles, R., Cagnazzi, D. and Marsh, H. 2013. *Status of the dugong population in the Gladstone area. A Report for Gladstone Ports Corporation Limited for Project CA 120017: Monitoring of Dugongs*, Centre for Tropical Water & Aquatic Ecosystem Research (TropWATER) Publication, James Cook University, Townsville, 37 pp.

Potential Threats, Pressures and Impacts

Potential threats (direct and indirect) to conservation significant marine species in the proposed Gladstone port master planned area have been identified.

Direct threats to marine fauna include:

- mortality as a result of vessel strike
- capital dredging, which may cause fauna mortality
- fishing and netting
- degradation of seabird foraging and nesting grounds.

Indirect threats to the species include:

- alterations to marine hydrology and water quality, including sediment deposition from offshore development and seabed disturbance, and contamination from runoff or activation of acid sulfate soils
- capital dredging, which may cause loss of foraging habitat (e.g. seagrass beds for dugongs)
- disruption to fish breeding life cycles through the loss of habitat, resulting in decreased foraging potential
- disturbance from ship movements
- inappropriate and accidental waste disposal particularly plastic litter, fish nets, lines, rope, bait box packaging bands which kill marine mammals, fish and birds
- noise and vibration, especially from underwater sources including construction and capital dredging
- land based development which degrades stormwater quality and increases stormwater flow, generates sediment discharge, and increased nutrient and pollutant inputs into coastal environments.

Onshore turtle nesting habitat is also threatened by:

- disturbance, including trampling by people or vehicles
- artificial lighting
- pests, including nesting predation by feral species.

7.5.2.1 Fish Habitat Areas

There are no declared fish habitat areas (Schedule 3, Fisheries Regulations) within the proposed Gladstone port master planned area. However the Calliope River is under consideration for declaration as a fish habitat area¹¹⁴.

The Port Curtis coast is known for its high species richness and abundance of fish in marine, coastal, estuarine and freshwater habitats. The estuarine areas, considered to be amongst the most productive natural habitat types in the world, are particularly significant in supporting barramundi and mud crab for much of their lifecycles.

¹¹⁴ Fisheries Resources of Calliope River, Gladstone Central Queensland. 2014. QPWS, Marine Resources, Department of National Parks, Recreation, Sport and Racing

7.5.2.1.1 Recreational and Commercial Fishing

Fishing is a popular recreational activity in the Port Curtis Coast region with extensive mangroves and protected waterways offering mud crabbing and estuary fishing, and the exposed shoreline, rocky headlands and reefs providing a range of ocean species¹¹⁵. Grahams Creek (on the boundary of Gladstone port master planned area) has been noted as a popular recreational location for fishing, crabbing and seasonal prawning¹¹⁶. Recreational fishing continues to grow with a 30 per cent increase in boat registrations between 2000 and 2012 and a 25 per cent rise in fishing effort.

Until recently Gladstone supported one of the largest commercial fishing fleets in Queensland and the area is still heavily used for trawl and crab fishing. Total commercial catch in 2011 was 535.3 tonnes (as retained for sale) with key species fished in Gladstone being barramundi, blue tread fin salmon, grey mackerel, mullet, sharks, banana prawns, and mud crab¹¹⁷. Mud crabs are a key target species for both recreational and commercial crabbers in the Gladstone region¹¹⁸. Commonly caught fish investigated, crustacean and molluscs known from Gladstone Harbour are listed below. Economically important species targeted within and surrounding the Calliope River include mullet, salmon, flathead, whiting, mangrove jack and penaeid prawns. With the Calliope River system, QPWS have compiled a listing of 167 species of fish, crustacean and mollusc species records reflecting the range and availability of habitat, with 91 species in the estuarine reach¹⁰⁹. QPWS have stated that this high species richness is due to that the Calliope River lies on a regional distribution overlap of southern and northern fish species; for example the diamond trevally, sea mullet and the southern herring are at their regional limits in Gladstone waters¹¹⁹. This overlap enables a wider variety of fish to utilise the habitats within the Calliope River.

Table 19 Fish, crustacean and molluscs known from Gladstone Harbour¹²⁰

Common name (* indicates multiple species in category)	Taxonomic Group (Family, genus or species)
Fish species	
Anchovies*	Engraulidae
Australian threadfin*	<i>Polygactylus spp.</i>
Barramundi	<i>Lates calcarifer</i>
Batfish*	Ephippigidae, Drepaneidae
Beach salmon	<i>Leptobrama muelleri</i>

¹¹⁵ Curtis Coast Coastal and Marine Resource Inventory Report. 2012. Gladstone Ports Corporation.

¹¹⁶ Fisherman's Landing Northern Expansion Environmental Impact Statement. 2009. GHD

¹¹⁷ Commercial Catch of Key Species Gladstone 2006-2011. 2012 DAFF.

¹¹⁸ Gladstone fish health survey Mud crab update. 2012. DAFF.

¹¹⁹ CSIRO. 2013. Australian National Fish Collection: Atlas of Living Australia cited in QPWS 1024

¹²⁰ Gladstone Harbour Fish Health Investigation 2011-2012. 2013. DAFF.

Common name (* indicates multiple species in category)	Taxonomic Group (Family, genus or species)
Black jew	<i>Protonibea diacanthus</i>
Blue threadfin	<i>Eleutheronema tetradactylum</i>
Bony bream	<i>Nematalosa erebi</i>
Bream*	<i>Acanthopagrus spp.</i>
Butter bream	<i>Monodactylus argenteus</i>
Catfish	Aridae
Cod / Groupers*	<i>Epinephelus spp.</i>
Flathead*	<i>Platycephalus spp.</i>
Mackerels and Bonito*	Scombridae
Grinner *	Bathysauridae, Synodontidae
Herring *	Clupeidae, Pristigasteridae, Elopidae
Javelin fish *	<i>Pomadasys spp.</i>
King threadfin	<i>Polydactylus macrochir</i>
Milk fish	<i>Chanos chanos</i>
Mullet *	Mugilidae
Ponyfish *	Leiognathidae
Queenfish *	<i>Scomberoides spp.</i>
River jew *	<i>Johnius spp.</i>
Scad *	Carangidae
Scats	Scatophagidae
Sharks and rays	multiple families
Silverbiddies	Gerreidae
Snappers	Lutjanidae
Snubnose dart	<i>Trachinotus blochii</i>
Sole *	Soleidae, Cynoglossidae

Common name (* indicates multiple species in category)	Taxonomic Group (Family, genus or species)
Sweetlips and emperors*	Haemulidae, Lethrinidae
Trevally *	Carangidae
Tripletail	Lobotidae
Whiting *	<i>Sillago spp.</i>
Crustaceans and Molluscs	
Moreton Bay bug *	<i>Thenus spp.</i>
Scallops	Pectinidae
Banana prawns	<i>Fenneropenaeus merguensis</i>
Other prawns *	Penaeidae
Crabs - Not mud crabs *	Portunidae
Mud crabs	<i>Sylla serrata</i>

7.5.2.2 Mudflats and Intertidal Areas

Mudflats are intertidal habitats created by sedimentary deposition in low energy coastal environments, particularly estuaries and often form transitional habitat between subtidal channels and vegetated saltmarshes and mangrove areas. They are often the most extensive part of an estuarine intertidal area. Mudflats play an important role in dissipating wave energy, thereby reducing the risk of erosion. The surface of mudflats plays a significant role in intertidal nutrient chemistry. Typically they are characterised by high biological productivity and support an abundance of organisms particularly microalgae, microbes and invertebrates feeding on detritus and phytoplankton. Mudflats support a diverse benthic (bottom-dwelling) community, including worms, crabs and yabbies. This, in turn, provides food for many fish species. Many internationally significant populations of migratory birds use intertidal habitats to forage and rest (refer to Section 7.4.2.2).

7.5.2.2.1 Introduced Marine Species

Gladstone Port Corporation (GPC) funded a survey of Port Curtis to establish a baseline list of native and introduced species within the Port as identified in Table 20¹²¹. While no pest species were detected, ten introduced species were identified, all of which are widespread in ports throughout Australia and internationally, and not considered a threat to native species.

¹²¹ Lewis, S., Hewitt, C and Melzer A. 2001. Port survey for introduced marine species. Port Curtis. Centre for Environmental Management, Centre for Land and Water Resources Management. Central Queensland University

Table 20 Introduced Marine Species¹²²

Introduced Species	Order/Class	Location
<i>Botrylloides leachi</i>	Ascidian (sea squirts)	Auckland Point; South Trees Wharf
<i>Styela plicata</i>	Ascidian	Wharf pylons throughout Port Curtis
<i>Amathia distans</i>	Bryozoan (moss animals)	Wharf pylons throughout Port Curtis
<i>Bugula neritina</i>	Bryozoan	Gladstone marina, Wharf pylons throughout Port Curtis
<i>Cryptosula pallasiana</i>	Bryozoan	Wharf pylons throughout Port Curtis
<i>Watersipora subtorquata/acuata</i>	Bryozoan	Wharf pylons throughout Port Curtis
<i>Zoobotryon verticillatum</i>	Bryozoan	Gladstone marina; Wharf pylons throughout Port Curtis
<i>Obelia longissima</i>	Hydrozoan (small predatory animal)	Wharf pylons throughout Port Curtis
<i>Paracerceis sculpta</i>	Isopod (crustaceans)	South Trees Wharf
<i>Alexandrium</i> sp.	Dinoflagellate (marine plankton)	Auckland Point; Channel marker S19

7.5.2.3 Dugong Protection Areas

Dugong Protection Areas (DPAs) are Special Management Areas which help with implementation of appropriate management strategies for species conservation within the Marine Park. Three designations make up the Rodds Bay DPA, all of which are directly adjacent to the proposed Gladstone port master planned area. One is situated to the southern border of the Gladstone PPDA, one off the south-eastern corner of Facing Island and one off the north-western corner of Facing Island.

7.5.2.4 Wetlands of International Significance

The proposed Gladstone port master planned area does not lie within or adjacent to any wetland of international significance (i.e. as listed under the Ramsar convention)¹²³.

Gladstone Harbour and intertidal areas of Curtis Island and the mainland including upstream of Calliope River and the South Trees Inlet are mapped as part of the larger Port Curtis wetland complex, which is listed on the Directory of Important Wetlands of Australia¹²⁴.

7.5.2.5 Wetlands of National Importance

Tidal areas of the proposed Gladstone port master planned area are mapped as part of the Port Curtis wetland complex (Figure 17). The Port Curtis wetland complex includes all tidal areas in the vicinity of Gladstone, from Laird and Friend Points, to Gatcombe Head and Canoe Point. It includes the seaward side of Facing Island and Sable Chief Rocks, and southern Curtis Land west of North Point / Connor Bluff.

¹²² Lewis, S., Hewitt, C and Melzer A. 2001. Port survey for introduced marine species. Port Curtis. Centre for Environmental Management, Centre for Land and Water Resources Management. Central Queensland University

¹²³ Department of the Environment. 2015. *Protected Matters Search Tool Report*. DOE, Canberra. Viewed 24th September 2015.

¹²⁴ Department of the Environment. 2015. Directory of Important Wetlands of Australia – Port Curtis Information Sheet. <https://www.environment.gov.au/cgi-bin/wetlands/report.pl> viewed 24th September 2015.

This wetland is recognised as containing important seagrass beds that provide vital habitat for commercially fished crustaceans and being the preferred feeding grounds of several migratory species. A number of mangroves present are also at or near the limit of their geographical distribution and a significant reef community is present on the seaward side of Facing Island.

The Port Curtis wetland is also recognised as providing significant roosting areas of migratory species and major nesting sites for a number of marine turtles.

7.5.2.6 Wetlands of State Significance

Several intertidal areas along the mainland near Fisherman's Landing and south in association with South Trees Inlet are mapped as wetlands of high ecological significance. Facing Island and a number of small, inhabited islands in the channel are also mapped as containing wetlands of high ecological significance (Figure 13).

Potential Threats, Pressures and Impacts

Potential impacts to significant wetlands within the proposed Gladstone port master planned area can only accurately be determined by site specific surveys and an understanding of the type of proposed activity taking place.

Direct threats to wetlands within the proposed Gladstone port master planned area include:

- clearing and reclamation activities.

Indirect threats to wetlands within the proposed Gladstone port master planned area include:

- alterations to hydrological regimes and water quality
- alterations to groundwater and water quality
- dust.

Figure 17

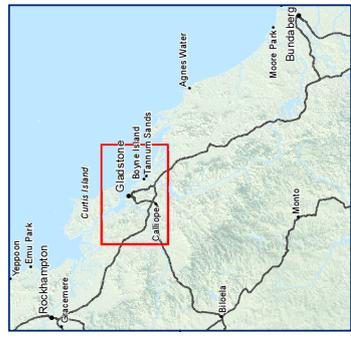
Wetlands

Legend

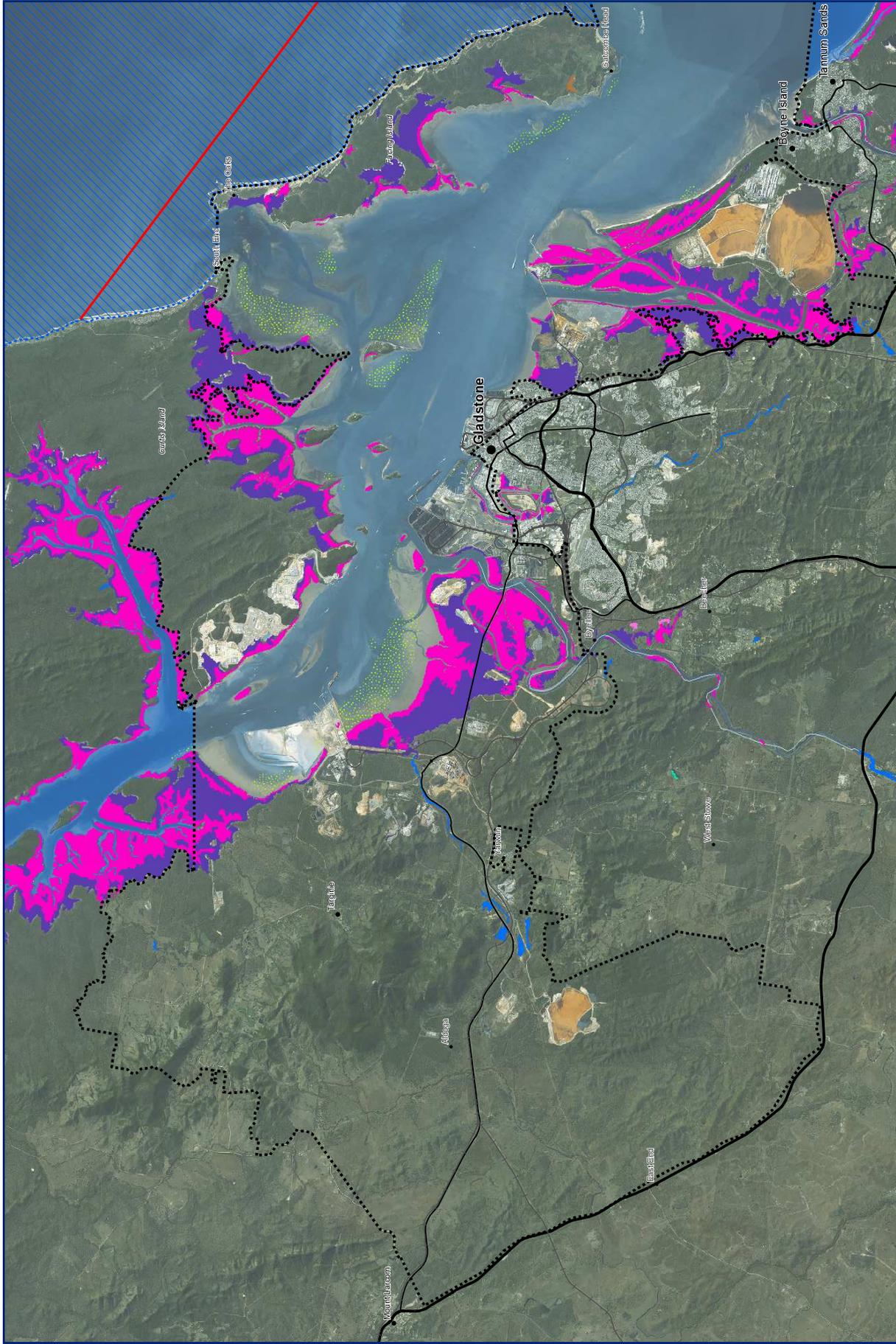
- Cities
- Urban centres
- Local centres
- Localities
- Railway
- Highway
- Secondary Roads
- Great Barrier Reef Marine Park
- Port limits
- Proposed Gladstone port master planned area
- boundary

Wetlands

- Coastal/ Sub-coastal floodplain grass, sedge and herb swamps
- Coastal/ Sub-coastal floodplain lakes
- Coastal/ Sub-coastal floodplain tree swamps (Melaleuca and Eucalypt)
- Coastal/ Sub-coastal non-floodplain grass, sedge and herb swamps
- Estuarine - Mangroves and related tree communities
- Estuarine - salt flats and saltmarshes
- Riverine
- Estuarine - water



10 November 2015



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7.5.3 Water Quality

Description and Context

Water quality in Port Curtis has been extensively monitored through the Port Curtis Integrated Monitoring Program (PCIMP) and now the Gladstone Healthy Harbour Partnership. The PCIMP was established in 2001 as a consortium of members from 16 bodies representing industry, government (both local and state), research institutions and other stakeholders to develop a cooperative, monitoring program for assessing the ecosystem health of Port Curtis, and to ensure the environmental sustainability of the Port of Gladstone. The Gladstone Healthy Harbour Partnership (GHHP) has built on the PCIMP in a partnership approach, guided and reviewed by an independent science panel. Major partners in the GHHP include Gladstone Ports Corporation and government, industry and the community. The Gladstone Harbour Report Card 2015 reports findings on 13 zones surrounding Gladstone Harbour, measuring the environmental, social, cultural and economic health of the zones between July 2014 and June 2015. A summary of its findings is set out below:

- Environmental health scored a satisfactory rating (C). The environmental indicators fell into three categories:
 - Water and Sediment Quality scored a very good rating (A)
 - Habitats scored a poor rating (D)
 - Connectivity scored a satisfactory rating (C).
- Social health was rated satisfactory (C) based on harbour access, liveability/wellbeing, and harbour usability indicators.
- Economic health was rated as good (B rating) based on economic values, economic stimulus and economic performance.
- Environmental results vary across the harbour zones with the best results in the inner harbour and the worst in Auckland Inlet (A) (see Plate 3). This result may have been influenced by the criteria including only water and sediment quality, as no habitat or connectivity scores were calculated for this zone.
- Grades were likely influenced in 2014 by below average annual rainfall, no major shipping incidents and no major dredging activities¹²⁵.

¹²⁵ Gladstone Healthy Harbour Partnership. Gladstone Harbour Report Card 2015 http://ghhp.org.au/assets/pdf/tech-report/2015%20Report%20Card%20Technical%20Report_FINAL.pdf

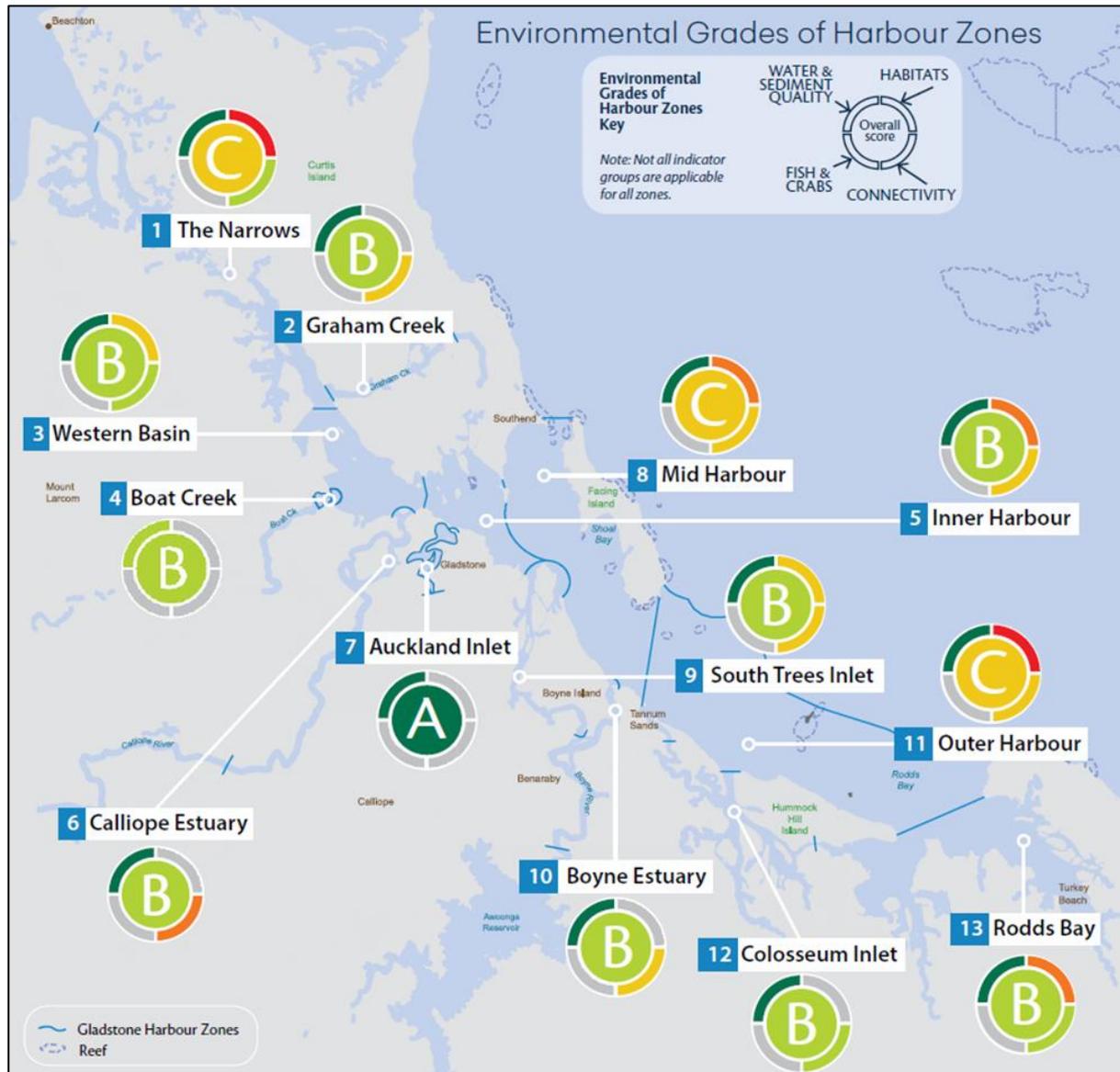


Plate 3 Harbour Zones for Environmental Grading, Healthy Harbour Pilot Report Card 2015

Water quality is regularly monitored by DEHP in the Calliope River. Analysis for the Calliope and Boyne estuaries showed natural variation in water quality due to seasons, flooding, rains and drought. Water quality parameters in the estuaries were consistent with historical levels. Water quality is considered of a high standard in Calliope River with elevated levels of turbidity, phosphorous, copper, manganese and zinc have been detected but all metals are below recommended guidelines¹²⁶.

All metals in sediment samples within the Calliope River are below recommended guidelines and polycyclic aromatic hydrocarbons (PAH's) are of low concentration¹²⁷.

¹²⁶ Department of National Parks, Recreation, Sport and Racing. 2014. *Fisheries Resources of Calliope River Gladstone*. DNPRSR, Brisbane.

¹²⁷ Storey, AW, Anderson, LE, Lynas, J, Melville, F 2007, *Port Curtis Ecosystem Health Report Card, Port Curtis Integrated Monitoring Program (PCIMP)*, Centre for Environmental Management, Central Qld University, 52pp.

Potential Threats, Pressures and Impacts

Potential threats (direct and indirect) to marine water quality include:

- clearing of riparian vegetation
- changes to hydrological regimes and surface water quality
- sediment export
- weed invasion
- alterations to marine hydrological regimes and water quality leading to increased turbidity and mobilisation of sediments
- land based development which degrades stormwater quality and increases stormwater flow, generates sediment discharge, and increased nutrient and pollutant inputs into coastal environments.

7.6 Water Ecosystems (Freshwater)

7.6.1 Freshwater Wetlands

Byellee Wetlands is a locally significant wetland located on the southern bank of the Calliope River, 14 km upstream and is on the boundary of the proposed Gladstone port master planned area. The wetland is approximately 350 ha and is at the interface of saltwater/freshwater influences, comprising of mangroves and saltpan and a freshwater wetland lagoon. Habitat includes riverine blue gum, riparian forest and paperbark tea tree¹²⁸.

7.6.2 Fauna

Description and Context

One conservation significant freshwater fauna species listed under the provisions of the EPBC Act and/or NC Act was identified from the desktop assessment as potentially occurring within the proposed Gladstone port master planned area (Table 21). It is recognised that migratory wetland species identified in Section 7.4.2 may also occur within freshwater ecosystems.

Potential Threats, Pressures and Impacts

Potential threats (direct and indirect) to conservation significant freshwater fauna species in the proposed Gladstone port master planned area have been identified.

Direct threats to freshwater fauna include:

- loss of habitat
- degradation of waterways
- excessive (near total) loss of eggs and hatchlings at the aggregated nesting areas from predation
- nest trampling from cattle.

¹²⁸ Department of National Parks, Recreation, Sport and Racing. 2014. *Fisheries Resources of Calliope River Gladstone*. DNPRSR, Brisbane.

Indirect threats to the species include:

- fragmentation of habitat from the construction of dams and weirs
- alterations to hydrology and water quality
- exacerbation of weeds and pest animals.

Table 21 Likelihood of occurrence of listed freshwater fauna species within the proposed Gladstone port master planned area

Scientific Name Common Name	Status*		Likelihood of occurrence ¹²⁹
	CTH	QLD	
<i>Eelseya albagula</i> Southern Snapping Turtle	CE	EN	Possible. No records for the white throated snapping turtle occur within the proposed Gladstone port master planned area. However potential habitat exists within proposed Gladstone port master planned area and overlaps with the species predicted distribution. As such this species is considered a possible occurrence.

*Conservation Status: CTH = Commonwealth (listed under the EPBC Act), QLD = Queensland (listed under the NC Act), CE = Critically Endangered, EN = Endangered.

7.6.3 Watercourses

Description and Context

Surface water quality in the proposed Gladstone port master planned area is an environmental value that influences the habitat value of the marine environment, and the fauna and flora they support. Water quality is integral to the health and persistence of many of the other environmental values occurring within the proposed Gladstone port master planned area.

The proposed Gladstone port master planned area lies mostly within the larger mainland catchment of Calliope River and to a limited extent in the Boyne River catchment as the river anabranch empties to the coast south of Gladstone (refer to Figure 18).

The Calliope River rises in the Calliope Range to the south-west and outside of the proposed Gladstone port master planned area, flowing through the proposed Gladstone port master planned area to the channel near Wiggins Island. The catchment area is approximately 2,255 sq. km in area with main tributaries and Calliope River is connected to the sea by a complex and extensive estuary.

Grazing land has been cleared on slopes and marginal areas resulting in erosion and salinity problems. Approximately 83 percent of the catchment has been cleared, mostly for grazing¹³⁰. Naturally occurring waterholes are present along the Calliope River and the most dominant water use in the catchment is for irrigation purposes, primarily for cattle-feed production¹³¹.

¹²⁹ Atlas of Living Australia. 2015. *Atlas of Living Australia*. <http://www.ala.org.au/> viewed 27th October 2015.

¹³⁰ Gladstone Area Water Board. 2009. *Gladstone – Fitzroy Pipeline Project*. GAWB, Queensland.

¹³¹ Department of Natural Resources and Water. 2007. *Calliope River Basin – Water Resource Plan Consultation Report*. DNRW, Brisbane.

The Boyne River catchment encompasses the portion of the proposed Gladstone port master planned area south of Gladstone. The Boyne River drains from the west including Awoonga Dam, flowing to the sea near Tannum Sands and encompasses a catchment area of 2,590 sq km. The main water use in this catchment is water storage which is then utilised by industry, power generation and port facilities within the proposed Gladstone port master planned area¹³².



Figure 18 Major waterways within the proposed Gladstone Port master planned area¹³³

Major tributaries of the proposed Gladstone port master planned area include:

- tributaries of Graham Creek on Curtis Island (with the main channel of Graham Creek outside the proposed master plan area)
- Mosquito Creek

¹³² Department of Natural Resources and Mines. 2014. *Boyne River Basin Water Resource Plan and Resource Operations Plan – Consultant Report*. DNRM, Brisbane.

¹³³ Department of Infrastructure, Local Government and Planning 2011. *Gladstone*, <http://www.dilgp.qld.gov.au/resources/map/reform/gladstone-map.pdf>

- Sandy Creek
- Larcom Creek
- Boat Creek
- Spring Creek
- Humpy Creek
- The Calliope River, Calliope River Anabranch, and feeder streams
- Auckland Creek and its feeder streams including Police Creek
- South Trees Inlet
- Boyne River (one of the river's anabranches flows into South Trees Inlet).

Waterway barrier works are regulated under the *Fisheries Act 1994* and the *Sustainable Planning Act 2009*, when barriers to fish movement are constructed across waterways. The colour designation of a waterway determines the complexity of the waterway and how important it is for natural fish populations. Further, the colour determines whether waterway barrier works can be conducted under the code for self-assessable development or if a Development Approval must be lodged.

Amber, green and red Queensland Waterways for Waterway Barrier Works exist within the proposed Gladstone port master planned area¹³⁴.

Values associated with water and water quality for the Calliope catchment are identified below¹³⁵:

- unregulated river (no significant barriers or dams)
- irrigation, farm, potable and industrial water source
- important for fish passage
- valued for barramundi fishing
- recreational and aesthetic values
- contains a narrow but nearly continuous riparian corridor and a diverse macro invertebrate and fish assemblage.

The Boyne catchment water and water quality values include:

- irrigation, farm, potable and industrial use water source
- recreational fishing
- recreation and aesthetic values.

Potential Threats, Pressures and Impacts

Potential (direct and indirect) threats to watercourses and freshwater wetlands within the proposed Gladstone port master planned area include:

¹³⁴ DAF classified waterways can be found on the Department of Infrastructure, Local Government and Planning's DA mapping system (<http://www.dilgp.qld.gov.au/about-planning/da-mapping-system.html>).

¹³⁵ Hale, J. and Box P. 2014. Identification and development of a water quality improvement and monitoring program for major catchments supplying Port Curtis.

- increased sediment loads
- barriers to fish movement for migration and life cycle requirements
- alteration to flow regimes and natural flow variation for example by alterations to flood flow, diurnal or daily flow, creation of constant unseasonal high flow and loss of overland flow
- changes in water chemistry (temperature, oxygen and sulphide levels)
- impoundments which trap sediment or cause downstream erosion and stream bed lowering
- loss of riparian vegetation and instream habitat
- introduction of fish and plants
- pollution by human activities (nutrient, heavy metals, pesticides, contaminants).

7.6.4 Groundwater Quality

Description and Context

Groundwater resources in the proposed Gladstone port master planned area is generally classified as fractured or fissured, with extensive aquifers of low to moderate productivity and containing saline groundwater¹³⁶. In the proposed Gladstone port master planned area, less groundwater is used than surface water as a percentage of total water use. There are over 90 registered bores distributed across the proposed Gladstone port master planned area (DNRM and private)¹³⁷. Clusters of bores are located in close proximity to developed areas.

Limited information is available on standing water level fluctuations in the DNRM Groundwater Database from existing bores. Historic groundwater level data for the area (for 2001 – 2009) suggest typical seasonal level fluctuations of 0.4 to 1 m in shallow groundwater (<15 m bgl) within natural strata. Groundwater levels close to the coastline are also likely to fluctuate on a sub-daily and monthly basis in response to tidal movements. Groundwater contains concentrations of dissolved metals (chromium, copper, cobalt, lead, nickel and zinc) and nutrients (ammonia as N) above the ANZECC (2000) guideline values for marine aquatic ecosystems (at the 95 per cent level of protection) at several monitoring locations in the proposed Gladstone port master planned area and groundwater immediately to the west is brackish to saline with a neutral to slightly acidic pH¹³⁸.

A key gap in groundwater quality is site specific information necessary to quantify local water quality and assess relevant impacts of proposed development.

Potential threats, pressures and impacts

Groundwater quality in the aquatic ecosystem is exposed to a range of indirect threats, including:

- alterations to freshwater hydrology and surface water quality

¹³⁶ Harrington N and Cook P. 2014. Groundwater in Australia. National Centre for Groundwater Research and Training, Australia

¹³⁷ Queensland Globe. Inland Waters Information. Searched 25 November 2015.

¹³⁸ GHD. 2009. *Western Basin Dredging and Disposal Project Environmental Impact Statement* GHD, Queensland.

- alterations to groundwater including activation of potential acid sulfate soils.

Issues for groundwater management generally in Australia include⁸³

- over allocation and over use
- impacts of groundwater extraction on surface water systems
- loss of groundwater as a source for ecosystems
- effect of climate change on availability and quality of groundwater resources
- seawater intrusion
- salinisation of groundwater resources and groundwater as an agent for salinisation.

Of these, pressures in the Curtis Coast region are thought to mostly relate to potential for over usage in localised areas for irrigation and stock watering and salt water intrusion.

7.6.5 EPP Water – Environmental Values and Water Quality Objectives

DEHP under the Environmental Protection (Water) Policy 2009 have set environmental values and water quality objectives for Curtis Island, Calliope River and Boyne River Basins¹³⁹ which applies to fresh and estuarine surface waters and groundwaters draining the basins of Curtis Island, Calliope River and Boyne River basins and coastal waters including Gladstone Harbour and the Narrows. Environmental values for water are the qualities for water that make it suitable for supporting aquatic ecosystems and human water uses and require protection from the impacts of habitat alteration, waste releases, contaminated runoff and changed flows. Particular waters have different environmental values and corresponding management intents with associated water quality objectives and are set out for seven broad areas. Given this, they are not summarised in this report.

7.7 Air Quality

7.7.1 Pollutants of Interest

Pollutants of major public health concern include particulate matter, carbon monoxide, ozone, nitrogen dioxide, and sulfur dioxide¹⁴⁰. Common sources of air pollution worldwide include household combustion devices, motor vehicles, industrial facilities and forest fires.

Particulate matter (PM) affects people more than any other pollutant, with the major components of PM being sulfate, nitrates, ammonia, sodium chloride, black carbon, mineral dust and water. Particulate matter is a complex mix of solid and liquid particles or organic and inorganic substances suspended in the air. The most health damaging particles are those with a diameter of 10 microns or less (PM₁₀ and less), which can penetrate and lodge deep inside lungs. World Health Organisation (WHO) Air Quality Guideline 2005 provides guideline values for PM, O₃, NO₂ and SO₂. There has been international discussion on the need to revise the current WHO air quality guidelines for PM₁₀ and PM_{2.5} as there is no

¹³⁹ DEHP. 2014. Curtis Island, Calliope River and Boyne River Basins Environmental Values and Water Quality Objectives. Basins 131, 132 and 133, including all waters of Gladstone Harbour, the Narrows, Curtis Island, Calliope and Boyne River basins, and adjacent coastal waters. State of Queensland.

¹⁴⁰¹⁴⁰ World Health Organisation. 2014. Ambient (outdoor) air quality and health. Fact Sheet No 313.

evidence of a safe level of exposure or a threshold below which no adverse health effects occur¹⁴¹. Note there is also a proposed variation to Australia's Ambient Air Quality NEPM for particle standards. The review of the NEPM standards has occurred in the context of significant challenges from climate change and population growth which are predicted to have significant impacts on air quality. Of concern is the likely predicted increase in frequency and severity of bushfires which will significantly increase particle levels in urban and rural areas. Prolonged periods of drought would also increase dust levels. Further population growth places pressure on sustaining air quality improvements due to increased transport demands, domestic emissions and energy use. The review also acknowledges that many pollutants do not have a recognised threshold for adverse health effects¹⁴².

New studies also show toxicological and health effects of SO₂ and over time there may also be new standards set for SO₂.

7.7.2 Legislation—Air quality goals and requirements

The air quality objectives and guidelines values shown in Table 22 and Table 23 are a summary of applicable pollutants of interest air quality goals within Queensland.

Table 22 Proposed Air Quality Goals for the proposed Gladstone port master planned area

Indicator	Air quality objective	Averaging period	Environmental value	Source
CO	9.0 ppm	8 hour	Health and well being	EPP Air
NO ₂	0.12 ppm	1-hour ¹	Health and well being	EPP Air
	0.03 ppm	Annual		
	0.016 ppm	Annual	Health and biodiversity of ecosystems	EPP Air
SO ₂	0.20 ppm	1-hour ¹	Health and well being	EPP Air
	0.08 ppm	24-hour ¹		
	0.02 ppm	Annual		
	0.0075 ppm	Annual	Health and biodiversity of ecosystems (for forests and natural vegetation)	EPP Air
	0.011 ppm	Annual	Protecting agriculture	EPP Air
TSP	90.0 µg/m ³	Annual	Health and well being	EPP Air

¹⁴¹ World Health Organisation Europe. 2013. Review of evidence on health aspects of air pollution –REVIHAAP Project Technical Report.

¹⁴² National Environment Protection Council. 2011. National Environment Protection (Ambient Air Quality) Measure Review. Review Report. NEPC, Adelaide.

Indicator	Air quality objective	Averaging period	Environmental value	Source
PM ₁₀	50.0 µg/m ³	24-hour ²	Health and well being	EPP Air
PM _{2.5}	25.0 µg/m ³ 8.0 µg/m ³	24-hour Annual	Health and well being	EPP Air
Dust deposition	120 mg/m ² /day	Monthly ³	Nuisance	DEHP Recommended

ppm parts per million

µg/m³ micrograms per cubic metreg/m²/month grams per metre squared per month

1 Not to be exceeded more than one day per year

2 Not to be exceeded more than five days per year

3 Not legislative, recommended goal to reduce likelihood of complaints

7.7.3 Ambient Air Quality

In order to characterise the existing air quality values in the Gladstone region, a desktop review of available air quality monitoring data was conducted. The Gladstone Air Study, a component of the Clean & Healthy Air for Gladstone project, monitored hazardous air pollutants between February 2009 to January 2010 with the aim to measure and report ambient air concentrations of PAHs, polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-*p*-dioxin/furans PCDD/Fs¹⁴³. Monitoring found the concentration of these pollutants in the air were within available health guidelines, did not contribute significantly to or exceed available international exposure standards and were consistent with or lower than the concentrations measured in other parts of Australia.

The Department of Science, Information Technology and Innovation (DSITI) currently report on air quality trend data for amenity and human health against an air quality index which converts measured pollutant concentrations into index values. The index value is the pollutant concentration expressed as a proportion of the National Environment Protection Measure for Ambient Air Quality (Air NEPM) standard or the Environmental Protection (Air) Policy 2008 (Air EPP) objective¹⁴⁴. Air NEPM standards are listed in Table 23 below.

Table 23 Air NEPM standards

Pollutant	Air NEPM standard	Averaging time
Ozone	0.10ppm	1 hour
Nitrogen dioxide	0.12ppm	1 hour
Sulfur dioxide	0.20ppm	1 hour

¹⁴³ Kennedy, K., Bentley, C. Heffernan, A., Paxman, C., Stevenson, G., Mueller, J. Gladstone Air Study 2009-2010: Monitoring for polycyclic aromatic hydrocarbons (PAHs), and polychlorinated dibenzo-*p*-dioxins (PCDDs) &-furans (PCDFs) and polychlorinated biphenyls (PCBs). The National Research Centre for Environmental Toxicology (Entox), The University of Queensland.

¹⁴⁴ Queensland Government website. <https://www.qld.gov.au/environment/pollution/monitoring/air-monitoring/regional-trends/>

Carbon monoxide	9ppm	8 hours
PM ₁₀	50ug/m ³	24 hours
PM ₂₅	25ug/m ³	24 hours
TSP	80ug/m ³	24 hours

Index values over 100 indicate the pollutant concentration exceeds the air quality standard based on health studies. In regards to visibility, index values over 100 only impact the aesthetic environment.

The air quality index comprises five colour-coded categories from very good, good, fair, poor to very poor. Live air data for the stations Boat Creek, Clinton, Auckland Point, South Gladstone within the proposed Gladstone master plan area in the Gladstone monitoring network as shown in Figure 18 are reported on line on the DEHP website and show the air quality indices for PM₁₀, PM_{2.5} and Visibility¹⁴⁵.

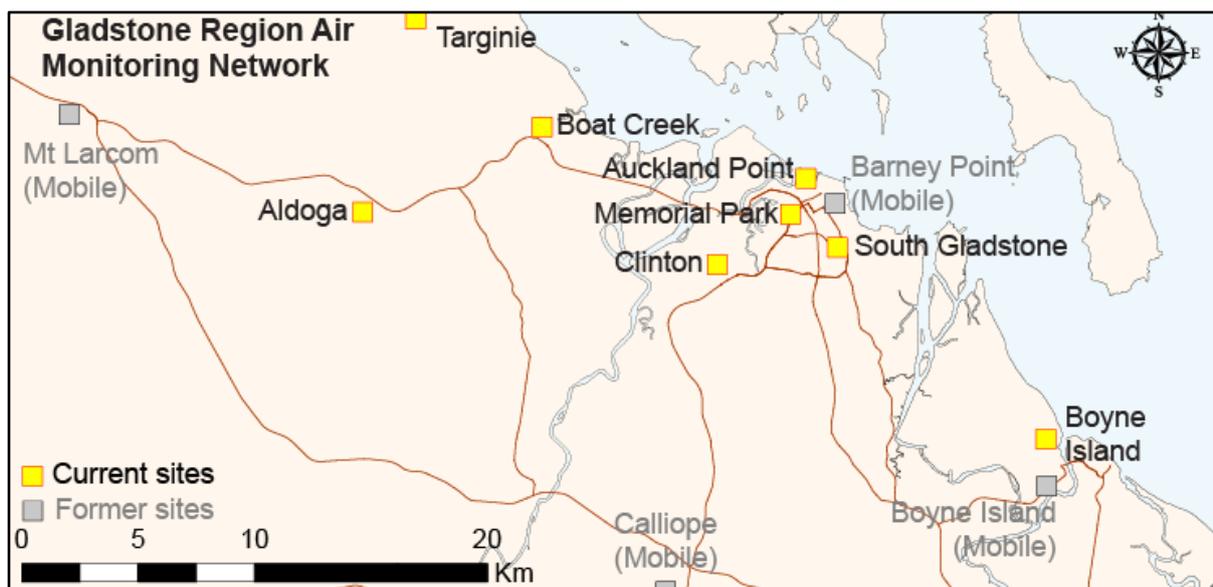


Figure 19 Gladstone monitoring network stations¹⁴⁶

The Department reports on regional trend data for air quality (human health) and air quality amenity for SE Queensland, Gladstone, Mackay, Townsville and Mt Isa based on the number of poor, fair and good air quality days for each year. Trend data for Gladstone from 2000 to 2015 is shown in Plate 4 and Plate 5.

¹⁴⁵ Department of Environment and Heritage Protection (DEHP) 2015, Hourly Air Quality Data, Source: <https://www.ehp.qld.gov.au/air/data/search.php>

¹⁴⁶ Smart Service Queensland 2015

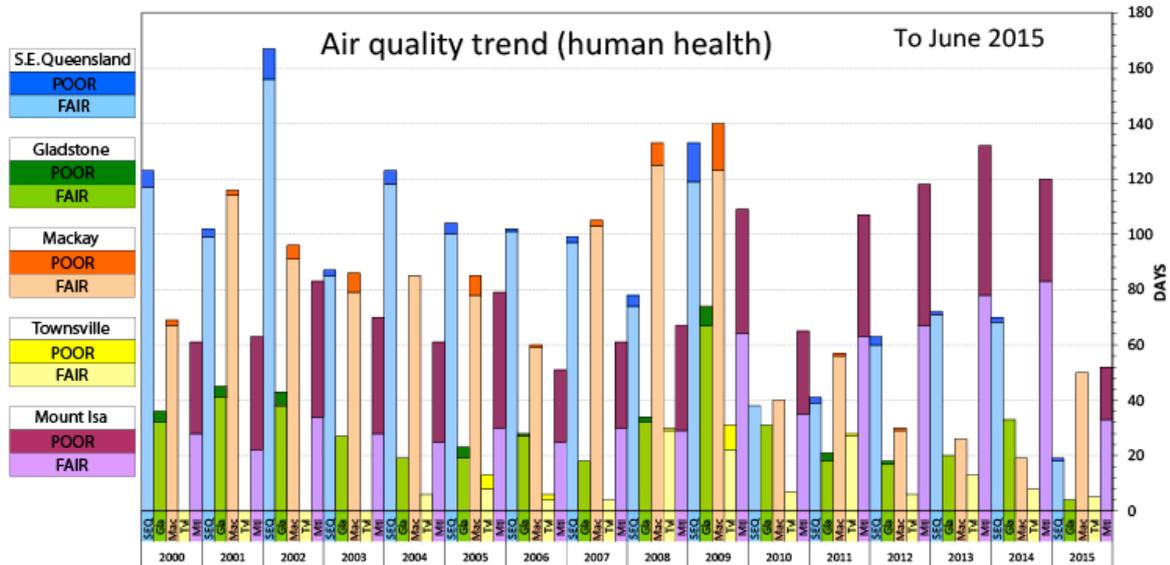


Plate 4 Air Quality Trend (human health) to June 2015 - Regional Queensland

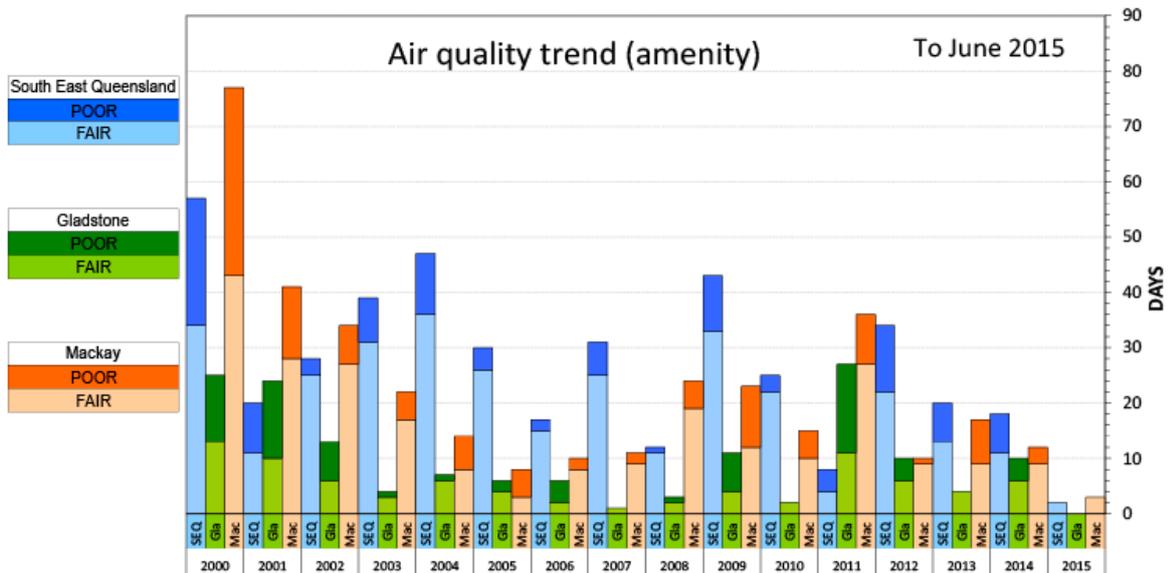


Plate 5 Air Quality Trend (amenity) to June 2015 - Regional Queensland

Trend data represented in the above graphs is expressed as:

- 'Poor' which reflects the number of days when at least one NEPM monitoring station did not meet the Environmental Protection (Air) Policy EPP (Air) air quality objective, reflecting poor visual amenity.
- 'Fair' equates to the number of days when all NEPM monitoring stations were within the EPP (Air) objective but at least one station reached at least half the objective for amenity or at least half the standards for one or more pollutants.
- 'Good' reflects the number of days when all NEPM monitoring stations were below half the NEPM air quality standards, reflecting good air quality or visual amenity.

It is noted that the DSITI and DTMR are developing a land use planning tool that (when finalised) may ensure a consistent approach to determining air and dust emission modelling and thus appropriate separation distances accounting for cumulative emission impacts for new developments.

7.7.4 Potential Threats, Pressures and Impacts

The Gladstone airshed currently has a large amount of air quality data available to aid in informing air quality assessment and is the subject of regular scrutiny. Further development within an airshed that is already showing exceedances of air quality objectives for particulate matter and contains a large number of combustion pollutant generating industries will need to be carefully planned. The region has prevailing winds typically blowing strongest from coastal locations, where port activities characteristically take place, inland to nearby residential land uses. Due to the existing ambient air quality environment and prevailing winds, potential air quality impacts for port activities need to be considered on a case by case basis.

The key threats to air quality in and around the proposed Gladstone port master planned area include:

- clearing and earthwork activities leading to dust creation
- bulk product stockpiling and handling leading to emissions
- construction activities including vehicle activity
- process industry emissions
- operational activities associated with the resource industry.

7.8 Conclusions

This report provides a high level review of environmental values in the proposed Gladstone port master planned area primarily using state and Commonwealth environmental databases. Detailed information exists in specific places within the proposed master planned area, often associated with development proposals. Ongoing site based specific surveys would be required to confirm local environmental values pertaining to any particular area and assessment of impacts on water and air quality values as set out under the relevant Environmental Protection Policies.

8 | Social Baseline



8.0 Social Baseline

8.1 Context

The primary intent of this section is to provide a social baseline and identify the community and social values of the port and surrounding areas. The proposed Gladstone port master planned area and its surrounds contain significant features of social amenity and cultural importance for both the local community and the traditional owners of the land. Gladstone relies heavily on the strength of its resources and industrial sector. The community therefore identifies strongly with industrial activities and the employment opportunities that it provides. The community also places significant value on the region's natural assets with the popularity of recreational activities such as fishing and boating reflecting the community's interest in upholding existing environmental values.

8.2 Residential communities

Table 24 identifies communities that are either located within or in close proximity to the proposed Gladstone port master planned area.

Table 24 Residential communities located within or adjacent to the proposed Gladstone port master planned area

Name of community	Location	Description and issues
Residential communities located within the proposed port master planned area		
Facing Island (including Farmers Point, Northcliffe and Gatcombe)	Facing Island is located approximately 11 km east from Gladstone mainland and the Gladstone CBD.	The island has three communities with a small permanent population of approximately 30 residents. The island has designated camping areas and is recognised for its recreational and environmental values. It is unlikely that there would be any encroachment from port related activity on Facing Island.
Residential communities located partially within the proposed port master planned area		
Barney Point	Barney Point is located approximately 2km east of the Gladstone CBD and immediately adjacent to Port Central. It is noted that only part of the residential locality is located within the proposed master planned area boundary.	Barney Point is a residential community of approximately 1,156 residents ¹⁴⁷ located immediately adjacent to Port Central. The interface between Barney Point and port activities located immediately adjacent to the residential locality is a critical land use consideration.
Gladstone Central	Gladstone Central is located near the mouth of Auckland Creek alongside Hanson Road. It is noted that a small proportion of Gladstone Central falls within the proposed master planned area boundary.	Gladstone Central is the CBD that services the greater Gladstone area. The CBD has a wide range of community services and primary social infrastructure facilities including the Gladstone Hospital. Approximately 1529 residents reside within the suburb of Gladstone Central. Gladstone Central has an interface with the Gladstone Marina and Auckland Point Wharves. The issues of residential air quality and visual amenity are therefore important factors to consider in the context of the future port activity within close proximity of Gladstone central.

¹⁴⁷ Australian Bureau of Statistics 2011, Census of Population and Housing

Name of community	Location	Description and issues
Residential localities located within close proximity to the proposed port master planned area		
Boyne Island/Tannum Sands	Boyne Island/Tannum Sands is located approximately 15km SSE of Gladstone Central.	Boyne Island/ Tannum Sands is a residential community of approximately 9350 residents located either side of the mouth of the Boyne River. The locality has a range of facilities of significant social value including schools, medical centres, churches, childcare centres and open space/ recreation areas. The broader social issue of increasing pressure on existing social infrastructure within this locality needs to be closely considered in the context of significant population growth.
Mount Larcom	Approximately 35km west of the Gladstone CBD, adjacent to the GSDA	The suburb of Mount Larcom comprised 278 residents and 134 dwellings as at the 2011 Census within a low density/rural residential setting. The township itself is located approximately 700m to the north-west of the GSDA boundary. There are unlikely to be any overt impacts to the residential community of Mount Larcom resulting from development within the proposed Gladstone port master planned area.
Southend	Approximately 11km NNE of the Gladstone CBD on the south eastern tip of Curtis Island	Southend is a small settlement on the southern tip of Curtis Island with basic community facilities. Curtis Island is recognised for its environmental values with the Curtis Island National Park making up a vast proportion of the Island's area.
Yarwun	Approximately 9km SSW of Fisherman's Landing and 13km west of the Gladstone CBD	Yarwun is a small residential community of approximately 239 people based around the Yarwun Railway Station. Social and community infrastructure includes Yarwun State School and an Australian Post Office. The township is located immediately adjacent to the proposed boundary for the proposed Gladstone port master planned area. The Gladstone Planning Scheme does not accommodate for any outward expansion of the township within the vicinity of the draft port master planning boundary.

8.3 Social baseline study

8.3.1 Assessment methodology

The existing social baseline study has been derived through a desktop review of a range of existing resources including:

- state government guidelines
- planning and development schemes
- publications
- studies
- current and completed Environmental Impact Statements for major projects within the Gladstone region.

Data relating to demography, housing/accommodation and employment/training has been sourced primarily from the Australian Bureau of Statistics (ABS), the Queensland Government Statistician's Office and Gladstone Regional Council's Community Profile. The potential cumulative impacts of the ongoing operation and expansion of existing and planned

activities within the Gladstone region have been assessed including local and regional impacts on:

- population and demography
- workforce participation and employment
- housing and accommodation.

8.3.2 Population and demography

Gladstone is one of the fastest growing LGAs in Queensland with strong non-resident population increases supplementing steady residential growth. Based on the Queensland Government Statistician's Office's (QGSO) most recent population estimate in June 2014, Gladstone (LGA) had an estimated resident population (ERP) of 65,845 and a non-resident workers on-shift population of 6,655 which totalled a full-time equivalent (FTE) population of 72,500 persons.¹⁴⁸

Table 25 highlights the fact that the proportion of non-residential workers on-shift has been steadily increasing as a proportion of the FTE population of Gladstone with the proportion increasing from two per cent of the total in June 2011 to nine per cent of the total in June 2014.

Table 25 Gladstone (LGA) population estimate, June 2014

	2011	2012	2013	2014	Change, 2013 to 2014	
	-Number-				-Number-	-%-
Estimated resident population ¹⁴⁹	59,460	61,465	63,955	65,845	1,890	+3
Non-resident workers on-shift	1,205	3,615	4,890	6,655	1,770	+36
FTE population estimate	60,665	65,080	68,845	72,500	3,655	+5
	-%-					
Estimated resident population	98	94	93	91	—	—

¹⁴⁸ Queensland Government Statistician's Office, Queensland Treasury and Trade 2014a, Gladstone region non-resident population projections 2014 to 2020.

¹⁴⁹ ABS estimates, 2011 to 2013; QGSO estimate, 2014a. Source: ABS 3218.0, *Regional Population Growth, Australia, 2012-13*; QGSO estimates

	2011	2012	2013	2014	Change, 2013 to 2014	
Non-resident workers on-shift	2	6	7	9	—	—
FTE population estimate	100	100	100	100	—	—

Population projections

The estimated resident population of the Gladstone LGA is forecast to nearly double from 65,845 in 2014 to 121,266 in 2036 (Queensland Government medium series population projections, 2013 edition). The average annual growth rate of Gladstone LGA between 2011 and 2036 is estimated to be 2.9 per cent which is one per cent greater than the Queensland estimate.

Table 26 Gladstone (LGA) Medium series population projections

LGA/State	As at 30 June						Average annual growth rate
	2011(a)	2016	2021	2026	2031	2036	2011-2036
	-number-						%
Gladstone	59,461	70,098	83,424	96,107	108,582	121,266	+2.9
Queensland	4,476,778	4,946,319	5,477,082	6,007,578	6,548,220	7,095,177	+1.9

Indigenous population

The number of Indigenous persons in Gladstone LGA as at the 2011 Census of Population and Housing was 2,049 persons (3.5 per cent of the LGA's population). This is on par with the percentage of Indigenous persons that make up the residential population of Queensland.

Indigenous social and cultural characteristics including native title rights and interests are discussed in Section 9—Cultural Heritage.

Table 27 Indigenous status, GRC LGA and QLD, 2011¹⁵⁰

LGA/State	Indigenous persons				Non-Indigenous persons		Total persons	
	Aboriginal	Torres Strait Islander	Both	Total	number	%		
	-number-			-number-	%	number	%	number
Gladstone	1,728	133	188	2,049	3.5	51,828	89.5	57,890
Queensland	122,896	20,094	12,834	155,824	3.6	3,952,707	91.2	4,332,740

Age structure

Figure 20 compares the service age structure of the Gladstone LGA with that of Regional Queensland and is derived from the 2011 ABS census of population and housing¹⁵¹.

The service age groups structure of Gladstone illustrates that the Gladstone LGA has a higher proportion of persons in the younger service age group categories compared to Regional Queensland, most notably in the babies and pre-schoolers, primary schoolers, the young workforce and parents and homebuilders categories. In contrast, Gladstone LGA has a significantly smaller proportion of residents in the seniors and elderly aged categories.

As the large proportion of the population (21 per cent) transition from the ‘parents and homebuilders’ service age groups to the older service age groups, it is likely that an increasing amount of pressure will be put on the capacity of social infrastructure such as hospitals and other aged care services.

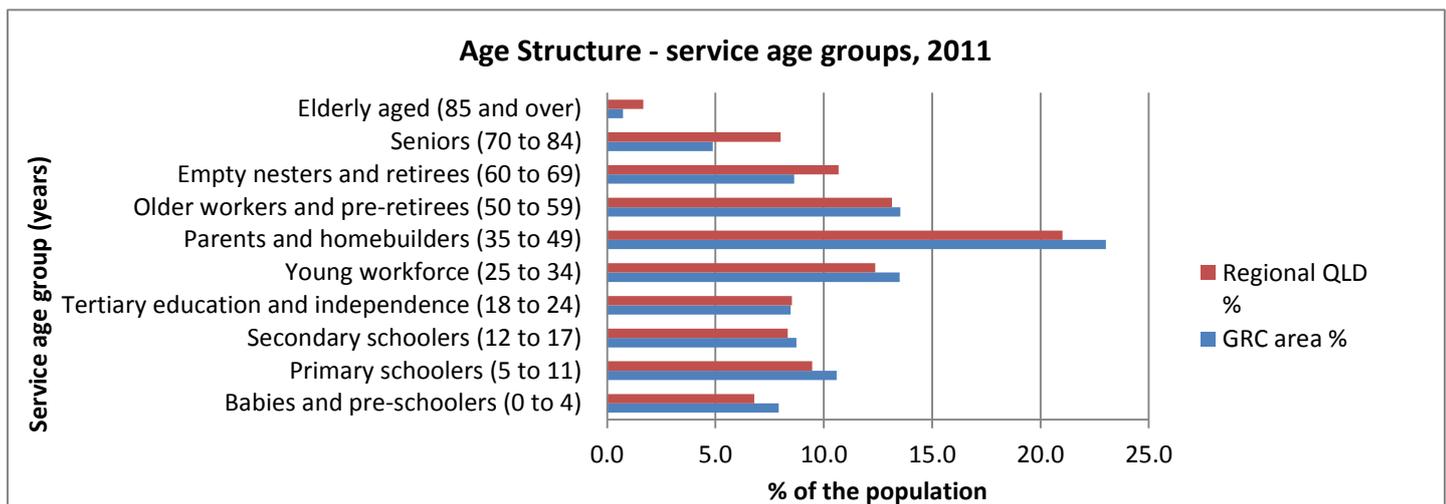


Figure 20 Age structure - service age groups, 2011.

¹⁵⁰ ABS, Census of Population and Housing, 2011, Indigenous Profile – IO2 (usual residence) and QLD Treasury and Trade estimates)

¹⁵¹ ABS, Census of population and housing, 2011 (Usual residence data)

8.3.3 Workforce participation, employment and diversity profile

Non-resident workers

The working population of Gladstone is strongly dependent on the resources sector with over 5,200 full-time employees and contractors having been employed in alumina refining, aluminium smelting, cement and chemicals production, rail transport and coal export operations in 2014.

Over the last five years, the workforce of Gladstone has grown significantly as a result of new resource-related projects including a new coal export terminal (Wiggins Island Coal Terminal), three LNG processing plants on Curtis Island, port dredging and the construction of associated electricity and rail infrastructure. Workers involved in the construction of these projects include a high proportion of FIFO/DIDO workers who increase the area’s on-shift population significantly.¹⁵²

As the LNG projects transition from the construction phase to operations during 2015, the size of the non-residential workforce will decrease significantly in Gladstone (refer to Figure 21) with the operational workforces of the LNG plants and port projects to be considerably smaller than the construction workforces.¹⁵³ It is noted that a significant proportion of the construction workforce have based their families in Gladstone and pursue FIFO/DIDO projects throughout the state and nation when there is a downturn in local demand.

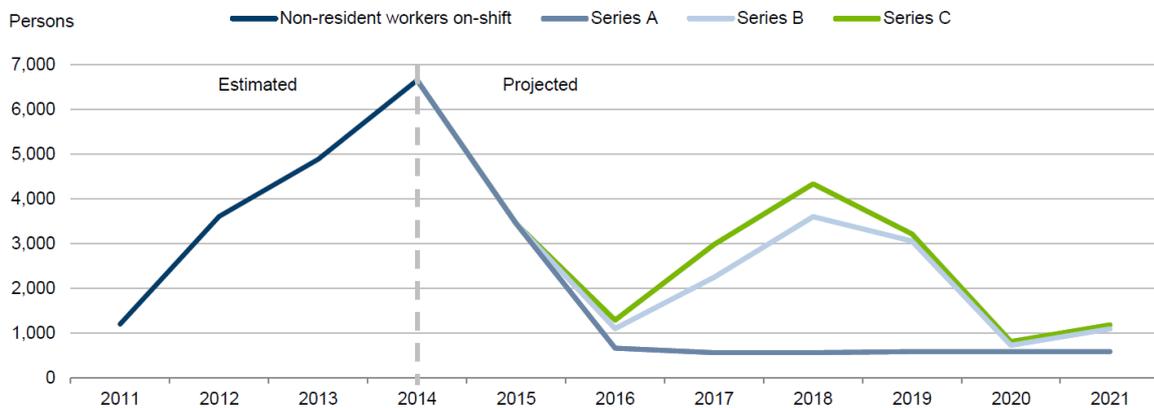


Figure 21 Past and projected non-resident workers on-shift, Gladstone (R).¹⁵⁴

Series A projection is based on the number of non-resident workers on-shift who were engaged in existing resource operations and associated infrastructure activities in the area at June 2014. The projection takes into account future changes to those operational workforces as advised by resource company sources, as well as the estimated non-resident construction and operational workforces of Category A projects [(i.e. those that had reached final investment decision (FID))] at the time of preparation.

Series B projection includes the Series A projection plus projected growth in the non-resident population arising from Category B projects (those that have an EIS approved but have yet to reach FID).

¹⁵² Queensland Government Statistician’s Office, Queensland Treasury and Trade 2015, Gladstone region non-resident population projections 2015 to 2021.

¹⁵³ Queensland Government Statistician’s Office, Queensland Treasury and Trade 2015

¹⁵⁴ QGSO, survey of accommodation providers, 2011 to 2014; QGSO, Non-resident population projections, 2015 to 2021

Series C projection includes the Series A and B projections, plus the projected growth in the non-resident population arising from Category C projects (those that have lodged an EIS, but have yet to proceed through to final approval).

Unemployment

- Gladstone LGA's estimated labour force as at June 2015 was 35,879 (54 per cent of the population).
- The estimated unemployment rate in the Gladstone LGA at June quarter 2015 was 5.4 per cent, in comparison to Queensland's rate of 6.5 per cent (Australian Government Department of Employment, Small Area Labour Markets Australia). The comparatively low unemployment rate for Gladstone can be largely attributed to the current strength of the construction and resources industry and the associated performance of the manufacturing industry.
- The operation and expansion of industrial and business activities within the proposed Gladstone port master planned area is critical to ensure that workforce participation remains high in Gladstone and unemployment stays at its current low rate. This is particularly important in the context of major regional projects transitioning from the construction phase to the operational phase.

Employment by industry

- Data derived from the 2011 Census of Population and Housing indicates that the top industry of employment with the Gladstone LGA is manufacturing (17 per cent). This is in comparison 7.6 per cent for Regional Queensland (refer to Figure 22).¹⁵⁵
- Other notable industries of employment include the construction industry (13.8 per cent), retail trade (9.5 per cent) and the transport, postal and warehousing industry (7.7 per cent).
- The abovementioned industries are strongly aligned with the operation of the Port of Gladstone. The management and sustained growth of these industries within the proposed Gladstone port master planned area is therefore an integral consideration in fostering the continued economic performance of the wider Gladstone area.
- Conversely, the industries of health care/social assistance (6.4 per cent) and education/training (7.7 per cent) in Gladstone represent comparatively low industries of employment in comparison to Regional Queensland.

¹⁵⁵ ABS, Census of Population and Housing, 2011 (Usual residence data)

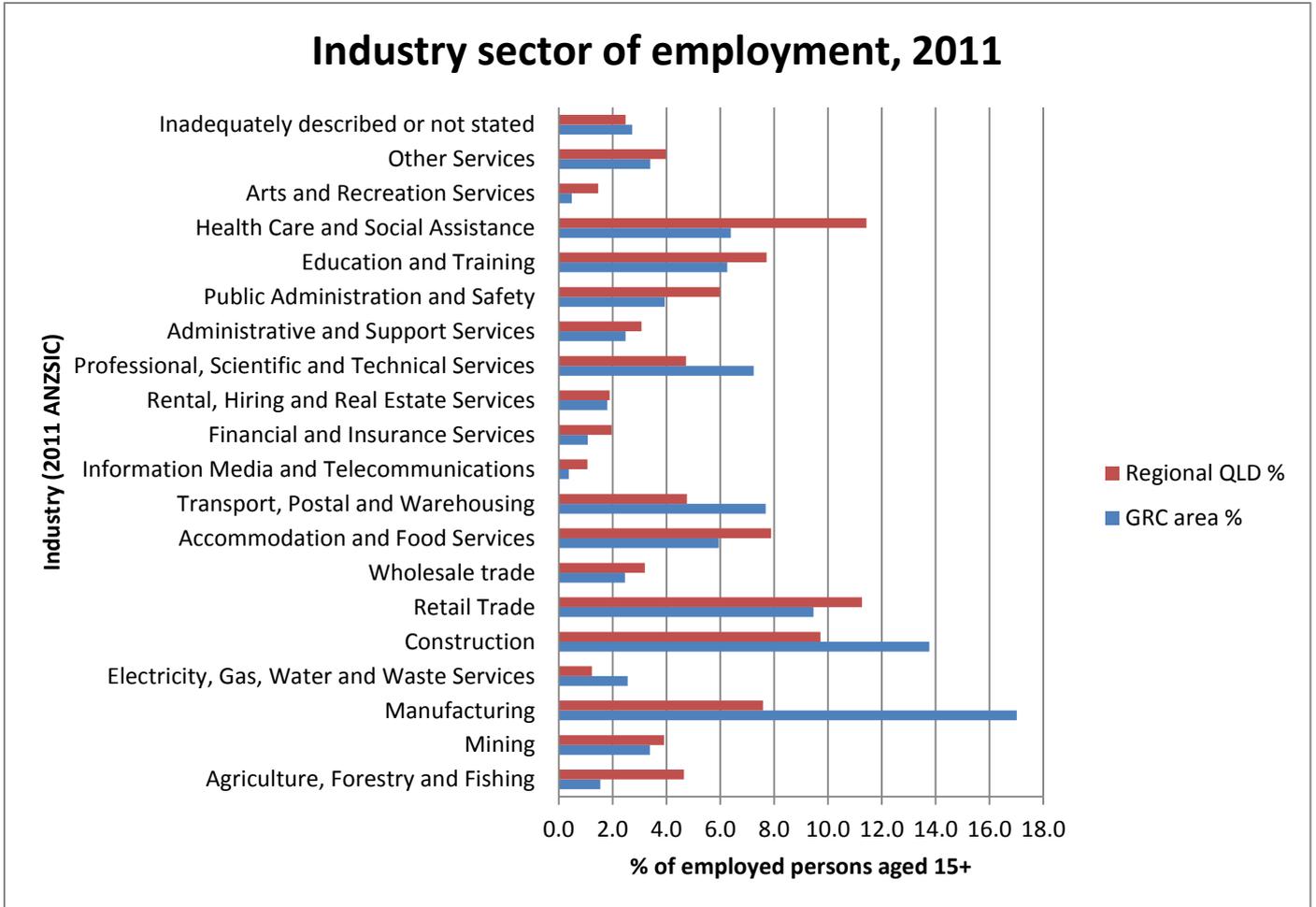


Figure 22 Industry sector of employment, 2011.

Occupation of employment

A comparatively high proportion of Gladstone’s resident workforce is employed as technicians and trade workers (22.4 per cent) compared to 16.3 per cent for regional Queensland (refer to Figure 23). Other notable occupations that make up a significant proportion of the Gladstone workforce include machinery operators and drivers (13.7 per cent) and labourers (12.9 per cent). It is surmised that the higher proportion of workers filling the abovementioned roles in comparison to regional Queensland is associated with the construction and operation of large resource and infrastructure projects.

Figure 23 Occupation of employment, 2011.¹⁵⁶

8.3.4 Housing and accommodation

The anticipated growth in Gladstone LGA's population is expected to place significant pressure on the supply of the local housing market to meet the future demand within the region. In turn, housing affordability will become a critical social issue. It is evident that Gladstone (R) has a comparatively higher proportion of occupied private dwellings that are being purchased (39.9 per cent) in comparison to Queensland (34.5 per cent) as indicated by Table 28 below.

Table 28 Occupied private dwellings (a) by tenure type, Gladstone LGA and Queensland, 2011¹⁵⁷

LGA/State	Fully owned		Being purchased (b)		Rented (c)		Other (d)		Total (e)
	number	%	number	%	number	%	number	%	number
Gladstone (R)	5,204	26.8	7,752	39.9	5,891	30.4	80	0.4	19,405
Queensland	448,617	29.0	533,868	34.5	513,415	33.2	14,304	0.9	1,547,303

(a) Excludes visitors only and other not classifiable households.

(b) Includes dwellings being purchased under a rent/buy scheme.

(c) Includes renting from a real estate agent, state housing authority, person not in the same household, housing co-op/community/church, other and not stated.

¹⁵⁶ ABS, Census of Population and Housing, 2011 (Usual residence data)

¹⁵⁷ ABS, Census of Population and Housing, 2011, Basic Community Profile – B32 (occupied private dwellings) and Queensland Treasury and Trade estimates

(d) Includes dwellings being occupied under a life tenure scheme.

(e) Includes tenure type not stated

The majority of occupied private dwellings in Gladstone (R) are detached houses (87.9 per cent) with only a small proportion of Gladstone's dwelling stock comprising of semi-detached or attached dwellings (nine per cent) as illustrated in Table 29.

Table 29 Occupied private dwellings (a) by dwelling structure, Gladstone Regional LGA and Queensland, 2011¹⁵⁸

LGA/State	Separate House		Semi-detached (b)		Apartment (c)		Caravan (d)		Other (e)		Total (f)
	number	%	number	%	number	%	number	%	number	%	Number
Gladstone (R)	17,050	87.9	601	3.1	1,154	5.9	477	2.5	103	0.5	19,406
Queensland	1,215,303	78.5	129,430	8.4	181,716	11.7	16,191	1.0	3,384	0.2	1,547,303

(a) Excludes visitors only and other not classifiable households.

(b) Includes row or terrace house, townhouse etc.

(c) Includes flat or units.

(d) Includes cabin and houseboat.

(e) Includes improvised home, tent, sleepers out; house or flat attached to a shop, office, etc.

(f) Includes dwelling structure not stated.

The number of dwellings (including for visitors) is projected to increase to approximately 46,655 by 2031¹⁵⁹. SGS's 2012 Gladstone Planning Scheme Analysis report predicted that a total of 25,600 new dwellings would be required by 2031, equating to an average of 1,024 new dwellings per year.¹⁶⁰

¹⁵⁸ ABS, Census of Population and Housing, 2011, Basic Community Profile – B31 (dwellings and persons) and Queensland Treasury and Trade estimates

¹⁵⁹ SGS Economics & Planning 2012a, Planning Scheme Analysis: 2012 Update, prepared on behalf of Gladstone Regional Council.

¹⁶⁰ SGS Economics & Planning 2012a

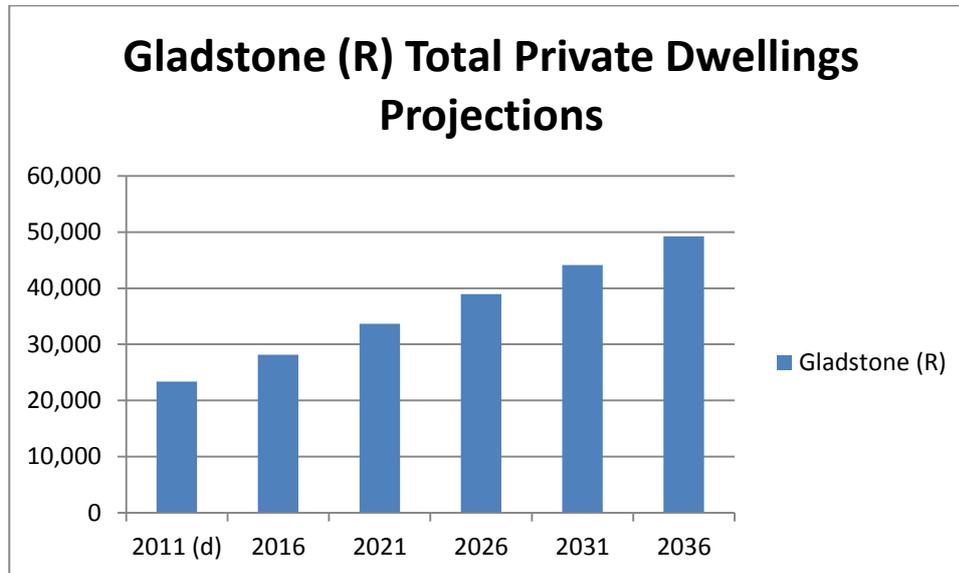


Figure 24 Projected dwellings (medium series), by local government area, Queensland, 2011 to 2036.¹⁶¹

Non-resident worker accommodation

The Queensland Government Statistician's Office (QGSO) released the *Gladstone Region Population Report, 2014* which provides information regarding the supply and take-up of commercial worker accommodation villages (WAVs) within the Gladstone (R) LGA. The report found that six worker accommodation villages (WAVs) were located within the Gladstone LGA as at June 2014 which housed 96 per cent of non-resident workers (6,400 workers). This included three temporary LNG project-specific WAVs located on Curtis Island and three mainland WAVS located in Gladstone (R) balance.¹⁶² The number of non-resident workers accommodated within the temporary Curtis Island WAVS reached 5,475 in June 2014.

The total combined bed capacity of the WAVs within Gladstone LGA was 8,065 beds as at June 2014. It is anticipated that the total WAV bed capacity in Gladstone will decline in 2014-15 as two WAVs have since closed in 2014, reflecting the transition of the workforce from the construction phase to the operational phase of projects. The report highlighted the fact that the use of non-resident WAVs has effectively eased demand for other commercial accommodation types including hotels and motels over the last two years with approximately 39 per cent of hotel/motel rooms being vacant and available as at June 2014 in comparison to 12 per cent as at June 2012.¹⁶³ It is anticipated that the permanent 1392 room WAV (Homeground Gladstone) located at Calliope will continue to provide for future worker accommodation needs in the Gladstone Regional Council area. These types of 'on demand' WAV facilities offer a more flexible opportunity to ease the shifting demands in temporary accommodation in comparison to project specific 'single use' WAVs.

¹⁶¹ Queensland Government household and dwelling projections, 2013 edition, QGSO; ABS, 2011 Census of Population and Housing. (d) The 2011 figure is an estimate based on estimated resident population (ERP).

¹⁶² Queensland Government Statistician's Office, Queensland Treasury and Trade 2014

¹⁶³ Queensland Government Statistician's Office, Queensland Treasury and Trade 2014

Table 30 Number of WAVS and WAV bed capacity, Gladstone (R), June 2014¹⁶⁴

Location	Number of WAVS				WAV bed capacity			
	2011	2012	2013	2014	2011	2012	2013	2014
Curtis Island	0	3	3	3	0	1,255	6,100	6,125
Gladstone (R) balance	1	4	4	3	80	1,300	2,090	1,940
Gladstone (R) Total	1	7	7	6	80	2,555	8,190	8,065

Residential buildings approvals

The trend of residential building approvals in Figure 25 below indicates that the number of approvals peaked in the financial year 2012-13 with a total of 1,570 residential approvals. The number of approvals declined steeply in the 2013-2014 financial year with a total of 816 approvals. As mentioned previously, SGS’s 2012 Gladstone Planning Scheme Analysis report predicted that a total of 25,600 new dwellings would be required by 2031, equating to an average of 1,024 new dwellings per year.¹⁶⁵ A continued shortfall in the residential housing supply in comparison to demand would have a marked impact on affordability and cost of living pressures for the community.

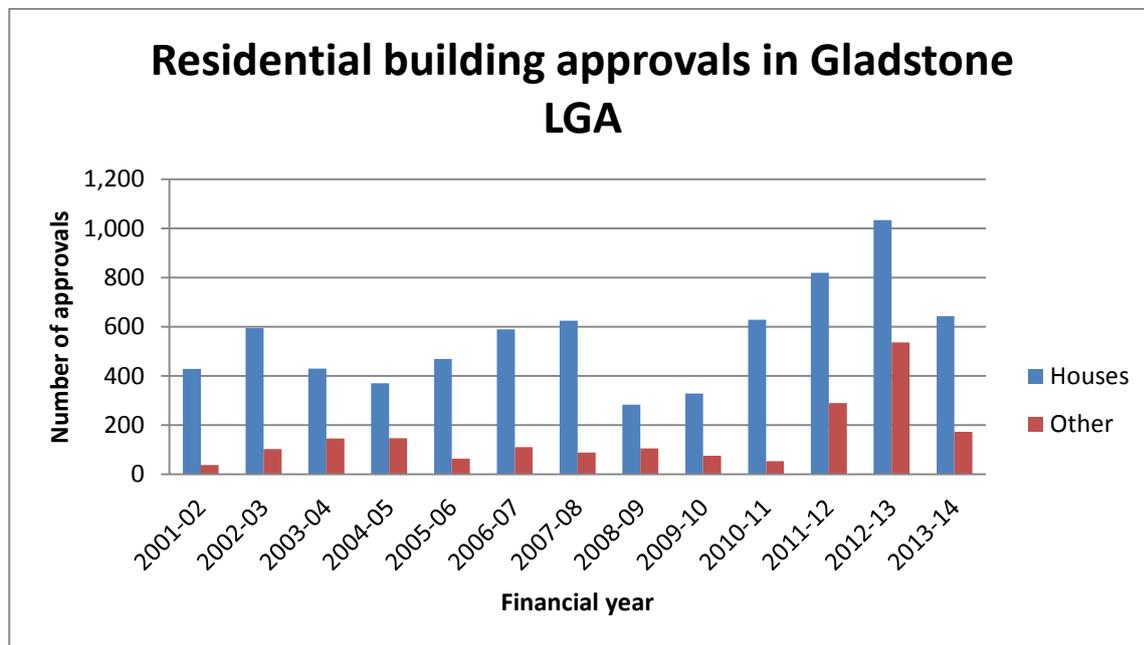


Figure 25 Residential building approvals.¹⁶⁶

¹⁶⁴ QGSO Gladstone region population report, 2014

¹⁶⁵ SGS Economics & Planning 2012a, Planning Scheme Analysis: 2012 Update, prepared on behalf of Gladstone Regional Council.

¹⁶⁶ Source: ABS, building Approvals, Australia (88731.0)

8.3.5 Education and training

A higher proportion of Gladstone residents with a qualification have a certificate as their highest level of education in comparison to Queensland. On the other hand, a lower proportion of persons with a qualification have a bachelor degree or higher. This reflects the high proportion of persons employed in Gladstone as technicians and trades workers.

Table 31 Non-school qualifications by level of education, Gladstone Regional LGA and QLD, 2011

LGA/State	Level of education						Persons with a qualification		Total persons
	Bachelor degree or higher		Advanced Diploma or diploma		Certificate		Persons with a qualification		Total persons
	Number	%	Number	%	Number	%	Number	%	Number
Gladstone (R)	4,346	9.7	2,425	5.4	11,461	25.7	23,576	52.8	44,659
Queensland	548,894	15.9	260,778	7.5	686,993	19.9	1,875,323	54.2	3,456,875

Source: ABS, Census of Population and Housing, 2011, Basic Community Profile – B37 and B40 (usual residence) and Queensland Treasury and Trade estimates

8.3.6 Income and cost of living

Figure 26 shows that Gladstone LGA has a larger proportion of households that earned a high income in comparison to regional Queensland. This can be partially attributed to the prevalence of higher-earning positions associated with the resources sector within the Gladstone region.

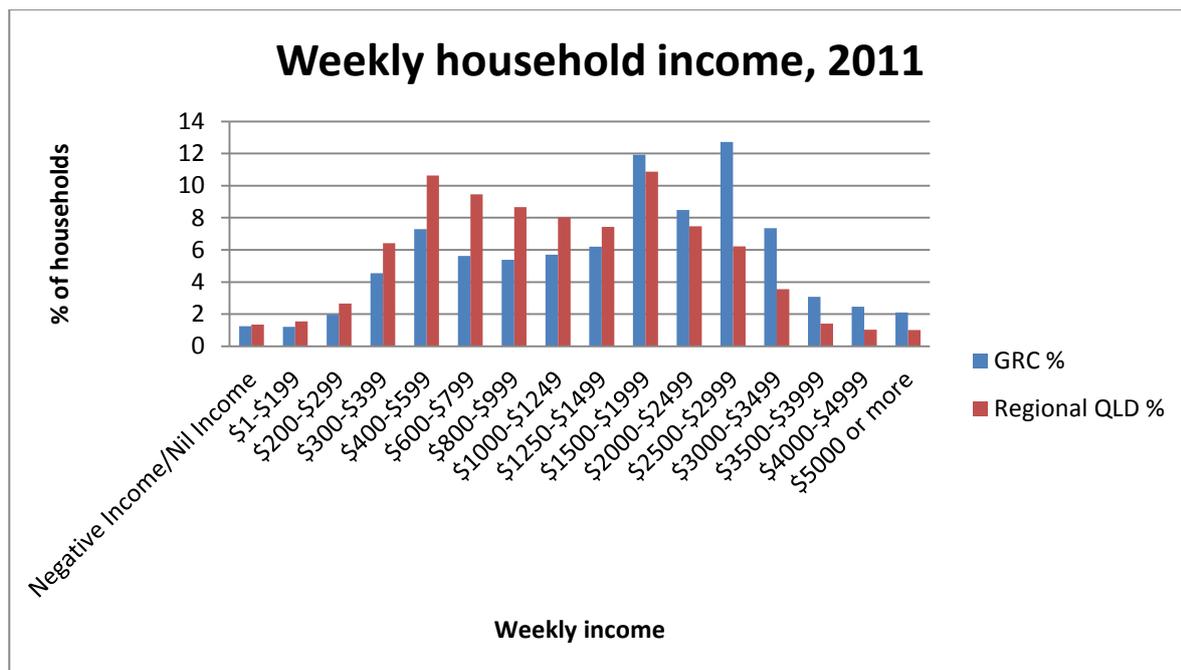


Figure 26 Weekly household income, 2011. Source: ABS, Census of Population and Housing 2011

Figure 27 illustrates that the median rent of three bedroom houses in Gladstone peaked in the 12 months ending March 2013 at approximately \$500 per week in comparison to the Queensland average of \$350 for the same period. The median rent in Gladstone has dropped significantly since that period to be \$300 per week which is \$50 below the Queensland median in the 12 months ending 30 September 2015 (refer to Table 32). This trend reflects the decreasing demand for rental accommodation associated with the housing of a large proportion of the temporary workforce within WAVs as well as the decrease in the construction workforce.

Table 32 Median rent by dwelling type, Gladstone LGA and Queensland 12 months ending 30 September 2015

LGA/State	Median rent			
	1 bedroom flat/unit	2 bedroom flat/unit	3 bedroom house	4 bedroom house
	-\$ per week-			
Gladstone (R)	192	250	300	380
Queensland	290	340	350	410

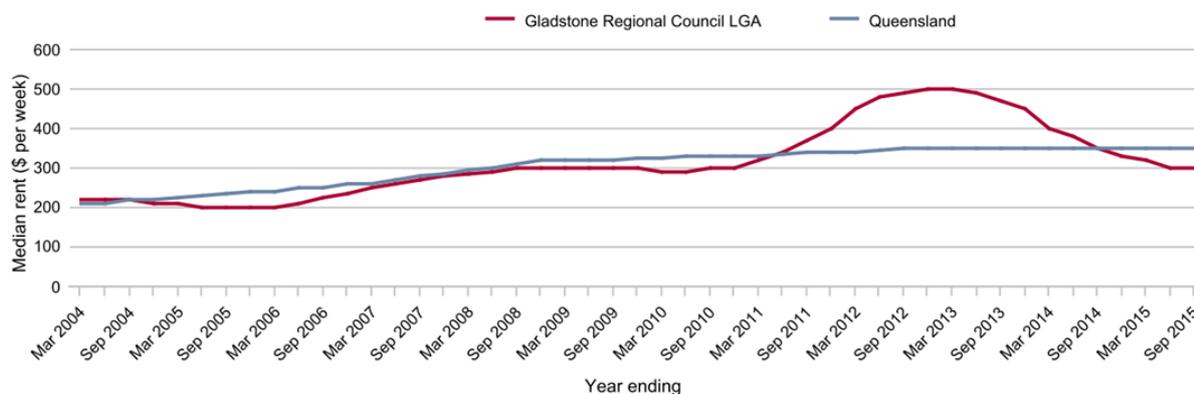


Figure 27 Median rent (\$ per week) of three bedroom houses.¹⁶⁷

Index of relative socio-economic disadvantage (SEIFA)

It is evident from Table 33 that Gladstone LGA has a relatively low proportion of its population within the most disadvantaged quintile (10.9 per cent). A significant proportion of the population fell within the second least disadvantage quintile (quintile 4). This is reflective of the large proportion of higher income earners (refer to Figure 26).

¹⁶⁷ Residential Tenancies Authority, Rental Bonds data (QGSO derived) and QLD Treasury and Trade estimates.

Table 33 Population by Index of Relative Socio-Economic Disadvantage quintiles, Gladstone Regional LGA and Queensland, 2011¹⁶⁸

LGA/State	Quintile 1 (most disadvantaged)	Quintile 2	Quintile 3	Quintile 4	Quintile 5 (least disadvantaged)
	%				
Gladstone (R)	10.9	22.9	19.0	31.2	16.0

It is important to note that certain geographic areas within the Gladstone LGA have a higher level of disadvantage than the index score for Queensland including Gladstone City, West Gladstone and South Gladstone – Barney Point.

8.3.7 Social and community infrastructure

A Social Infrastructure Strategic Plan (SISP) and Needs Assessment was undertaken for the Gladstone region in 2009 by the previous Queensland Department of Employment, Economic Development and Innovation (DEEDI) in conjunction with Buckley Vann, Briggs & Mortar and Andrea Young Consultants. The report found that significant investment in social infrastructure would be required to meet the needs of Gladstone's projected population growth to 2031.¹⁶⁹ The needs were found to be greatest in the key residential growth areas of outer Gladstone, Boyne Island/Tannum Sands and Calliope (refer to Figure 28). It is recognised that there is a range of community infrastructure projects that are being supported by the Gladstone Ports Corporation including the East Shores waterfront precinct. A number of obligations from Social Impact Management Plans of significant project proponents are coming to a close.

The findings from the SISP needs assessment in relation to the social infrastructure category are summarised below.

Health and Wellbeing

- The population growth of the Gladstone LGA will require a significantly larger hospital and higher service levels by 2031.
- The existence of Gladstone as an industrial hub of Queensland may necessitate an increase in the number of accident and emergency and intensive care facilities.
- A larger community health centre will be required in Gladstone by 2031. Furthermore a community health centre should be planned to be provided at Boyne Island/Tannum Sands by 2021.
- Strategies should be developed in liaison with TAFE and Central Queensland University to train allied health professionals in short supply in Gladstone.

Education Facilities

- The number of primary schools and high schools in the Gladstone LGA compared favourably with the anticipated numbers based on the benchmarking undertaken in the

¹⁶⁸ ABS 2033.0.55.001, Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia – Data only, 2011, (Queensland Treasury and Trade derived)

¹⁶⁹ Department of Employment, Economic Development and Innovation (DEEDI) in conjunction with Buckley Vann, Briggs & Mortar and Andrea Young Consultants 2009, Social Infrastructure Strategic Plan (SISP) and Needs Assessment.

study. It was considered that a number of existing schools could accommodate further growth/expansion if required.

- The study found that the existing TAFE facility in Gladstone should be upgraded to accommodate the broad range of skills demanded by Gladstone's core industries. In addition, it was recommended that a smaller TAFE facility should be considered within the Boyne Island/Tannum Sands catchment in the longer term.
- The Central Queensland University determined that the overall facilities of the campus are sufficient to meet the current service demand of users.

Children, Youth and Family Facilities and Services

- At the time of the SISP needs assessment there were seven preschools/kindergartens in the Gladstone LGA with a total maximum capacity of 174 places.
- This was found to be an under-provision of facilities in terms of the state average and it was considered that several additional centres would be required in the long term, particularly in outer centres such as Boyne Island/Tannum Sands.
- Domestic violence and child related abuse was found to be a significant issue within the region and a need for prevention and early intervention programs was identified
- Benchmarking from SISP identified the need for two additional youth centres within Gladstone by 2031 to meet the foreseeable demand.

Aged care services

- The number of aged care service operational places in Gladstone Regional LGA as at 30 June 2013 was 316 places.
- Community consultation coupled with community care data from the SISP Needs Assessment found that the greatest areas of need were for domestic assistance, social support, allied health care and personal care.
- The needs assessment found that additional services are required to increase the frequency and range of existing community transport services.

Disability Services

- At the time of the SISP needs assessment, there was only one provider of residential care in the Gladstone LGA for people with a disability which only had the capacity for six clients.
- Other needs that were identified included the need for additional traditional care facilities and purpose built residential facilities.

Indigenous Housing

As at September 2009, there was only one Indigenous housing provider in Gladstone with 34 houses. At that time, there were an estimated 20-30 people on the waiting list and the Needs Assessment considered that the undersupply would continue into the future.

Department of Housing and Public Works Public Housing

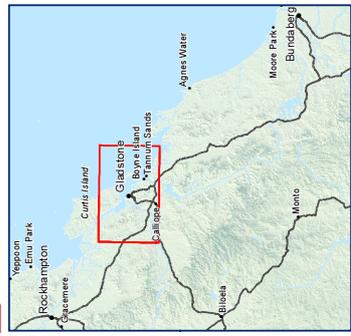
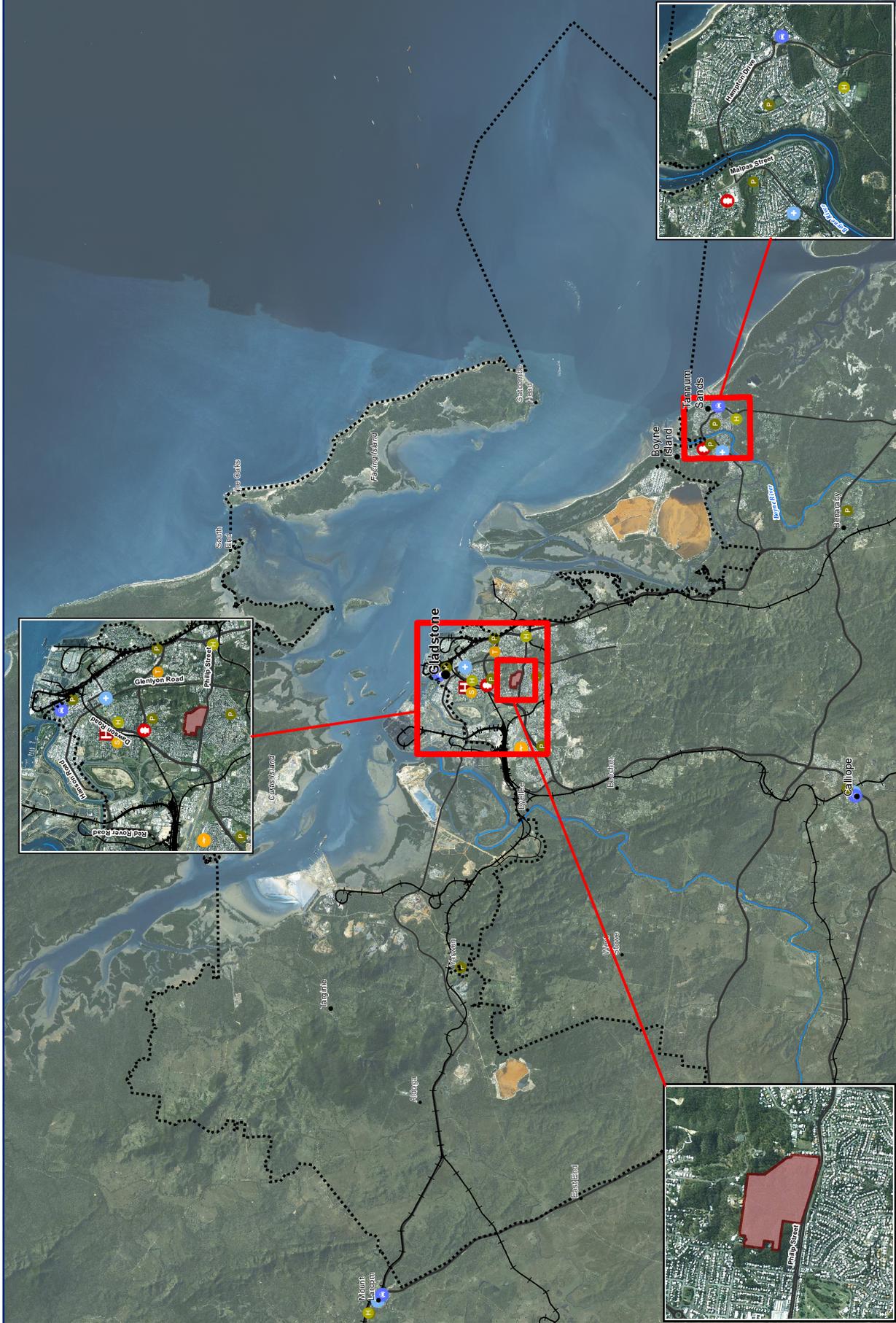
The Queensland Government owns a significant stock of land within the Gladstone LGA with localised areas of concentrated social housing. It is noted that some of that housing stock is located in close proximity to port operations at Barney Point outside of the proposed master planned area.

Figure 27

Social and Community Infrastructure

Legend

- Cities
- Urban centres
- Local centres
- Localities
- Watercourses (Major)
- Proposed Gladstone port master planned area boundary
- Transport**
- Railway
- Highways
- Secondary Roads
- Education**
- TAFE
- Special School
- High School
- Primary School
- Emergency**
- Hospital (Major)
- Hospital (Minor)
- Specialist Hospital
- Royal Flying Doctors
- Police
- Ambulance
- Fire
- Planning**
- Phillip St Communities Precinct (Proposed)



10 November 2015



Coordinate System: GDA 1984 MGA Zone 56
 Projection: Transverse Mercator
 Datum: GDA 1984

8.3.8 Community values

The Gladstone region has a number of features of environmental, recreational, social and economic value to the surrounding community. These values have been identified through a number of previous community engagement processes and studies including (but not limited to):

- The SISP Needs Assessment
- Arrow LNG Plant Social Impact Assessment (SIA), Australia Pacific LNG SIA, Gladstone Steel Plant SIA, Fisherman's Landing Northern Expansion SIA, Western Basin Dredging and Disposal Project SIA
- The Gladstone Healthy Harbour Partnership.

The key values that have been expressed by the community through the abovementioned studies include:

- Environment:
 - the biodiversity and natural values of the environment
 - protection of the Great Barrier Reef
 - the protection of areas with high visual amenity
 - minimising noise, dust and degradation to air and water quality
- Recreation and social:
 - the water-based recreational value of the harbour and its surrounds, particularly for boating and fishing
 - maintained wellbeing and amenity in the context of industrial development and growth
 - the social benefits of national parks and state forests aesthetically, health-wise and recreationally
 - access and use of the harbour including the foreshore, beaches, boat ramps and viewing facilities
 - access to an adequate provision of social and community infrastructure
 - recognition of Indigenous heritage
- Economic:
 - tourism
 - affordability
 - job opportunities
 - access to high quality transport infrastructure including roads and public transport
 - access to education and training facilities.

The Gladstone community largely embraces the managed growth of industrial development related to the Port of Gladstone and values the positive impact on the local economy. It is important from the community's perspective that development does not take place at the expense of the abovementioned community values.

8.3.9 Transport and access

The vast majority of the Gladstone LGA population travel by car to work (73.6 per cent). This is reflected in the fact that 22.8 per cent of dwellings in Gladstone LGA had three or more cars as the 2011 ABS Census of population and housing in comparison to 17.3 per cent for Queensland. In 2011, 2.7 per cent of the population used public transport to travel to work in comparison to 76.1 per cent of the population who used private vehicles.

A Gladstone Area Transport Study was undertaken in 2011 by PSA Consulting on behalf of the Department of Transport and Main Roads. The study found that scheduled urban bus services are poorly patronised due to the limited temporal coverage and long travel times and distances which made it difficult for public transport to compete with private transportation.¹⁷⁰ Other emerging issues associated with Gladstone's transport system that were highlighted in the report include:

- the lack of distinct transport hubs or formal park and ride locations
- major industries requiring high volume passenger transport options between worker camps and worksites
- the limited capacity of the road network to handle heavy vehicle designs with higher freight loads
- the growth in the ageing population and those with limited transport options requires increasing community transport options within urban areas.

8.4 Potential impacts

Table 34 provides a summary of both the positive and negative impacts associated with the ongoing operation and expansion of activities within the proposed Gladstone port master planned area that have been identified as part of the social investigation, evaluation and gaps analysis. This assessment has been based on the findings from a desktop review of existing studies, SIAs, Social Impact Management Plans (SIMPs) and stakeholder engagement programs within the Port of Gladstone geographic area as well as the baseline data compiled in Section 8.3.

Table 34 Potential impacts relating to the operation of current and planned activities within the Port of Gladstone master planned area

Description of potential impact	Potential duration
Workforce participation and employment	
An opportunity to increase labour force participation and increase local skills capacity	During the construction and operational phases of development.
Existing services may expand and new enterprises may be attracted to the region to cater for the growing population base	During the construction and operational phases of development.
Decline of construction workforce as major	Post-construction of major development.

¹⁷⁰ PSA Consulting 2011, Gladstone Area Transport Study – Preliminary Draft Transport Strategy report, prepared for TMR.

projects move from construction to operation	
Housing and accommodation	
Increased demand for housing and short term accommodation as a result of an expanded construction and operational workforce	During the construction and operational phases of major development.
Reduced housing affordability for low income earners due to increased demand and associated shortage	Cyclic
Income and cost of living	
The expansion of development may enhance the income earning potential of the wider Gladstone community	Ongoing
High rental and house prices associated with the influx of the construction and operational workforce of regionally significant projects	Cyclic
Social and community infrastructure	
Increasing pressure on community infrastructure – particularly health service facilities	Ongoing
Need to accommodate social infrastructure in appropriate locations within the proposed Gladstone port master planned area	Medium–long term
Community values	
Potential increase in crime (particularly relating to recreational drugs, physical abuse and firearm crimes) associated with an influx of temporary project workers	Cyclic
Reduction in recreational opportunities within the proposed Gladstone port master planned area as a result of the expansion of industrial port related activities	Ongoing
Cumulative impacts on the environment, air quality, noise, lighting and visual amenity as a result of further heavy/ noxious industrial development	Ongoing
Loss of Indigenous cultural areas and landscapes, impacting traditional practices	Ongoing

8.5 Conclusions

This section has provided a demographic snapshot and identified the social values that exist amongst the communities residing or working within the proposed Gladstone Port PDA and surrounding localities. Key conclusions that have been drawn from the social baseline assessment are summarised below:

- Gladstone is one of the fastest growing LGAs in Queensland with strong non-resident population increases supplementing steady residential growth. The estimated resident population of the Gladstone LGA is forecast to nearly double from 65,845 in 2014 to 121,266 in 2036 (Queensland Government medium series population projections, 2013 edition).
- Population growth derived from major infrastructure projects and port expansion will be difficult to project into the future and will place pressure on the provision of trunk infrastructure, accommodation/housing and key social services.
- The Social Infrastructure Strategic Plan (SISP) and Needs Assessment undertaken for the Gladstone region found that significant investment in social infrastructure would be required to meet the needs of Gladstone's projected population growth to 2031. This included the identified need for a significantly larger hospital and higher service levels by 2031.
- The working population of Gladstone is strongly dependent on the resources sector with over 5,000 full-time employees and contractors working in alumina refining, aluminium smelting, cement and chemicals production, rail transport and coal export operations in 2014.
- As the LNG projects transition from the construction phase to operations in 2015, the size of the non-residential workforce will decrease significantly in Gladstone (refer to Figure 21) with the operational workforces of the LNG plants and port projects likely to be considerably smaller than the construction workforces.
- Data derived from the 2011 Census of Population and Housing indicates that the top industry of employment with the Gladstone LGA is manufacturing (17 per cent). This is in comparison 7.6 per cent for Regional Queensland (refer to Figure 15).
- Other notable industries of employment include the construction industry (13.8 per cent), retail trade (9.5 per cent) and the transport, postal and warehousing industry (7.7 per cent).
- The abovementioned industries are strongly aligned with the operation of the Port of Gladstone. The management and sustained growth of these industries within the proposed Gladstone port master planned area is therefore an integral consideration in supporting the continued economic performance of the wider Gladstone area.
- The Gladstone region has a number of features that have environmental, recreational, social and economic value to the surrounding community. These have been summarised in Section 8.3.8.

9 | Cultural Heritage



9.0 Cultural heritage

9.1 Introduction and methodology

Indigenous and non-Indigenous cultural heritage in Queensland is protected and conserved using a framework which includes National, State and local government legislation, policies and guidelines. Significant Indigenous and historical cultural heritage values are known to exist throughout the proposed Gladstone port master planned area.

A number of previous heritage studies have been conducted in and around the proposed Gladstone port master planned area, and this document seeks to collate this information to create a consolidated list of known items, locations or areas of Indigenous and non-Indigenous cultural heritage significance through:

- a review and summary of existing reports and studies where available
- a Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP) Register and Database Search to identify any recorded Aboriginal cultural heritage and the Native Title Party(s), Aboriginal Party(s) and/or Cultural Heritage Body(s) for the area
- a non-Indigenous cultural heritage register search including the Queensland Heritage Register, National Heritage List, Commonwealth Heritage list, National Shipwrecks Database, Register of the National Estate and local government area plans and heritage registers where available
- review of consultation processes undertaken during previous studies
- identification of any gaps within the above information
- identification of potential adverse impacts to heritage and preparation of corresponding mitigation or management measures
- recommendation for further research or monitoring as required to ensure legislative compliance.

This desktop, due diligence assessment is based on a review of pre-existing reports and data, and is therefore limited to what information is 'already known' about an area. There is still the potential for currently unknown heritage sites to exist that have not yet been investigated.

9.2 Legislative framework

9.2.1 Australian Government legislation

Australian Government legislation governing cultural heritage includes the:

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*
- *Australian Heritage Council Act 2003*—the Act provides for the establishment of the Australian Heritage Council (AHC) which is the principal advisory group to the Australian Government on heritage issues. The AHC Act also provides for registration of places considered on national significant on the National and Commonwealth Heritage Registers and the Register of the National Estate (RNE) or the Australian Heritage Places Inventory (AHPI). Australian Government legislation for the protection of

Aboriginal cultural heritage only applies when state legislation provides insufficient protection or when an inconsistency arises

- *Historic Shipwrecks Act 1987*—the Act provides protection for all shipwrecks and associated artefacts more than 75 years old. The Department of Environment and Heritage Protection administers the *Historic Shipwrecks Act 1987*.

9.2.2 Queensland Government legislation

Aboriginal Cultural Heritage Act 2003

The principal legislation in Queensland with regard to Aboriginal cultural heritage is the *Aboriginal Cultural Heritage Act 2003* (ACH Act). The intent of the ACH Act is to effectively recognise and protect Aboriginal cultural heritage and to establish a process whereby this can be achieved. Aboriginal cultural heritage under the Act is defined as:

- a significant Aboriginal area or Aboriginal object in Queensland
- evidence of archaeological or historical significance of Aboriginal occupation of an area in Queensland.

The ACH Act places an onus on land uses or anyone whose activities might harm Aboriginal cultural heritage to take all reasonable and practical measures to avoid or minimise harm to Aboriginal cultural heritage by observing a ‘duty of care’. In the event that Aboriginal cultural heritage may be impacted through land use activities a program of mitigation and protection of surface and subsurface cultural heritage is to be undertaken through negotiation with the proponent and relevant Aboriginal party(s). Duty of care provisions apply to any activity where Aboriginal or Torres Strait Islander cultural heritage is located, including cultural heritage located on freehold land regardless of whether or not it has been registered or recorded in a database. The ACH Act also provides guidelines to assist a land user to identify reasonable and practical measures for managing activities in order to avoid or minimise harm to Aboriginal cultural heritage. The ‘Cultural Heritage Duty of Care Guidelines’ are framed around five categories of activities identified in the following table.

Table 35 Cultural Heritage Duty of Care Guidelines - categories

Category	Activity
Category 1	Category 1 relates to activities involving no surface disturbance. Such activities are generally unlikely to harm Aboriginal cultural heritage, meaning the proposed activity will comply with the duty of care guidelines. As a result, further cultural heritage assessment is not necessary.
Category 2	Category 2 applies to activities that will cause no additional surface disturbance and as such will not result in additional harm to Aboriginal cultural heritage.
Category 3	Category 3 applies to activities that are to occur in Developed Areas under the Guidelines. Activities that occur in these areas, and within existing development footprints, are generally unlikely to harm Aboriginal cultural heritage and may proceed without further cultural heritage assessment. Categories 3 of the Guidelines relate to the nature and extent of past uses

	in the area affected by the activity.
Category 4	<p>Category 4 applies to activities that occur in an area that has been subject to significant ground disturbance. In these circumstances it is generally unlikely that the activity will harm Aboriginal cultural heritage and therefore reasonable and practicable that the activity may proceed without further cultural heritage assessment. However, the Guidelines warn that in some cases, despite an area having been previously subject to significant ground disturbance, certain features of the area may have residual cultural heritage significance.</p> <p>Categories 4 of the Guidelines relate to the nature and extent of past uses in the area affected by the activity.</p>
Category 5	<p>Category 5 applies to an activity that causes additional surface disturbance or an activity in an area that does not fall within Categories 1-4. Where an activity is proposed under Category 5 there is generally a high risk that it could harm Aboriginal cultural heritage. In these circumstances, the activity should not proceed without cultural heritage assessment.</p> <p>It is generally necessary under category 5 to notify the appropriate Cultural Heritage Body or the Aboriginal parties for the area to seek advice in relation to cultural heritage values of the area.</p>

The Cultural Heritage Duty of Care guidelines detail circumstances whereby it may be necessary to notify the Aboriginal Party(s) and seek: (a) advice as to whether the feature constitutes Aboriginal cultural heritage and (b) if it does, agreement as to how best the activity may be managed to avoid or minimise harm to any Aboriginal cultural heritage. It is generally necessary under category 5 to notify the appropriate cultural heritage body or the Aboriginal Party(s) for the area to seek advice regarding cultural heritage values of the area. Under Part 5 of the ACH Act an Aboriginal cultural heritage database and Aboriginal cultural heritage register administered by the DATSIP has also been established for the collection and management of Aboriginal cultural heritage information.

Gidarjil Cultural Heritage Corporation is the registered cultural heritage body for the Port Curtis Coral Coast (PCCC) registered native title claim (representing the Bailia, Gooreng Gooreng, Gurang and Taribelang Bunda Traditional Owners) which applies to the proposed Gladstone port master planned area. Gidarjil Cultural Heritage Corporation has the responsibility of administering and managing all cultural heritage activities on behalf of PCCC. The area of the PCCC claim extends from the Burrum River in the south, north to Raglan Creek and Curtis Island and west towards Monto the Auburn Ranges. Land users wishing to undertake activities within the PCCC claim area are expected to abide by 'best practice' principles of cultural heritage management in the spirit of the ACH Act and should consult the Gidarjil Cultural Heritage Corporation's protocols for the management of Aboriginal Cultural Heritage (<http://www.gidarjil.com.au/what-we-do/cultural-heritage>).

There are eight registered Indigenous Land Use Agreements (ILUAs) between the PCCC and various proponents and one ILUA (area Agreement) with Gladstone Ports Corporation registered with the National Native Title Tribunal. An ILUA is a voluntary agreement between a native title group and others about the use of land and waters.

Queensland Heritage Act 1992

Cultural Heritage matters are covered in the *Queensland Heritage Act 1992* (QH Act) administered by the Department of Environment and Heritage Protection. The Act defines Cultural Heritage Significance as 'a place or a feature of a place which has aesthetic, architectural, historical, scientific, social or technological significance to the present, past or future generations'. The QH Act provides for the conservation of cultural heritage by protecting all places and areas entered into the Queensland Heritage Register (QHR).

Under Section 35(1) of the QH Act, a place may be entered in the QHR if it satisfies one or more of the following criteria:

- (a) If the place is important in demonstrating the evolution or pattern of Queensland history
- (b) If the place demonstrates rare, uncommon or endangered aspects of Queensland cultural heritage
- (c) If the place has potential to yield information that will contribute to an understanding of Queensland history
- (d) If the place is important in demonstrating the principal characteristics of a particular class of cultural places
- (e) If the place is important because of its aesthetic significance
- (f) If the place is important in demonstrating a high degree of creative or technical achievements at a particular period
- (g) If the place has a strong or special association with a particular community or cultural group or for social, cultural or spiritual reasons
- (h) If the place has a special association with the life or work of a particular person, group or organisation of importance in Queensland history.

The QH Act and subsequent amendments do not apply to the following Aboriginal Cultural Heritage:

- (i) A place that is of cultural significance solely through its association with Aboriginal tradition or Islander custom; or
- (j) A place situated on Aboriginal or Torres Strait Islander land unless the place is of cultural heritage significance because of its association with Aboriginal tradition or Islander custom and with European or other culture, in which case the Act applies to the place if the trustees of the land consent. (Section 61) (for example Aboriginal Missions).

The QH Act also regulates the discovery of historical archaeological artefacts and shipwrecks older than 75 years.

9.2.3 Local legislation

The proposed Gladstone port master planned area is located within the Gladstone Regional Council LGA, and is covered by the new Gladstone Planning Scheme 2015. In carrying out the change in planning schemes, Gladstone Regional Council instituted a new local heritage register which came into effect as of July 2013.

This local heritage register aims to maintain the significance of local places by:

- preventing the demolition or removal of local heritage places, unless there is no prudent and feasible alternative to the demolition or removal
- maintaining or encouraging, as far as practicable, the appropriate use of local heritage places
- protecting, as far as practicable, the materials and setting of local heritage places
- ensuring, as far as practicable, development on a local heritage place is compatible with the cultural heritage significance of the place.

9.3 Cultural heritage baseline study

The following section is not intended to be an exhaustive archaeological or historical review of the Gladstone region. Rather, the intent of this brief historical and archaeological overview is to provide a regional context for the Indigenous and non-Indigenous heritage sites within the proposed boundary for the Gladstone port master planned area. Further research and analysis of specific areas and sites may be required to address specific cultural heritage issues arising from future project activities.

9.3.1 World, Commonwealth and National Heritage

A search of the Australian Heritage Database has been carried out using the coordinates of the proposed boundary for the Gladstone Port master planned area.

This area encompasses the Great Barrier Reef World Heritage Area and Region but not the Great Barrier Reef Marine Park Area.

Table 36 below confirms that the Great Barrier Reef is the only heritage place of global or national significance that is located within the proposed boundary.

Table 36 National heritage places within the proposed Gladstone port master planned area

Site ID	Name	Location
World Heritage List		
105709	Great Barrier Reef	Cape York to Fraser Island (partially includes the proposed Gladstone Port master planned area)
National Heritage List		
105709	Great Barrier Reef	Cape York to Fraser Island (partially includes the proposed Gladstone Port master planned area)
Commonwealth Heritage List		
105573	Great Barrier Reef	Cape York to Fraser Island (partially includes the proposed Gladstone Port master planned area)

It has been well documented that the Great Barrier Reef World Heritage Area and Region is of great significance to the Port Curtis Coral Coast (PCCC) Native Title Group, and that marine resources such as turtle, dugong and numerous fish and shell species and their habitats play an important role in the social, cultural, spiritual and economic lives of the Aboriginal people of the area.

9.3.2 Aboriginal Cultural Heritage Database and Register

A search of the DATSIP Aboriginal and Torres Strait Islander Cultural Heritage Database and Register indicates that there is both a Cultural Heritage Body and Aboriginal Party within the proposed Gladstone port master planned area.

The Cultural Heritage body is the:

Gidarjil Cultural Heritage Corporation

The Aboriginal party is the:

Port Curtis Coral Coast Claim (QC01/29 –QUD6026/01)

The Port Curtis Coral Coast (PCCC) has been consulted during numerous studies carried out within the preliminary investigation area. However, most of this consultation has been conducted as part of the negotiation of project specific Cultural Heritage Management Plans (CHMPs), few of which are publically available for review.

As noted, there are a number of known sites in the Gladstone region, and there is strong potential for further Aboriginal cultural heritage places to exist, given the proximity to the river and wetlands. Even if all tangible evidence of past occupation (such as archaeological places and scarred trees) has been removed, intangible Aboriginal cultural values may persist.

9.3.3 DATSIP Database –Heritage Sites

The search of the DATSIP database indicated that there are 49 recorded Aboriginal cultural heritage sites within the proposed Gladstone port master planned area boundary. These sites represent a range of heritage site types including artefact scatters, shell middens, hearths, and scarred or carved trees.

Table 37 Recorded Aboriginal Cultural Heritage Sites on the DATSIP database located within the proposed Gladstone port master planned area

Site ID	Date Recorded	Site Type
JF:B64	12/05/1993	Shell Midden
JF:B65	12/05/1993	Shell Midden
JF:B66	12/05/1993	Shell Midden
JF:B67	26/08/1993	Artefact Scatter
JF:B68	12/08/1993	Shell Midden
JF:B69	12/08/1993	Scarred/Carved Tree
JF:C08	13/04/1993	Shell Midden
JF:C10	1/11/1979	Artefact Scatter, Shell Midden

Site ID	Date Recorded	Site Type
JF:C11	1/11/1979	Artefact Scatter, Shell Midden
JF:C13	1/11/1979	Artefact Scatter, Shell Midden
JF:C14	1/07/1978	Not Stated
JF:C15	1/08/1980	Not Stated
JF:A91	4/07/1989	Artefact Scatter
JF:A92	4/07/1989	Artefact Scatter
JF:C65	1/02/1999	Artefact Scatter
JF:C66	1/02/1999	Artefact Scatter
JF:C68	1/02/1999	Scarred/Carved Tree
JF:C70	1/03/1998	Cultural Site
JF:C71	1/03/1998	Artefact Scatter
JF:D10	1/01/1987	Artefact Scatter, Shell Midden
JF:D11	1/01/1987	Artefact Scatter, Shell Midden
JF:D12	1/01/1987	Artefact Scatter, Shell Midden
JF:D13	1/01/1987	Artefact Scatter, Shell Midden
JF:D14	1/01/1987	Artefact Scatter, Shell Midden
JF:D51	1/11/2001	Scarred/Carved Tree
JF:D72	6/05/2009	Artefact Scatter
JF:D73	6/05/2009	Artefact Scatter
JF:D74	16/07/2009	Artefact Scatter
JF:D75	16/07/2009	Artefact Scatter
JF:D76	16/07/2009	Artefact Scatter
JF:D77	16/07/2009	Artefact Scatter

Site ID	Date Recorded	Site Type
JF:D78	16/07/2009	Scarred/Carved Tree
JF:D79	16/07/2009	Shell Midden
JF:D80	16/07/2009	Artefact Scatter
JF:D81	16/07/2009	Shell Midden
JF:D82	16/07/2009	Artefact Scatter
JF:D83	16/07/2009	Shell Midden
JF:D84	16/07/2009	Artefact Scatter
JF:D85	16/07/2009	Artefact Scatter
JF:D86	16/07/2009	Artefact Scatter
JF:D87	16/07/2009	Artefact Scatter
JF:D88	16/07/2009	Artefact Scatter
JF:D89	16/07/2009	Artefact Scatter
JF:D90	16/07/2009	Artefact Scatter
JF:D91	16/07/2009	Artefact Scatter
JF:D92	16/07/2009	Artefact Scatter

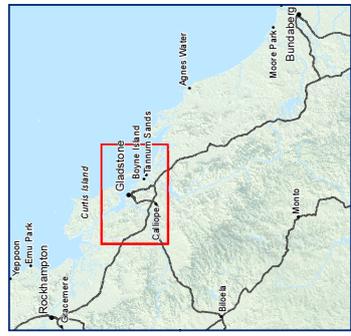
Figure 29 shows the location of recorded Aboriginal cultural heritage sites within the proposed Gladstone port master planned area boundary.

It should be noted that there is still potential for currently unknown sites to exist in the area, particularly in undisturbed contexts. Previous studies in the region suggest that archaeological sites are most likely to be found near waterways and coastal areas, and are most likely to be evidenced by collections of stone tools and discarded shells.

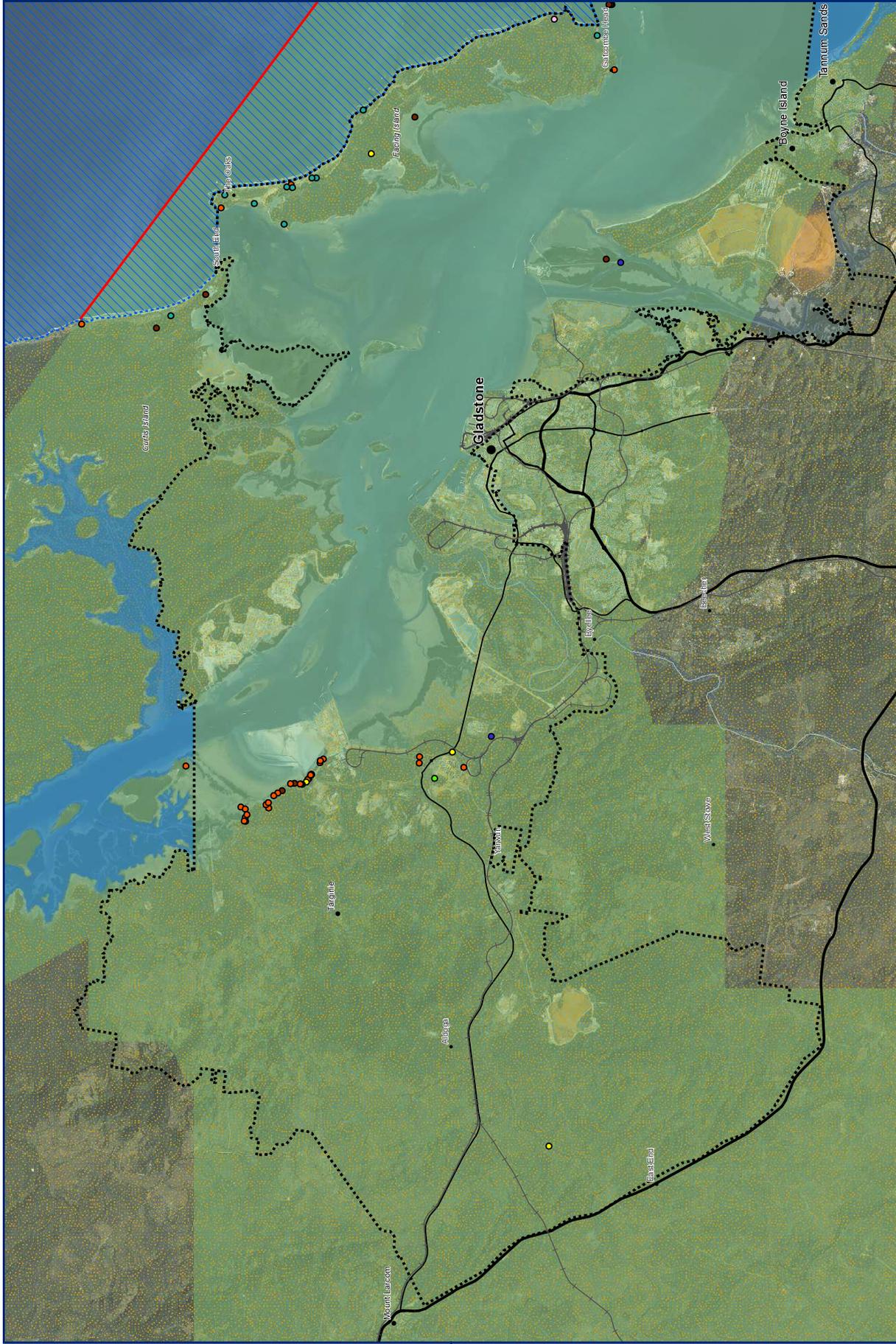
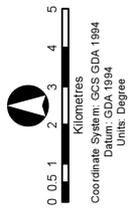
Figure 28

Indigenous heritage

- Legend**
- Cities
 - Urban centres
 - Local centres
 - Localities
 - Railway
 - Highways
 - Secondary Roads
 - Port limits
 - ⋯ Proposed Gladstone port master planned area boundary
 - ▨ Great Barrier Reef Marine Park
 - ▨ Great Barrier Reef Coast Marine Park
 - ▨ Indigenous land use agreement
 - ▨ Native Title Determination Application
 - Cultural Heritage
 - Not described
 - Artefact Scatter
 - Artefact Scatter, Shell Midden
 - Cultural Site
 - Hearth Oven
 - Scarred/Carved Tree
 - Shell Midden



10 November 2015



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9.3.4 State and Local Heritage Register

There are a total of three cultural places located either within or at the border of the proposed Gladstone port master planned area that are listed on the Queensland State Heritage Register (refer to Table 38 below and Figure 30).

Table 38 List of non-Indigenous cultural heritage places on the Queensland State Heritage Register

Site ID	Name	Location
601341	Friend Park and Graves (borders the proposed Gladstone Port master planned area boundary)	Friend Street, Barney Point
602711	Port Curtis Sailing Club House	1 Goondoon Street, Gladstone
601811	William Wyndhams gravesite & remnant orchard trees (borders the proposed Gladstone Port master planned area boundary)	Boyne Island

There are also seven sites on the Gladstone Regional Council Local Heritage Register that are either within or on the border of the proposed Gladstone port master planned area (refer to Table 39 and Figure 30).

Table 39 List of non-Indigenous cultural heritage places on the Gladstone Regional Council Local Heritage Register

Site ID	Name	Location
GRCLHL	Barney Point Beach (partially within the proposed Gladstone Port master planned area boundary)	Prince Regent Esplanade
GRCLHR	Euroa Homestead	1261 Gladstone – Mount Larcom Road
GRCLHL	Flinders Parade and Auckland Hill	Flinders Parade, Gladstone
GRCLHL	Mount Larcom Station Original Homestead Site	52780 Bruce Highway
GRCLHL	O'Connell Wharf	Flinders Parade, Gladstone
GRCLHL	Settlement Point	Facing Island
GRCLHL	Targinie Cemetery	433 Targinie Road, Targinie
GRCLHL	Victoria Park and Auckland Hill	Auckland Hill/ Flinders Parade

The proposed Gladstone port master planned area also contains seven places that are registered on the non-statutory DEHP Reported Places database which contains a list of places of potential heritage value reported to the department. There are no legislative requirements regarding places on this list although it does indicate places that may be of importance to the local community or have the potential for archaeological remains.

Consequently, such places should be taken into account in the context of a heritage assessment (refer to Table 40). Furthermore, there are other places not identified on statutory/non-statutory registers that hold particular significance within the local community due to natural values (e.g. Mt Larcom) or anthropological values (e.g. Targinnie for its Russian history).

Table 40 List of cultural heritage places on the DEHP Reported Places database

Site ID	Name	Location
24287	Midden	-23.82409; 151.14795
24456	Pyealy Creek yards	-23.85676; 151.17004
28363	Pilot station (former)	Facing Island
30269	Possible ship wreckage	Inter tidal zone approx. 400m north of surf club
30988	Mt Larcom Station Milking Yards	-23.87139; 151.03083
31311	Curtis Island Well	-23.78039; 151.22028
22476	Targinnie	n/a

It should also be noted that while a number of heritage studies have been conducted within the Gladstone region, coverage of the area is by no means complete. There is the potential for additional places of heritage significance to exist across the area. Any such places are likely to be associated with early pastoral, mining, maritime or railway activities, and may include surface or subsurface archaeological deposits.

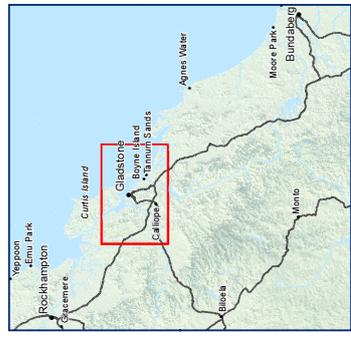
Archaeological remains with the potential to provide new information about Queensland's past are protected under the QH Act, and their discovery must be immediately reported to DEHP so that necessary assessments and management measures can be put into place. Failure to notify of an archaeological find or intentional damage to a find can attract penalties under the QH Act (Section 60, 89 and 90).

Figure 29

Non-Indigenous heritage

- Legend**
- Cities
 - Urban centres
 - Local centres
 - Localities
 - Railway
 - Highways
 - Secondary Roads
 - Property boundaries
 - Port limits
 - Proposed Gladstone port master planned area boundary

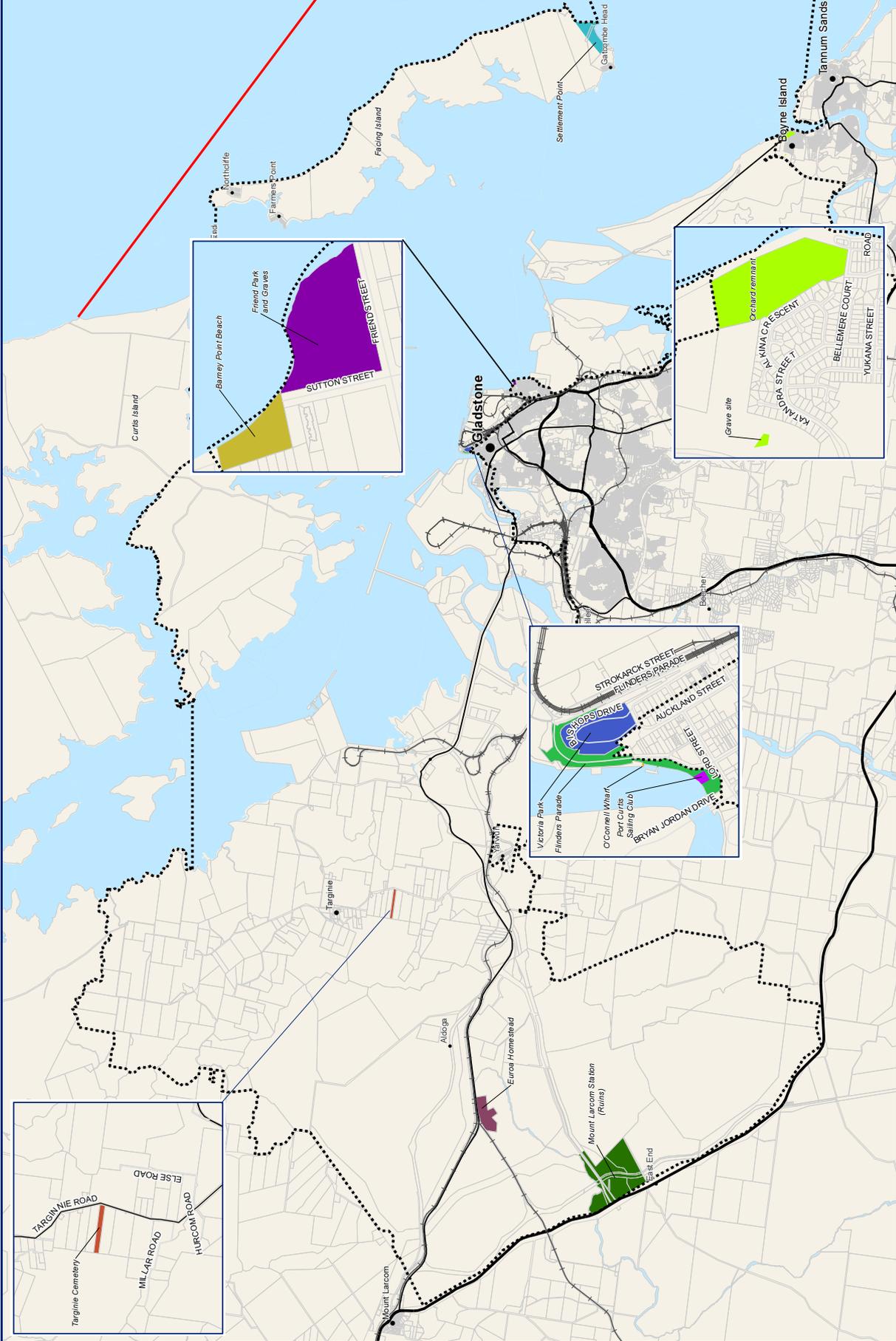
- Registered Non-Indigenous Heritage**
- Barney Point Beach
 - Euroa Homestead
 - Flinders Parade and Auckland Hill
 - Friend Park and Graves
 - Mount Larcom Station (Ruins)
 - Settlement Point
 - Targinie Cemetery
 - Victoria Park, Flinders Parade, Auckland
 - O'Connell Wharf
 - Port Curtis Sailing Club House
 - William Wyndams grave site and orchard remnant



10 November 2015



Coordinate System: GCS GDA 1984
Datum: GDA 1984
Units: Degree



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9.4 Conclusions

This section has identified the listed Indigenous and non-Indigenous cultural heritage sites located within the proposed Gladstone port master planned area. All potential impacts on the sites identified in Figure 29 and Figure 30 need to be recognised, considered and appropriately managed. Land use planning for the port will need to provide suitable protection for these sites through the inclusion of development controls to ensure heritage protection. It is noted that there are several sites located immediately adjacent to the proposed boundary of the master planned area. Whilst these sites fall outside of the defined boundary, future development will need to take into account the potential impacts that they may have on the values of the adjoining heritage sites.

In summary, the following listed sites of cultural heritage significance have been identified either within or immediately adjacent to the proposed Gladstone Port master planned area boundary:

- World, Commonwealth and National Heritage
 - Great Barrier Reef World Heritage Area
- Aboriginal Cultural Heritage
 - 49 recorded Aboriginal cultural heritage sites within the proposed Gladstone port master planned area boundary including shell middens, scarred/carved trees and artefact scatters
- Non-Indigenous cultural heritage places on the Queensland State Heritage Register
 - Port Curtis Sailing Club House
 - Sites immediately adjacent to the proposed Gladstone port master planned area boundary: William Wyndhams gravesite and remnant orchard trees & Friends Park and Graves
- Non-Indigenous cultural heritage places on the Gladstone Regional Council Local Heritage Register
 - Flinders Parade and Auckland Hill
 - Victoria Park and Auckland Hill
 - O'Connell Wharf, Flinders Parade
 - Settlement Point, Facing Island
 - Sites immediately adjacent to the proposed Port master planned area boundary: Barney Point Beach, Targinie Cemetery
- Non-statutory DEHP Reported Places database
 - Seven sites identified within the proposed Gladstone port master planned area that have been reported to DEHP as having potential heritage value.

10 | Economic Factors



10.0 Economic factors

10.1 Introduction

The purpose of this section of the report is to provide background material of an economic nature which will assist in the preparation of the Master Plan for the Port of Gladstone.

It focuses on the factors which impact on the port of Gladstone and collects data from numerous sources which are mostly in the public domain. Ports are about trade and the factors influencing the movement of imports and exports are key to the report. Gladstone has a significant industrial capacity which is supported by port activity – for example, bauxite is imported and converted into alumina and aluminium which are then exported. Fuel is imported to support industrial, agricultural and mining activity in Central Queensland for the production and export of coal, grain etc.

The continued attraction of industry with import and/or export requirements is recognised as a strong growth opportunity for the Port of Gladstone. Future production industries are able to be located close to port export/import facilities.

10.1.1 Context for the Port of Gladstone

The Port of Gladstone is Queensland's largest multi-cargo Port and is the fifth largest coal export terminal in the world (by throughput). The Port of Gladstone is a major centre for the import and export of products for the manufacturing, mining and process industries. Handling more than 1800 vessels annually, it is one of the busiest ports in Australia and plays a vital role in the local, state and national economies.

The Port's major functions are to facilitate the export of resources from the Central Queensland region and to handle the import of raw material and the export of finished products from major industry established in Gladstone. The Port is a convenient point for the worldwide distribution of the resources of central and southern Queensland with rail links to the rich hinterland to the west of the city providing access to coal and other minerals, timber, agricultural and pastoral areas of the Callide/Dawson Valleys, Central Highlands and Bowen Basin. A new rail link would facilitate the export of a variety of natural resources from the Galilee and Surat Basins through Gladstone.

The relationship between Gladstone Port's marine infrastructure and the supply chain to industry is a critical consideration in the context of the efficient operations and future growth of the port. For the efficiency of the port and the maximisation of infrastructure use, the shorter the loading/discharge time, the better the utilisation of the overall infrastructure, including channels and berths. For the vessel, the demurrage and costs are similarly reduced due to the lower time at a port.

Some products can be immediately transferred significant distances from the wharf while others cannot. Bulk liquids present the greatest opportunity for storage being located remote from the wharf. The transport distance is related to the viscosity of the product handled and therefore the power of the installed pumping capacity. Low viscosity products such as ULP may be pumped considerable distance with the installed capacity of the tanker. Crude oils may require additional pump installations to achieve the same distance.

In comparison, cryogenic bulk liquids need to have the distance between the plant/storage minimised due to the temperature losses that may result from the overall pumping, etc. For example, pumping LNG distances of up to a kilometre is considered to be optimal, however two kilometres of pumping has been used at some sites.

Bulk solids can be conveyed over a considerable distance but the capital and operating costs increase as a consequence of the distance. A balance is required between the provision of storage in close proximity to the berth with high conveying rates followed by trickle feed between the storage and the plant, versus a reduced discharge rate from the berth to a distant storage facility, resulting in increased marine interface costs.

Break bulk and container trades are best served through the product being stored adjacent to the berth and short transfer distances during the loading/discharge cycle. For efficiency, land backed facilities are preferable. The logistics supply chain also needs to reduce the need for double handling with a rail interface being available at a storage yard, particularly for container trades.

The Port of Gladstone lies within and adjacent to the Gladstone Regional Council area. Industries within the harbour catchment area include pastoral, agricultural, processing and manufacturing. Major processing and manufacturing industries located in the Gladstone Region include an aluminium smelter, two alumina refineries, an electricity generator, a manufacturer of sodium cyanide, ammonium nitrate, chlorine and a cement manufacturer. Three LNG plants have been recently commissioned on Curtis Island. Wiggins Island Coal Terminal (WICT) has commenced operations with the first shipment having been exported in May 2015. A large capital dredging project, the Western Basin Dredging and Disposal Project (WBDDP) was completed in 2013 in association with these new industries.

10.2 Current port trade activity

Over 30 products are currently handled through the Port of Gladstone and shipped to more than 30 countries. By far the largest traded commodity is coal, which represented 69 per cent of total cargo throughput in 2014-15¹⁷¹ when total trade through Gladstone was 99.29 million tonnes.

In 2014-2015 coal, bauxite, alumina, petroleum products and cement products represented the largest throughput volumes:

- coal – 68,564,790 tonnes (export)
- bauxite – 17,128,958 tonnes (import)
- alumina – 5,641,425 tonnes (export)
- petroleum products – 1,511,579 tonnes (import)
- cement products – 1,697,551 tonnes (export).

All other products are handled in volumes of less than 1Mt. However, as the identified Liquid Natural Gas (LNG) export facilities come online LNG exports will become a significant commodity with up to 25mtpa.

¹⁷¹ Gladstone Ports Corporation Annual Report 2014/15.

10.2.1 Exports

Table 41 illustrates time series data for export activity over the six financial years from 2008/09 to 2013/14. Grain includes wheat, chick peas and sorghum. Some other minor and/or intermittent products were exported e.g. burner fuel oil. The total volume of exports for the Port of Gladstone has averaged around 64mtpa. The leap in coal exports in 2013/14 of about 10mtpa substantially lifted exports for that year.

Table 41 Port of Gladstone Export activity by product from 2008-09 to 2013-14 (tonnes pa)

Financial year	2008-09	2009-10	2010-11	2011-12	2012-13	2013-2014
Alumina	4,094,263	4,214,205	3,794,339	3,909,386	4,891,708	5,082,561
Aluminium	368,535	322,675	334,661	373,726	334,883	385,448
Ammonium nitrate	0	0	2,000	0	0	0
Bunker coal	182,305	161,385	162,282	102,411	6,631	0
Calcite	113,778	136,820	103,794	137,477	141,078	136,973
Caustic soda	0	43,582	75,533	57,986	25,898	13,016
Cement/clinker	1,131,896	1,278,273	1,197,842	1,185,476	1,101,711	1,238,573
Coal - Barney Point	3,803,285	4,787,636	3,956,642	4,115,675	2,934,912	4,642,069
Coal- RG Tanna	52,396,680	55,602,406	49,232,706	55,638,013	54,378,793	64,980,430
Containers	9,303	237	3,929	37,905	69,704	85,719
Cotton seed	0	14,128	0	0	0	0
Electrofused magnesia	0	6,576	6,095	19,485	11,684	8,019
Fly ash	99,443	98,021	129,945	153,309	139,045	125,755
General cargo	36,934	5,053	10,688	27,369	42,044	20,800
Grain	446,449	240,762	260,218	338,245	386,879	149,387
Ilmenite	6,100	0	0	0	46,357	0
Limestone	44,540	22,321	29,301	39,119	28,527	45,694
Magnesia	46,628	57,000	84,670	70,240	58,412	53,732
Military eq./Vehicles	2,130	5,011	0	0	0	0
Scrap metal	22,345	32,229	49,310	38	44,685	74,454
Total exports	62,804,614	67,028,320	59,433,955	66,243,652	64,642,951	77,042,630

Source: TMR Trade Statistics for Queensland Ports For the five years ending 30 June 2014¹⁷²

¹⁷² Department of Transport and Main Roads, (DTMR), April 2013, *Trade Statistics for Queensland Ports, For the 5 years ending 30 June 2013*

Export coal dominates the volumes accounting for about 90 per cent of the total in most years (Table 42). The leading three commodities alumina, cement/clinker and coal account for about 98 per cent of the total tonnage (Table 43). Gladstone is one of the highest volume coal ports in the world. The high volume of coal in some ways overshadows significant volumes of other products such as grain or aluminium which have an annual average of over 300,000 tonnes per year.

Table 42 Leading Commodities Export Activity - Proportions from 2008-09 to 2013-14

Financial year	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Alumina	7%	6%	6%	6%	7%	7%
Cement/clinker	2%	2%	2%	2%	2%	2%
Coal	89%	90%	90%	90%	89%	90%
All other	2%	2%	2%	2%	2%	1%
Total	100%	100%	100%	100%	100%	100%

The main commodities exported can be classified into three groups:

- coal and mining products
- agricultural produce – grains, lupins, seeds
- manufactured products – cement, alumina.

This reflects the focus of the regional economy. Gladstone is one of the few Queensland cities with a significant secondary industry presence. Combined with its role as a major regional port, Gladstone has a more diverse economic base than many other Queensland coastal centres which are single sector (e.g. sugar) or only one or two sectors (e.g. sugar and tourism).

Coal

Export coal is easily the biggest commodity handled by the port of Gladstone. Most is handled through the RG Tanna Coal Terminal (RGCT) with a lesser amount through Barney Point Terminal (BPT). The new Wiggins Island Coal Terminal (WICT) will play a significant role in the future having exported its first shipment in May 2015. Stage one of WICT provides an additional coal handling capacity of 27mtpa¹⁷³.

Coal exports have shown consistent growth over the past 19 years, tripling from 1995 to 2014 with some minor fluctuations reflecting market variations (Figure 31). Except for 2010-2011 when there was catastrophic flooding at some coal mines, the port has consistently handled between about 53 and 59 mtpa in recent years (Table 41 and Figure 31). In 2013-14 there was a significant jump in volume to just under 70 million tonnes. While both metallurgical (coking) coal and thermal coal is exported from Gladstone, 75 per cent of total coal export is metallurgical and 25 per cent is thermal coal. The majority of coking coal is

¹⁷³ Wiggins Island Coal Terminal Environmental Impact Statement 2011

exported to Japan, South Korea, Taiwan, India, Italy and France for high quality steel manufacturing. Thermal coal is exported to Japan, Hong Kong, Taiwan, South Korea and Israel for power generation.

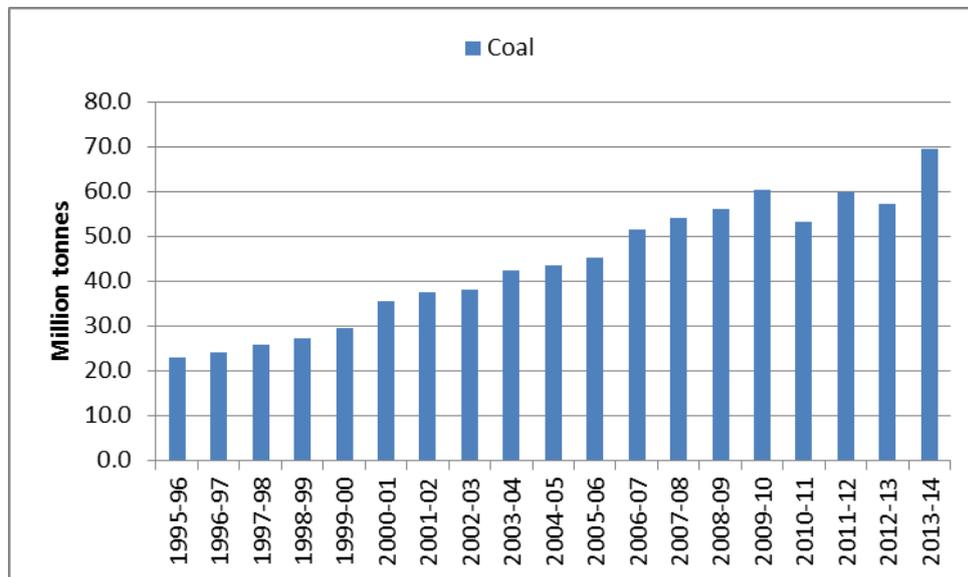


Figure 31 Coal Exports 1995 – 2014

Alumina

Alumina is produced at Queensland Alumina Limited's (QAL) 3.95mtpa rated refinery south east of Gladstone and at the Rio Tinto Alcan Yarwun refinery which is rated at 3.4mtpa. The bauxite feedstock is shipped in from Weipa in the Gulf of Carpentaria via South Trees (for QAL) and Fisherman's Landing (for Rio Tinto Alcan). The processed material is then exported or consumed locally and converted to aluminium at Boyne Smelters Limited at Boyne Island. In the long term export volumes have been stable averaging about 4.2mtpa (Table 41). However there was substantial growth from 2012/13 and 2013/14 when over 5mtpa was exported.

Alumina exports have grown steadily over the past 19 years, doubling from 1995 to 2013 (Figure 32). The two significant growth periods in 2005 and 2012 coincided with the commencement of operations in stage 1 and stage 2 of Rio Tinto's Yarwun Alumina Refinery (RTYAR). Growth within process industries such as alumina refining tend to be lumpy in nature, coinciding with operational expansions of facilities.

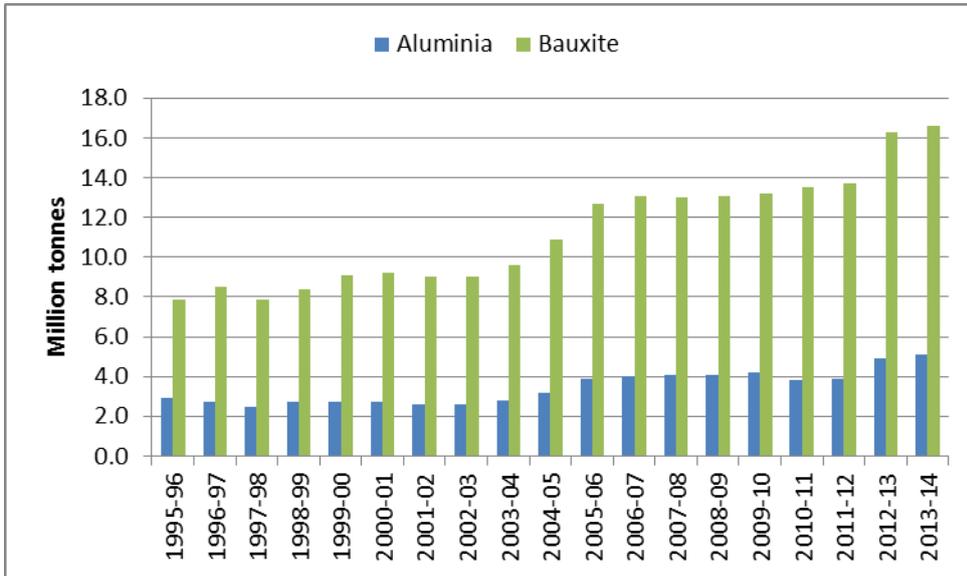


Figure 32 Alumina and Bauxite Trade

Cement/clinker

There has been considerable rationalisation of cement manufacturing in Australia over the last 20 years with many plants now closed and supply concentrated into a small number of very large plants. The Cement Australia facility at Gladstone is now Australia’s largest with a 1.7mtpa capacity. The plant supplies the silo at the Port of Townsville by sea. Smaller markets e.g. Rockhampton and Mackay are supplied by a mix of road and rail. Shipments of cement/clinker and flyash are currently approaching 1.4mtpa (Table 43). Cement and clinker exports combined increased significantly at the end of the 1990’s and again in the mid 2000’s only to have declined slightly over the past seven years (Figure 33).

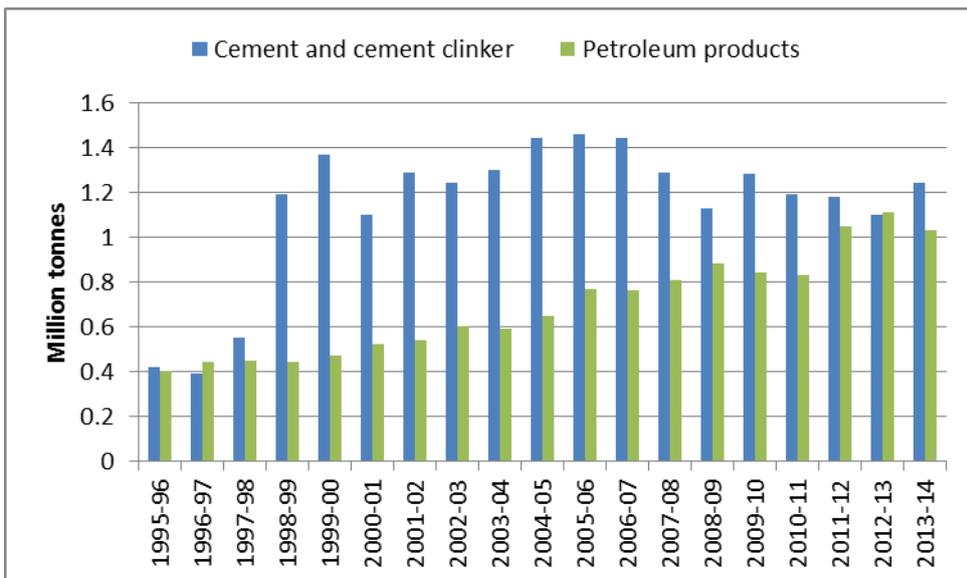


Figure 33 Cement, clinker and petroleum products

Liquefied Natural Gas

There has been extensive investment in LNG export facilities at the Port on Curtis Island. Three LNG export facilities are under construction in Gladstone, two of which have

commenced exports (QCLNG December 2014 and GLNG September 2015). It is expected that LNG exports will represent a major commodity for the Port. Initially, the three LNG facilities will have a combined export capacity of 25mtpa with an ultimate volume of LNG export estimated to be 40mtpa¹⁷⁴.

10.2.2 Imports

Table 43 shows six years of time series data for the majority of import activity from 2008/09 to 2013/14^{175&176}. Bauxite dominates the volumes accounting for about 80 per cent of the total in the sample years. Similar to the leading three export commodities accounting for about 98 per cent of the total tonnage, the three leading imports (bauxite, caustic soda and petroleum) account for 94 per cent of the total (Table 44). Minor and/or intermittent imports not included in Table 43 or Table 44 include LP gas, gypsum, copper slag etc.

The imports strongly reflect the industrial focus of the city. Bauxite is a key input for the two alumina refineries and caustic soda is crucial in the Bayer process of alumina production. The combined output of the two Gladstone alumina plants is amongst the largest alumina production in the world. Another import which is crucial to alumina/aluminium production is petroleum coke which is also one of the major commodities imported averaging 210,000tpa. Petroleum is a key input into the mining sector as is magnetite.

Table 43 Import Activity 2008-09 to 2013-14 (tonnes pa)

Import tonnes	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Bauxite	13,106,900	13,195,900	13,549,380	13,671,250	16,321,662	16,610,286
Bunker coal	0	0	64,885	0	0	0
Caustic soda	1,481,785	1,440,717	1,500,702	1,687,585	1,889,707	1,854,233
Cement gypsum	44,320	34,069	59,161	49,231	75,622	57,745
Containers	316	0	317	1,635	3,837	3,910
Fuel oil bunker	162,798	175,432	171,510	158,043	0	156,752
General cargo	76,690	35,661	142,825	246,527	419,722	176,914
Liquefied petroleum gas	11,151	11,801	10,390	12,027	11,518	8,598
Liquid ammonia	233,864	263,354	244,940	273,827	233,071	255,250

¹⁷⁴ QGC 2015, www.qgc.com.au, Santos GLNG 2015, www.santosglng.com, APLNG 2015, www.aplng.com.au

¹⁷⁵ Trade Statistics for Queensland Ports – for the five years ending 30 June 2013

¹⁷⁶ Trade Statistics for Queensland Ports – for the five years ending 30 June 2014

Import tonnes	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Liquid pitch	45,528	45,572	47,786	50,603	43,088	49,831
Magnetite	74,382	84,270	74,638	82,151	98,312	127,590
Military Vehicles	2,167	3,396	0	0	0	0
Petroleum coke	209,439	203,603	217,971	203,369	207,949	216,629
Petroleum product	881,405	843,576	830,432	1,048,074	1,292,214	1,028,389
Scrap metal	8,695	0	0	0	0	0
Sulphuric acid	0	0	55,793	61,619	54,107	40,409
Total imports	16,341,644	16,337,351	16,970,730	17,545,941	20,650,809	20,586,536

Table 44 Major Commodities Import Activity - Proportions from 2008-09 to 2013-14

	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
Bauxite	81%	81%	80%	78%	79%	81%
Caustic soda	9%	9%	9%	10%	9%	9%
Petroleum product	5%	5%	5%	6%	6%	5%
General cargo	0%	0%	1%	1%	2%	1%
Liquid ammonia	1%	2%	1%	2%	1%	1%
Petroleum coke	1%	1%	1%	1%	1%	1%
All Other	3%	2%	3%	2%	2%	2%
Total	100%	100%	100%	100%	100%	100%

Bauxite

The six year Bauxite import average was just over 14mtpa showing substantially higher exports in 2012/13 and 2013/14 at over 16mtpa (Table 43). Bauxite imports have grown steadily over the past 19 years, doubling from 1995 to 2013 (Figure 32). Output levels of alumina and the finished aluminium product is broadly in line with the amount of bauxite imported.

Petroleum Product

Petroleum is imported through Auckland Point Berth 3. BP and Shell are co-located as are Mobil and Caltex terminals. Petroleum product imports have grown steadily over the past 19 years, more than doubling from 1995 to 2013 (Figure 33).

10.2.3 Vessel Statistics

A detailed summary of vessel statistics for five years from 2009/10 to 2013/14 is provided in Table 45. This data indicates that the number of vessels increased by approximately 12 per cent between 2009-10 and 2013-14. Whilst the number of vessels within the 50,000 – 100,000 deadweight tonnage (DWT) category decreased over the five year period, there has been a significant increase in the number of vessels greater than 180,000 DWT (rising from 30 vessels in 2009-10 to 102 vessels in 2013-14). This has also translated to a marked increase in the number of vessels with drafts greater than 15m operating within the port (increasing from 147 vessels in 2009-10 to 261 vessels in 2013-14).

Similarly the number of vessels greater than 230m in length increased 34 per cent over the five year period. The increase in the number of largest vessels corresponds with the increase in coal throughput at the Port of Gladstone over the same period.

Table 45 Vessel statistics^{177 178}

Financial Year	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
By Deadweight tonnage (DWT)					
>180,000	30	34	54	60	102
100,000-180,000	145	171	200	217	199
50,000-100,000	791	669	655	625	715
>50,000	466	471	543	609	585
Total Vessels	1432	1345	1452	1511	1601
By Length (m)					
<185	354	346	398	426	512
185-230	678	611	601	535	553
>230	400	388	453	550	536
Total Vessels	1432	1345	1452	1511	1601
By Draft (m)					
>15.00	147	158	200	221	261

¹⁷⁷ Department of Transport and Main Roads 2014, Trade Statistics for Queensland Ports for the five years ending 30 June 2014

¹⁷⁸ Department of Transport and Main Roads 2014, Trade Statistics for Queensland Ports for the five years ending 30 June 2012

Financial Year	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
13.00-15.00	339	249	280	232	316
11.00-13.00	260	244	209	181	165
<11.00	686	694	763	877	859
Total Vessels	1432	1345	1452	1511	1601

10.3 Future prospects for Gladstone

The following section considers the future growth prospects for Gladstone over the master planning timeframe (up to 2050). It identifies potential economic growth drivers in both the global and local context as well as labour and workforce trends.

10.3.1 Drivers for Port Activity

The volume of throughput at the Port of Gladstone is influenced by the two main functions of the port i.e. the export of resources from the Central Queensland region and the import of raw material and the export of finished products associated with major industries in Gladstone. Both of these functions are driven by global and local economic factors.

Global Economic Drivers

The recent slowdown in the global economy is not as widespread as previous years. On a dollar basis, global output grew by around US\$1.3 trillion in 2014 - more than in 2012 and 2013. Although Japan and Italy are in recession, other economies such as the UK, the US and Canada, are performing better than expected. Therefore Wood Mackenzie's growth forecast for global GDP growth remains at 2.4 per cent for 2015. Wood Mackenzie expects global GDP growth to accelerate over the next few years, averaging a little over three per cent per annum between 2015 and 2020. This is because the US story remains robust and their China forecast is unchanged. These two economies are projected to contribute around a quarter of global GDP growth this year, next year and to 2020¹⁷⁹.

More information regarding the predicted trade volumes based upon global economic factors including demand is provided in the following sections.

Local Economic Drivers

As an economic unit Gladstone city represents:

- a major coastal population centre
- an industrial city and economic powerhouse with a heavy port focus
- a major logistics hub for central and central western Queensland including the Central Highlands and coal fields

¹⁷⁹ Wood Mackenzie for the Queensland Treasury Corporation 2015, Draft - unpublished

- a regional service centre for the surrounding areas such as Calliope, Dawson and Callide Valleys.

A future local economic driver is that of cruise ship stop-overs at the port which has the potential to create economic flow on benefits for the Gladstone tourist industry. P&O Cruises has announced that a new Southern Barrier Reef discovery cruise will commence in March 2016 which will include a stop-over in Gladstone.

Labour and Workforce Trends

Table 46 summarises June 2015 workforce data. It shows unemployment in the region 1.6 per cent below the Queensland average and despite the recent downturn in coal, which impacts on the three LGAs, the June 2015 data reflects how strongly the local economies continue to perform.

Table 46 Estimated Unemployment and Labour Force (June quarter 2015)¹⁸⁰

	Unemployed	Labour force	Unemployment rate
	Number		%
Banana	328	8,315	3.9
Central Highlands	823	18,593	4.4
Gladstone	1,944	35,879	5.4
Subtotal	3,095	62,787	4.9
Queensland	162,154	2,494,162	6.5

10.4 Potential growth in current export commodities

This section provides information regarding the potential growth of existing major commodities exported through the Port of Gladstone.

10.4.1 Coal

Product sources of supply

A port's catchment area typically corresponds to the area that can be served on a lowest cost basis by the port. Distance and connectivity to the hinterland define the boundaries of the catchment. The Port of Gladstone catchment area comprises areas from two major coal basins (the southern and central parts of the Bowen basin and the northern parts of the Surat basin), as well as two smaller basins (the Callide and Mulgildie basins) and is serviced by the Moura and Blackwater rail systems. The other small basin in the catchment is Maryborough

¹⁸⁰ Australian Government Department of Employment, Small Area Labour Markets Australia, various editions and Queensland Treasury and Trade estimates.

which is serviced by Queensland Rail's North Coast Line. Currently 17 mines export through the Port of Gladstone¹⁸¹.

As mines in the catchment area for Gladstone fall largely within the Bowen basin, and the Bowen basin has largely metallurgical coals, about 75 per cent of total coal exported through Gladstone is metallurgical coal.

Conversely, thermal coal exports volumes are proportionately much less than metallurgical coal, accounting for only around 25 per cent of total coal exports through Gladstone. Thermal coal is mainly consumed in power generation and metallurgical coal is used for making steel.

International and National Macroeconomic effects

Global demand for energy and steel product are major drivers of the proposed Galilee Basin mines north-west of Gladstone.

There are many competitors in the international coal market including Brazil, Indonesia, South Africa, USA and potential new comers such as Mongolia. Russia, China and India all have major domestic reserves which have the potential to displace Australian sourced supplies. However, in the case of China, it is the difficulty and complexity of supply chains competing with efficient seaborne material from Australia. In India there is a very complex legal situation and government policy which favours preserving strategic domestic materials and direct importation.

Product demand/substitutes

Changing consumption patterns in favour of less polluting energy sources, and a reduction in energy-intensity in heavy industry will also have a downside effect on growing demand for coal over the longer term. Although coal continues to be the favoured fuel supply option due to its cost competitiveness, public pressure is mounting in various countries to strike a balance between generation economics and environmental protection. LNG and other gases have already been identified as potential fuel substitutes. Nuclear and alternative energies are also active in the main markets in which Gladstone export coal competes.

Thermal coal demand in the Pacific basin is forecast to remain strong over the next twenty years. Higher economic growth, strong rates of electricity generation growth stimulated by an emphasis on electrification, industrialisation and infrastructure build, coupled with a lack of suitable alternative, abundant, and competitively priced fuel sources, will create a growing need for seaborne coal. Global thermal markets are currently facing extraordinary challenges and uncertainties driven by weakening global economic growth, substantial overhang in mine and export capacity, low oil prices, volatile currencies in key supplier countries, and ever-tightening environmental policies¹⁸². However, over the longer term, continued growth in demand for energy worldwide, will provide a platform for the continuation of strong demand for thermal coal over the next several decades.

China and India will be the engines of thermal coal demand as they develop additional coal-fired capacity of 841GW and 285GW respectively between 2014 and 2035. At the same

¹⁸¹ Wood Mackenzie for the Queensland Treasury Corporation 2015, Draft - unpublished

¹⁸² Wood Mackenzie for the Queensland Treasury Corporation 2015, Draft - unpublished

time, Japan, South Korea and Taiwan will remain large consumers of thermal coal. Global seaborne thermal coal imports are forecast to increase from 936Mt in 2014 to 1,860Mt by 2035. China's demand for Australia's high energy coal is expected to increase slowly through 2026 followed by a faster rate of increase through 2033 driven by Indian demand.

Metallurgical coal which is used for making steel is a much smaller and more specific market with arguably a less predictable long term trend. The easy recyclability of steel, apparently endless availability of low cost scrap feedstock and low cost Electric Arc Furnace (EAF) plants contribute to the large demand. Demand for metallurgical coal is predicted to remain positive in the long term from countries such as China and India.

Wood Mackenzie (unpublished) forecast that the expansion of Chinese steel and hot metal production as well as India's urbanisation will drive strong demand for hot metal, coke and coking coal in these countries. In the long term, growth in metallurgical coal demand will be largely driven by the increase in steel demand in the rapidly industrialising and urbanising development economies of Asia, most of which lack sufficient domestic reserves of metallurgical coal to satisfy their steel production needs. Therefore, global demand for/supply of metallurgical coal from countries such as Australia will continue to expand through to 2035 from approximately 280Mt in 2014 to 410 Mt in 2035.

Local factors

While 17 mines currently export through Gladstone, a further 23 projects are forecast to ship through the port by 2065. Coal export volumes through Gladstone are expected to grow strongly over the short to medium term out to 2020/21. To accommodate this growth, construction of Stage one of the Wiggins Island Coal Terminal commenced in 2011. Stage one of the project will deliver an additional coal handling capacity at Gladstone of 27mtpa. The first coal export from the new terminal occurred in May 2015. Future stages of the Wiggins Island Coal Terminal will see up to 84 mtpa of coal export capacity.¹⁸³

Existing mines in the Bowen and Callide basins have a total of 1,766Mt of export marketable reserves for export through the Port of Gladstone. A further 23 potential projects earmarked for export through the Port of Gladstone have marketable reserves totalling 2,485Mt.

Coal throughput at the Port of Gladstone is forecast to increase by 60Mt from 72Mt in 2015 to a peak of 132Mt by 2030. While some mines and projects will start to decline from 2031, Wood Mackenzie estimates there will be additional supply to offset this decline. Further expansion potential beyond 2035 will depend upon development of greenfield projects that have been delayed due to low coal prices.

Outlook

The majority of Australian thermal coal export growth is forecast to occur in Queensland with thermal exports expected to reach 184Mt by 2027. Subsequent to the development of the Galilee and Surat Basin, Queensland could provide approximately 75 per cent of Australia's thermal coal exports by 2035.

¹⁸³ Wiggins Island Coal Terminal Supplementary EIS

Supply of metallurgical coal is concentrated between Australia, the USA, Canada and Russia, currently accounting for 87 per cent of the seaborne market. Australia accounts for over half of the global supply.

The outlook for coal exports through the Port of Gladstone is favourable but potentially improved with the Surat Basin and WICT being fully developed. The demand for coal is growing and the high quality of the Gladstone product combined with efficient and economic logistics chains, provides a strong defence of the existing status quo with a solid platform for future growth. The majority of Galilee Basin coal seems to be destined to be exported via Abbott Point due to proximity, with a smaller volume potentially exported through Gladstone.

10.4.2 Export Grain and Broad acre Crops

Grains include sorghum, chick peas, and wheat and broad acre crops include lupins, pulses, oilseeds, cotton fibre and seed.

Product sources of supply

Biloela and Emerald areas currently export through the Port of Gladstone and are part of the Fitzroy region for which data is available. Around 20 per cent of Queensland wheat is grown in the Fitzroy region. Approximately 164,000ha in the Fitzroy region is planted with wheat compared to 52,000ha of chickpeas. Chickpea exports have grown marginally due to wheat growers gaining better wheat crops when rotated with chickpeas¹⁸⁴.

Due to the fact that wheat is a winter crop, farmers of the Fitzroy region also often produce sorghum during the summer which is interchanged by cotton farmers around the Emerald region when the price of cotton is not sufficient. Because of this flexibility, Queensland is the largest producer of sorghum nationwide. Sorghum is mostly used as a feed grain for livestock, and any excess that is not consumed locally is exported¹⁸⁵. Sixty-five percent of Australia's sorghum is produced in Queensland with 20 per cent grown in the Fitzroy region which is serviced by the Port of Gladstone.

International and National Macroeconomic effects

People in the Asian boom economies are increasingly adopting western influenced lifestyles and dietary patterns away from the traditional rice and mainly vegetable/fish diet, at least on a minimum scale. The rate of consumption seems related to increased wealth, and the associated western accoutrements. This provides favourable market conditions for the future particularly if the product quality is good and reputation is important in the market. More countries than ever are attempting to join this market and the existence of multinational commodities traders and logistics companies complicate matters. For example it may be possible to substitute Australian grain with Russian or Argentinian grain.

Gladstone wheat is currently exported to Fiji, Vietnam, Malaysia and New Zealand. Sorghum is currently traded to New Zealand and China and the bulk of chick peas were exported to India and Bangladesh in 2013/14¹⁸⁶.

¹⁸⁴ BIS Shrapnel 2015 for Gladstone Ports Corporation – Non-Commodity Trade – Due Diligence Report – Draft - Unpublished

¹⁸⁵ BIS Shrapnel 2015 for Gladstone Ports Corporation – Non-Commodity Trade – Due Diligence Report – Draft - Unpublished

¹⁸⁶ BIS Shrapnel 2015 for Gladstone Ports Corporation – Non-Commodity Trade – Due Diligence Report – Draft - Unpublished

From a national perspective Australia only exports the grain surplus to local consumption. In some cases such as small crops and rapidly escalating local demand for grain not only for human consumption but more recently in commercial uses e.g. production of industrial starches and esters, there may be nothing to export. Potential bio-fuel use will also consume local production. In central Queensland the growth of feedlots has taken a considerable amount of the formerly exported grain out of the system.

Product demand/substitutes

Grain exports through Gladstone in 2013/14 was 33kt of wheat, 71kt of sorghum and 46kt of chick peas. Both Sorghum and chick peas exports were down significantly from 2012/13.

There has been significant growth in recent years for containerised grain. Increasingly customers are Asian based and have container handling capacity at ports but many do not have food-grade bulk handling equipment, contamination - free secure storage and the associated logistics chains to support bulk movements. These latter movements are the traditional trades for Gladstone.

Containerisation represents a significant challenge to Gladstone which relates to the whole logistics chain part of which is beyond the control of the Gladstone port. In 2014, AECOM noted¹⁸⁷ there were 10ktpa of cottonseed and cotton fibre exported from the Central highlands via Brisbane in containers and approximately 20kt of containerised grains, lupins etc. from the Central highlands were exported through Brisbane. Structural changes in marketing and distribution of grain have led to a relative decline in the importance of the traditional silo based handling system giving the option of alternative supply chains. On-farm storage in containers is one means to bypass the silo system and use trucks to port for export. There may be an opportunity to expand export of containerised grains through Gladstone.

Local factors

There have been significant changes in the industry with a rise of local and regional feed-lotting since the 2000's which is consuming locally produced grain, particularly sorghum which traditionally has been exported through Gladstone. There is therefore a potentially smaller pool to draw from. The industry is still very volatile due to changes in climate and particularly water supply. There does not seem to be a way to reduce this volatility in the long term on a year by year basis. There has also been a shift away from traditional grains in favour of lupins and pulses, especially crops such as chickpeas. Based on the existing logistics chain, exports through the port of Gladstone are based on the traditional bulk supply by rail direct from inland silos.

Outlook

It is forecast that chick pea area planted will increase by two per cent per annum, sorghum yields will grow by 1.6 per cent per annum and wheat exports are likely to remain constant¹⁸⁸.

The outlook of grain production will depend on several factors including growing conditions. It is however, expected that prices and production volumes through Gladstone are projected to

¹⁸⁷ AECOM 2014a, Central Queensland Transport Supply Chain Study.

¹⁸⁸ BIS Shrapnel 2015 for Gladstone Ports Corporation – Non-Commodity Trade – Due Diligence Report – Draft - Unpublished

remain steady (wheat) with slow steady increases of chick peas and sorghum. The outlook could be more favourable with an improved logistics chain.

10.4.3 Horticultural and Other Agriculture Products

Product sources of supply

Central Queensland has a valuable agricultural sector primarily comprised of beef and cereal grains production, irrigated cropping including cotton, horticulture, forestry and commercial fishing (Central Queensland – Economic and Infrastructure Framework, 2013). The region's growing horticulture industry supplies a significant proportion of Queensland's tomatoes, capsicum, green beans and sweet corn, as well as high-quality mangoes¹⁸⁹.

Statistics for locally produced products are indistinguishable in the market. Meat products are produced throughout Queensland and the horticultural products are produced from the Atherton Tableland and coastal areas south to the NSW border. However, there are three abattoirs located in Central Queensland. JBS Australia in Rockhampton which has a daily processing capacity of 676 head of beef; Teys Australia in Rockhampton which has a daily processing capacity of 1,731 head of beef; and Teys Australia in Biloela which has a daily processing capacity of 703 head of beef.

The Central Queensland region had a total of 3,642 agricultural businesses in June 2011, of which beef cattle farming accounted for 2,634 businesses or 72 per cent of the total number of agricultural businesses in the region.

International and National Macroeconomic effects

The real cost of freight has declined to the point where even low value commodities can be transported to distant markets. In this global economy out of season products can be obtained freely from other parts of the world.

Increasing affluence combined with western media penetration is changing tastes and demands in many traditional societies in Asia, Africa and Eastern Europe. Foreign products are seen as better, more prestigious and more desirable and this attitude is becoming entrenched.

There is a growing movement which promotes a "consume local not global" to reduce transport greenhouse gas emissions and carbon footprint. It is debatable whether this can reduce the consumer demand for anything at any time anywhere.

Australian agri-marketers have been as active in foreign countries promoting Australian produce just as hard as competitors from other countries are. This is encouraged and supported by all levels of government, growers and supply chain providers.

Product demand/substitutes

Central Queensland is a major producer of:

- beef via two abattoirs in Rockhampton and one in Biloela

¹⁸⁹ GHD 2014, *Economic Development Queensland Regional Queensland Industrial Land Supply Study*, Central Queensland Region.

- pineapples and tropical fruit in the coastal strip particularly from Yeppoon to Yarwun.

Very little of this is exported through Gladstone. The meat is sold in the domestic (Queensland and southern) markets or containerised and exported via the port of Brisbane. The tropical fruit is sold in Brisbane and southern markets. Most of this material is easily containerised but at the moment Gladstone is not well equipped to handle this or other refrigerated cargo in the same way Brisbane can. However, there are two shore harbour cranes now available at Auckland Point and many handy size gear vessels which could address this issue.

Local factors

According to GHD¹⁹⁰: *The profitability of the industry is being strongly driven across the agribusiness supply chain through adoption of the latest technology and better responding to national and international markets (Central Queensland – Economic and Infrastructure Framework, 2013).*

Outlook

As noted earlier, it is supply chains rather than ports which compete with each other and unless Gladstone can attract greater frequency of container ship calls, it will be difficult to capture the containerised grain business from Brisbane. However on the flip side, ships will not call unless there is a container exchange sufficient to justify the cost of a day's shipping time lost, along with extra port costs. The future potential for the shipment of agricultural products is dependent on the nature of the market being served. Containers bound for South East Asia can be accommodated on feeder lot services whereas trade to the West Coast of America and further afield require liner services to optimise the transit times. The number of container exchanges has a major influence on the desirability for a port of call.

10.4.4 Alumina and Aluminium

Product sources of supply

Located within the Port of Gladstone catchment area are the Rio Tinto Alcan (RTA) and Queensland Alumina Limited (QAL) alumina refineries and the Boyne Island aluminium smelter (Pacific Aluminium). Both refineries are dependent on imported bauxite shipped from Rio Tinto's Weipa mine in north Queensland. Bauxite is a relatively common element and mined in many countries. Current bauxite supplies in Weipa are expected to deplete in 10-15 years; however, further development is proposed to the south of Weipa with bauxite production expected to reach 50 mtpa¹⁹¹. The goods logistics chain to Gladstone with deep water ports, good supply of electricity, workforce and other resources ensure it has a competitive edge. The two refineries in Gladstone produce a reliable supply of alumina which is used locally at Boyne Island and exported.

¹⁹⁰ GHD 2014, Economic Development Queensland Regional Queensland Industrial Land Supply Study, Central Queensland Region.

¹⁹¹ Rio Tinto Alcan 2011, South of Embley Environmental Impact Statement, http://www.riotintoalcan.com/ENG/ourproducts/1818_environmental_impact_statement.asp.

RTA started production of alumina in 2004 (capacity of 1.2mtpa) and upon completion of an expansion by 2018 plant capacity is anticipated to be 3.5mtpa. QAL started in 1967 with a capacity of 2,740ktpa, however expansions have led to a current plant capacity of 3.3mtpa¹⁹².

Pacific Aluminium is Australia's largest aluminium smelter with a capacity of 570ktpa. The smelter utilises alumina from QAL to produce aluminium, some of which is consumed domestically, however the majority of aluminium is exported through the Port of Gladstone.

International and National Macroeconomic effects

Aluminium is a highly traded metal in much demand around the world. Increasing incomes allow people to trade up in terms of housing and transportation and this trend can be observed around the world. This increasing wealth underwrites the future of construction and manufacturing and therefore of the materials used in these processes such as aluminium.

Asia is the fastest growing aluminium consumption region with China accounting for nearly 80 per cent of Asian and 50 per cent of the world's aluminium consumption in 2014.

Aluminium global capacity is forecast to grow from 59mtpa in 2013 and plateau at around 78mtpa in 2020 while demand growth continues. However, new global aluminium projects waiting on price appreciation and to ensure capacity meets demand through to 2035.

Product demand/substitutes

Aluminium has been used in a wide variety of applications for many years. It offers a strong, light-weight, non-rusting alternative to traditional material such as steel. As fuel becomes more expensive and car manufacturers attempt to reduce mass to provide better performing cars increased use of aluminium and alloys is expected. Away from industrial applications, aluminium is widely used in the packaging industry and there are few substitutes with the versatility of aluminium. For example, for food and beverage packing, few materials can match the quality and durability of aluminium cans.

On the horizon there is the threat of new materials for specific applications. Most noteworthy is the Boeing 787 Dreamliner which has substituted high tech composite materials where formerly aluminium would have been used. Already the Airbus 350 (the B787's direct competitor) has adopted some composite features and all manufacturers are examining weight saving options which could result in reduced demand for aluminium.

However, Wood Mackenzie expect global alumina demand to grow about six per cent per annum to 2020 and thereafter 3.1 per cent per annum to 2035. Global demand is forecast to increase from 133mtpa in 2013 to 158mtpa in 2020 which would result in an increase to capacity utilisation from 79 per cent to 95 per cent. Further increases in utilisation up to 98 per cent by 2022 indicates there will be an urgent need for additional capacity in the short to medium term.

Global aluminium demand is anticipated to grow by an average of 5.2 per cent over the 2013-2017 period driven by firm demand growth in emerging markets and by the increasing penetration of aluminium in end-use sectors such as automotive, transportation and power. Beyond 2017, global consumption growth is expected to gradually decelerate with an average of 3.3 per cent growth per annum from 2013 to 2035.

¹⁹² Wood Mackenzie for the Queensland Treasury Corporation 2015, Draft - unpublished

Local factors

The QAL alumina refinery has a life to at least 2041 and Yarwun has an expected life to 2052. Beyond these terms, significant capital investment would be required, however increasing demand in Asia leads Woods Mackenzie (unpubl.) to believe both refineries will still be operating in 2065. The RTA refinery employs modern technology and both refineries are within the lowest half of the global alumina cost curve and favourably located to Asian markets so both plants are competitive in world terms.

Alumina exports from the Port of Gladstone are forecast to increase from approximately 5mtpa in 2014 to approximately 6.4mtpa in 2019 where exports are predicted to remain until 2035.

There is the potential for RTA to undertake a Stage 3 expansion and for QAL to undertake a possible 400ktpa brownfield expansion in favourable economic circumstances. In the long term (out to 2050) the volume of alumina exported out of Gladstone is forecast to increase to 10mt as reported by GHD¹⁹³.

The Pacific Aluminium Smelter is expected to remain operational until at least 2060. Exports are predicted to increase from approximately 364kt in 2013 to 371ktpa by 2016 where export volumes will remain until 2035.

Outlook

The outlook for future alumina and aluminium exports through the Port of Gladstone is favourable. The global industry's aluminium utilisation rate could reach 90 per cent by 2021 and quickly surge to 95 per cent in 2024 reflecting a tightening of the capacity/demand situation. Gladstone aluminium exports are forecast to increase approximately two per cent by 2016 and remain stable until 2035. In conjunction, Pacific Aluminium has shown considerable faith in the Boyne Island smelter with significant investment for future aluminium production.

Similarly, Gladstone alumina exports are expected to increase approximately 28 per cent by 2019 and then remain relatively stable until 2035. QAL has invested in process improvements and efficiency while RTA is in the process of doubling its capacity. The growth in Alumina trade is unlikely to be linear and will more likely be reflected in block jumps as new sites become operational.

10.4.5 LNG

Product sources of supply

Coal Seam Gas (CSG) and natural gas are found in many countries, but unless there is the infrastructure and logistics chains in place to extract, process, store, transport and distribute it, it will remain an untapped resource. In this aspect Gladstone is very well served by pipeline connection to the Surat Basin and other potential sources. The construction of processing plants, port infrastructure etc. at Gladstone gives it a significant advantage over other sources of supply.

¹⁹³ GHD 2014, Economic Development Queensland Regional Queensland Industrial Land Supply Study, Central Queensland Region.

The LNG facilities on Curtis Island in the Port of Gladstone are the world's first dedicated CSG to LNG supply projects i.e. Australia Pacific LNG (APLNG), Santos' Gladstone LNG (GLNG) and Queensland Curtis LNG (QCLNG).

Significant CSG reserves are located primarily in Queensland in the Surat and Bowen basins. As the operators develop the gas reserves further and understand the performance of the wells better, the true extent of the reserves can be determined with greater confidence. Current estimates of gas-initially-in-place for the Bowen Basin and Surat Basin is 142 trillion cubic feet (tcf) and 252 tcf respectively. The existing projects have agreements with credible energy companies for a duration of 20 years.

Potential exists for additional gas resources in under-explored areas, such as tight gas and shale gas however, technical issues create higher cost challenges if they were to compete with other LNG projects globally.

International and National Macroeconomic effects

As noted above, the world has a growing appetite for energy and there are a number of fuels which can support that. The ease of extraction, portability via pipelines, economical transport and other factors have led to its relatively recent surge in popularity. In the USA a number of coal fired power plants have been converted or replaced by gas. Currently there is a seemingly inexhaustible demand in China for this cheap reliable fuel. Gas has other important industrial applications in the production of chemicals, fertilisers and acids.

The demand for rapid industrialisation and economic growth particularly in Asia has resulted in pollution and environmental concerns. The chief culprit is coal fired powerhouses and this has created a demand for cleaner energy. New gas fired powerhouses provide a good alternative to old technology based on inefficient processes using low grade coal. In the long term the drive to transform economies ensures the future demand for the product and if Gladstone can stay at the cutting edge, it will have a dominant presence.

The three LNG companies in Gladstone have significant long term supply agreements with power generators and gas distributors e.g. in Japan and Korea. Another key buyer group are national oil companies e.g. in Malaysia and China who look to resell the LNG to other buyers.

Product demand/substitutes

Gas has been used as fuel for many years but it is currently experiencing a surge in demand. While there are substitute products e.g. coal, petrol, they do not provide a direct economical alternative for a number of applications.

Local factors

LNG exports have commenced from two of the three Gladstone LNG facilities and are expected to grow. The third facility is expected to commence exports by the end of 2015. LNG outputs are expected to ramp up from 2015 and reach peak capacity in 2019. The three facilities are expected to produce approximately their plant capacities (up to 25mtpa combined) for 20 years. Extension of the life of the projects beyond 20 years is expected given the significant infrastructure in place but will be subject to availability of reserves in terms of volume, cost and location. Many other LNG projects world-wide have demonstrated operational lives of 30 to 45 years.

Wood Mackenzie¹⁹⁴ believe that APLNG and QCLNG will expand by one train each around 2025. The Arrow LNG project is not expected to go ahead in its current format as a greenfield development but could be developed as supply of gas or as part of an expansion of one or more of the existing facilities.

Outlook

The contributions from the LNG projects are likely to extend out to the year 2050. In 2020/21, it is estimated that the industry has capacity to export over 33 million tonnes of LNG through Gladstone Port. Whilst final output will be influenced by market factors, this export volume is estimated to be valued at over \$13.6 billion (undiscounted).

10.4.6 Cement

Product sources of supply

All cement clinker and cement exported through the Port of Gladstone is produced by Cement Australia's plant at Fisherman's Landing, which is Australia's largest cement plant and produces over 1.666mtpa of cement clinker. The plant produces clinker, most of which is ground into cement at the site, and a range of other products including flyash and lime. Limestone for the production of cement clinker is sourced from the East End mine (24 km from Gladstone)¹⁹⁵.

International and National Macroeconomic effects

The range of products includes relatively crude semi processed materials to fully manufactured finished goods in the case of cement.

Extensive infrastructure damage resulting from floods has necessitated a larger infrastructure rehabilitation and restoration program since 2011. As some of these works finish, demand will inevitably decline however the potential development of the Galilee Basin mines will result in high levels of demand during the construction phase, normally estimated at between 2-3 years, depending on the size and complexity of the mine. Apart from the mines there is significant civil infrastructure e.g. upgraded or new rail lines and roads to service the industry, housing and amenities for the workforce.

Cement is critical to all sectors in the economy ranging from consumption in domestic housing applications to commercial retail centres, from civil infrastructure to public and private works.

Product demand/substitutes

It is difficult to find a product which could be used as substitute for cement. Its future demand remains positive. Sunstate Cement based in Brisbane is a competitor but has little presence in the markets which are targeted by Cement Australia in Gladstone. Cement is freely traded in international markets and it would be possible for foreign sourced material to be directly imported through Townsville or Cairns (or Mackay) if there was demand which could potentially displace material shipped out of Gladstone.

¹⁹⁴ Wood Mackenzie for the Queensland Treasury Corporation 2015, Draft - unpublished

¹⁹⁵ BIS Shrapnel 2015 for Gladstone Ports Corporation – Non-Commodity Trade – Due Diligence Report – Draft - Unpublished

Cement clinker and cement produced at Fisherman's Landing is either consumed in the Gladstone area or is transported through Gladstone Port to other Cement Australia facilities throughout Australia e.g. Bulwer Island grinding plant and Townsville and Cairns terminals which lack their own mill facilities. No cement or clinker is currently exported overseas from Gladstone.

Currently coal mining accounts for almost 80 per cent of local demand for cement. The construction of the Galilee Basin mines and associated infrastructure will consume additional material which might otherwise be directed from Gladstone to markets in North Queensland. After the mine construction phase, it is normal for demand to decrease in line with the operation/production phase.

Local factors

With growing populations and demand for expanded urban and industrial infrastructure, there will be continued high demand potentially for decades. The Department of Transport and Main Roads (TMR) has significant works planned in central Queensland and concrete is integral to many of these projects. DSD is also examining infrastructure opportunities and regional economic development throughout the region. Given that the Gladstone plant is near capacity at present future expansion will be required to maintain shipments through the port given the number of potential new domestic regional customers. Otherwise as local demand rises, there will be less surplus for shipping through the port.

The major generators/consumers are mining companies, private developers, consumers, and civil infrastructure providers such as commonwealth, state and local government.

Outlook

The outlook is mixed. There is the potential for new coal mine development to increase local demand and therefore decrease surplus exports. The possibility of direct imports into Townsville from another source provides another significant threat to trade through Gladstone. However, there is also the potential for historical circumstances that have contributed to the recent closure of cement plants in the last five years to result in the plant altering its production from producing clinker to grinding imported clinker which would increase port imports.

10.5 Potential growth in current import commodities

Imports are dominated by two groups of products:

- bauxite and materials used in alumina/aluminium production
- petroleum and materials used in the mining, agricultural and transport sectors.

Only the major commodities are covered here in detail.

10.5.1 Bauxite

Product sources of supply

All bauxite utilised at Gladstone is currently sourced from Weipa with the mine being owned by Rio Tinto Alcan which also owns the RTA at Yarwun in Gladstone and is part owner of QAL in Gladstone. The deposit and adjoining sites in Weipa are extensive with current reserves expected to deplete in 10-15 years. The only risks to supply are when significant

climatic events such as cyclones disrupt shipping patterns or damage equipment at ports or plants.

International and National Macroeconomic effects

Over 85 per cent of bauxite mined globally is converted to alumina for the production of aluminium metal. An additional 10 per cent goes to non-metal uses in various forms of specialty alumina and the remainder is used for non-metallurgical bauxite applications e.g. commercial applications as abrasives and refractories¹⁹⁶.

All bauxite used to produce alumina and aluminium in Australia is sourced from Australia. Australia is the largest bauxite producer in the world with 74.9Mt produced in 2011. Bauxite production in Australia is estimated to reach 82 million tonnes in 2014-15¹⁹⁷. There are currently five Australian bauxite mines providing feedstock for the seven alumina refineries, which in turn supply alumina to the six Australian aluminium smelters and the export market. The bauxite is generally exported from one port via coastal shipping to another Australian port which results in a high volume of bauxite imports for Gladstone where two of Australia's five refineries are located.

From Gladstone's perspective, it is trade in the finished product alumina or aluminium rather than the raw product which is important. Thus the trends in the bauxite market tend to reflect the dynamics on the downstream products and how they are in demand during periods of economic boom or slowdown.

Product demand/substitutes

There are no other products from which alumina and therefore aluminium can be produced.

The expansion of Australian bauxite, alumina and aluminium production over the past few years reflects high demand for the commodities and significant investments are being undertaken in prospective projects. Along with well-developed production areas around Weipa, Gove and the Darling Range, bauxite occurrences in Western Australia, Cape York in Queensland and in central New South Wales and Queensland have maintained commercial exploration and development interest¹⁹⁸.

Local factors

GHD report a relatively favourable future for the Alumina/Aluminium production at Gladstone¹⁹⁹: *The volume of bauxite, alumina and aluminium handled at Gladstone is forecast to grow at a steady rate over the short to medium term and the long term. In the short to medium term, the volume of bauxite produced in Weipa is forecast to increase from 23 million tonnes in 2011/12 to just over 38 million tonnes in 2020/21. This represents an average annual increase of just over 7.1 per cent. The value of this production is forecast to increase from \$699 million in 2011/12 to just over \$1.1 billion in 2020/21 (undiscounted)*

¹⁹⁶ Australian Bauxite Limited 2012, ASX announcements 29/06/12, 03/12/12, www.australianbauxite.com.au

¹⁹⁷ IBIS World 2015, Bauxite Mining in Australia: Market Research Report, <http://www.ibisworld.com.au/industry/default.aspx?indid=66>

¹⁹⁸ Geosciences Australia 2010, *Bauxite*, www.ga.gov.au

¹⁹⁹ GHD 2014, Economic Development Queensland Regional Queensland Industrial Land Supply Study, Central Queensland Region.

(QRC, 2013). The volume of alumina produced in Gladstone is forecast to increase from 5.3*** million tonnes in 2011/12 to 7.4 million tonnes in 2020/21. The value of this production is forecast to increase from \$1.5 billion in 2011/12 to just over \$2.0 billion in 2020/21 (undiscounted) (QRC, 2013).

In the long term (out to 2050), the volume of bauxite produced in Weipa is forecast to increase to 50 million tonnes. The value of this production is forecast to increase to just over \$2.1 billion in 2050 (undiscounted). In the long term (out to 2050), the volume of alumina exported out of Gladstone is forecast to increase to 10 million tonnes. The value of this production is forecast to increase to just over \$2.75 billion in 2050 (undiscounted).

Outlook

The outlook for bauxite demand is very favourable according to most sources due to the continued strong demand for aluminium.

10.5.2 Petroleum Products

Product sources of supply

There are currently two bulk petroleum product terminals (excluding fuel oil bunkers) based in Gladstone. Annual petroleum imports have increased from approximately 880kt in 2009 to 1mt in 2014²⁰⁰. The countries from which fuel is sourced varies from year to year but always includes Australia. Other source countries can include Japan, Taiwan, and Korea. Bunker fuel is usually sourced from Singapore²⁰¹.

International and National Macroeconomic effects

Currently (early 2015), the price of crude oil has dropped to its lowest level in nine years at under \$US 48 per barrel. The main reason for this is several OPEC members have flooded the market with cheap oil to preserve volumes if not market share in a sluggish world market. It is unknown how long the state will prevail but it is placing pressure on other sources of fuel – e.g. CSG.

Product demand/substitutes

Few commodities are as widely traded and as useful as fuel. In the long term bio fuels and LNG/LPG may offer some alternatives to fossil fuels.

The Australian Institute of petroleum estimates that over the past decade, Australian use of petroleum products has increased by two per cent per day. Approximately 40 per cent of petroleum products consumed in Australia were imported. Unleaded, diesel and jet fuel account for 89 per cent of the total petroleum demand in Australia. Diesel demand has increased due to mining industry growth and to a lesser extent, growth in sales of vehicles with new diesel technology and jet fuel has increased due to increased demand for air travel.

²⁰⁰ Gladstone Ports Corporation 2014, Invitation for Expressions of Interest November 2014 – An opportunity to develop and operate a petroleum products import facility at the Port of Gladstone Central Queensland.

²⁰¹ Gladstone Ports Corporation 2015, Trade Statistics 2015, www.gpcl.com.au

However unleaded fuel demand has slightly declined and is expected to continue to decline slowly due to the development of higher efficiency vehicles²⁰².

For the applications of fuel imported through Gladstone there are no short and few medium term alternatives. An increased demand for fuel, particularly diesel is expected due to:

- the mining sector diesel requirements for power generation, fuel for equipment and trucks and for use as a component in explosives
- the agriculture sector requirement for diesel for farm equipment, plant and power
- the transport sector requirements for diesel for locomotives and trucks
- the aviation sector requirements for jet fuel, aviation gas and other products
- the growing urban and rural population's requirement for petrol for their cars.

BIS forecast that petroleum product imports at Gladstone will increase from 1mt in 2015 to 2mt in 2037 and over 4mt by 2060²⁰³.

Local factors

In terms of economic drivers, the consumption of petrol is tied to population patterns and domestic demand. The population is growing in the region, although at different rates in different towns. This air of confidence is supported by PSA who claim²⁰⁴: *Over the last decade, the Gladstone area has experienced a high level of economic and residential growth, driven by an increasing level of industrial development and exports. This growth is forecast to not only continue, but also intensify over the medium to long term horizon.*

These demographic trends are supported by SGS Economics and Planning SGS E&P who report²⁰⁵: *Office of Economic and Statistical Research (OESR) projects Gladstone Region's current population of about 63,000 people will grow to approximately 111,670 by 2031.*

Diesel consumption is driven by industrial demand particularly relating to the mining and agricultural sectors which have growth ambitions therefore it is expected demand will continue to increase. Recent volatility in the mining sector makes long term predictions difficult; however, the long term trend identified by multiple sources indicates an upward pattern.

The major unknown is when the proposed mines in Galilee Basin will come on line and whether they will be supplied out of Gladstone or Mackay. These proposed mega mines are many times larger than even the largest existing mines in the Bowen Basin and have the potential to demand input commodities such as fuel, explosives etc. in unprecedented quantities.

²⁰² BIS Shrapnel 2015 for Gladstone Ports Corporation – Non-Commodity Trade – Due Diligence Report – Draft - Unpublished

²⁰³ BIS Shrapnel 2015 for Gladstone Ports Corporation – Non-Commodity Trade – Due Diligence Report – Draft – Unpublished.

²⁰⁴ PSA Consulting 2011, Gladstone Area Transport Study – Preliminary Draft Transport Strategy report, for TMR.

²⁰⁵ SGS Economics & Planning 2012a, Planning Scheme Analysis: 2012 Update, prepared on behalf of Gladstone Regional Council.

Outlook

The outlook for petroleum product imports is positive with import volumes forecast to double in 20 years. However, the potential exists for significant growth in imports should new large mines be developed in the Galilee Basin. It is noted that with the imminent closure of Australian refineries, there is potential for the import of petroleum products direct from South East Asia. The economies of direct import within LR1 and LR2 tankers increases the potential coverage of the supply network into the Surat and Galilee basins.

10.6 Summary of Potential Growth in Existing Commodities

In assembling data of future predications it is important to understand that linear growth does not apply in many industries. For example, a cement plant is built to a nameplate capacity and the aim is to ramp up to that volume as quickly as possible. However, capacity enhancements are usually very irregular with major steps in capacity following capital development rather than incremental one per cent per year increases. Forecasting is also an imprecise science and it should be noted the forecast throughput estimates below are based on multiple and sometimes inconsistent sources therefore caution should be exercised with these indicative numbers.

The throughput estimates for the Port of Gladstone below consider a long term time horizon to 2050 and are based on information currently available.

In relation to exports, overall even with a minimal growth projection it is expected there will be larger export volumes mainly driven by the dominant commodity, coal (Table 47) as well as LNG as facilities commence exporting. For medium and high growth projections a more favourable trend is anticipated (Table 47).

LNG exports, which weren't included in the above analysis, have commenced from two of the three Gladstone LNG facilities and are expected to grow. The third facility is expected to commence exports by the end of 2015. Within the next 30 years both QCLNG and APLNG are expected to expand from two trains each to three trains each²⁰⁶, potentially increasing LNG exports by one third.

Table 47 Summary of Estimated Export Trends for next 30 years

Export Commodity	Minimal	Medium	High	Comments
Alumina/Aluminium	Stable	1% pa	2-4% pa	Limited by scale of production, irregularity of expansion and size of markets
Cement/clinker/flyash	Stable	1% pa	2-4% pa	Limited by scale of production, irregularity of expansion and size of

²⁰⁶ Wood Mackenzie for the Queensland Treasury Corporation 2015, Draft - unpublished

Export Commodity	Minimal	Medium	High	Comments
				markets
Coal	1-2% pa	2-4% pa	5%+ pa	Depends on Surat Basin development
Containers	Stable	1% pa	2-3% pa	Could expand in place of breakbulk
Grain	Stable	Stable	1%	Depends on markets, marketing arrangements and logistics chains and weather
Magnesia	1-2% pa	2-4% pa	5%+ pa	Limited by scale of production, irregularity of expansion
Scrap metal	Stable	1% pa	2-3% pa	Depends on markets and logistics chains

In relation to imports, overall even with a minimal growth projection it is also expected that there will be larger volumes (Table 48). This is because bauxite consumption will increase in line with the anticipated expansion of Yarwun and petroleum consumption will increase mainly driven by mining demand and also transport sector demand.

Table 48 Summary of Estimated Import Trends for next 30 years

Import Commodity	Minimal	Medium	High	Comments
Bauxite	Stable	1%	2-4% pa	Limited by scale of production, irregularity of expansion and size of markets
Caustic soda	1-2% pa	2-4% pa	5%+	Used in mining, chemical and alumina industries
General cargo	Stable	1%	2-3% pa	Multiple drivers – population, mining, agriculture and transport industries
Liquefied petroleum gas	Stable	Stable	Stable	Separate supply chain from export material
Liquid ammonia	Stable	2-4%	5%+	Used in chemical industry
Magnetite	1-2% pa	2-4% pa	5%+	Used in mining industry

Import Commodity	Minimal	Medium	High	Comments
Petroleum coke	Stable	1%	2-4% pa	Used alumina industries
Petroleum products	1-2% pa	2-4% pa	5%+	Multiple drivers – population, mining, agriculture and transport industries

10.7 Potential new port commodities

Gladstone Port is equipped as a major multi-cargo import and export port, with significant potential for expansion and substantial rail and supporting infrastructure. Gladstone is the location of bulk material handling facilities for coal, bauxite, calcite, magnetite, magnesia, grain, limestone, and intermittently a number of smaller products for example cottonseed and magnesite.

There is significant potential to expand upon existing bulk materials handling at Gladstone Port, particularly at Port Central and Fisherman's Landing. In addition, Gladstone is in a position to facilitate new exports or imports of new or temporary commodities at short notice at Port Central due to the winding down of the construction phase of the LNG facilities on Curtis Island. Fisherman's Landing also provides the potential for new portside storage/handling facilities and the development of new bulk material loading facilities.

10.7.1 Mineral Mining Prospects

A great variety of existing and potential mines are located within the Central Queensland region around Gladstone. A number of small mineral mines are in operation or development/exploration in the Central Queensland region south west of Gladstone providing potential new commodities for export at the Port of Gladstone. Development of regional transport solutions would assist the successful development of new mines through to exports from Gladstone.

Ilmenite and Associated Minerals

Ilmenite is a raw material used in the manufacturing of titanium pigments and metals. The Goondicum mine in the Monto area was commissioned in April 2015 after a \$7.6 million refurbishment and produced 18,000 tonnes of ilmenite before a weak prevailing market resulted in the mine being placed into care and maintenance in October 2015.

Exports of ilmenite may also potentially occur from the Wateranga Project near Mt Perry (approximately 215km from Gladstone). The Wateranga Project has identified a resource of 204Mt including five per cent ilmenite. Exploration to date has also identified a 20 per cent concentration of high alumina feldspar, a mineral composed of silica, aluminium and alkali elements mainly used in glass manufacturing and ceramic products, Corundum, with the exception of diamonds, the hardest mineral known and used as a high quality abrasive, occurs in the deposit at up to 1.8 per cent²⁰⁷.

²⁰⁷ Bonzle Digital Atlas of Australia 2015, www.Bonzle.com

The Wateranga Project ores also contain 0.8 per cent apatite, 0.2 per cent zircon 0.2 per cent, 0.1 per cent rutile and 30ppm scandium with an indication of magnetite as well. The project has the potential for export volumes reaching up to 600,000tpa by 2018.

The same region of Central Queensland provides a number of potential new exports including magnetite iron ore from Hawkwood, bauxite from Gayndah, copper/molybdenum from Merlin or Monto, limestone from Taragooola, kaolin from Duaringa, pyrite/copper/molybdenum from Mt Morgan area and nickel from Marlborough. There are several other minerals in the region that could be mined such as feldspar, silver and zinc. There are also a number of new coal deposits e.g. near Tiaro, Maryborough and Monto that have been identified for mining. These mines and mineral deposits are in various stages of investigation, exploration, development or maintenance. Tonnage potential from prospective mines varies from as little at 100,000tpa up to 5Mtpa.

Magnetite Iron Ore

Eastern Iron is investigating the potential for the development of magnetite iron ore deposits at two major locations, Eulogie (80km west of Gladstone) and Hawkwood (200km southwest of Gladstone) in proximity to existing rail and Gladstone Port infrastructure. The Hawkwood Iron Project is 250km by rail from the Port of Gladstone. Eastern Iron Limited announced a maiden inferred resource at Hawkwood of 100Mt at 13.8 per cent iron in May 2012. The ore contained high quality magnetite with concentrate grade of 54.6 per cent iron with notably lower concentrations of titanium than comparable deposits²⁰⁸.

Copper/Molybdenum

More than half the copper consumed is used in electrical generators and motors, electrical power and lighting fixtures, electrical wiring, radio and television sets, computers and almost everything electrical. Copper is also used where heat needs to be conducted well and where corrosion resistance is required²⁰⁹. Copper could potentially be mined at a variety of locations within Central Queensland and is generally found in conjunction with gold (see Gold and Pyrite below).

Most of the world's molybdenum is mined as a by-product of copper mining and this is the case in Central Queensland. This means the supply of molybdenum is closely related to the economics of copper mining. A drop in the price of copper could lead to a shortage of molybdenum. There are currently no molybdenum mines in Queensland, however, the world's highest grade deposit which occurs at Merlin, south of Cloncurry is undergoing development. The closest project to Gladstone is the Greater Whitewash mine near Monto south west of Gladstone. The deposits have an indicated resource of 185Mt grading 1189ppm copper, 263ppm molybdenum and 1.55ppm silver with a contained 48.5kt of molybdenum²¹⁰.

About two thirds of molybdenum is used for the production of alloy steels (stainless steel and superalloys e.g. the high strength steel in skyscrapers. Because of its strength and ability to

²⁰⁸ Eastern Iron Limited 2013, Hawkwood, www.easterniron.com.au

²⁰⁹ Australian atlas of minerals resources, mines and processing centres 2014, Copper, <http://www.australianminesatlas.gov.au/aimr/commodity/copper.html>.

²¹⁰ DNRM 2014, *Molybdenum opportunities in Queensland*, Geological Survey of Queensland, www.dnrm.qld.gov.au

withstand extreme temperature without softening or expanding it is also used in armour, aircraft parts and industrial motors.

Gold and Pyrite

The project entitlements at the Mount Morgan mine include copper and molybdenum as well as silver, gold, zinc and pyrite. Pyrite is a brass-yellow mineral, is composed of iron and sulphur and has a chemical composition of iron disulphide. Pyrite can be used in the production of sulphur and sulphuric acid. Gold and pyrite form together so that pyrite can contain small deposits of gold. Although the gold by weight is a tiny fraction of the ore, the value of gold is so high that pyrite might become a worthwhile mining target if the gold can be recovered in a cost efficient manner. It may be possible to export the pyrite for cost effective extractive methods elsewhere²¹¹.

Carbine Resources Limited are currently assessing the feasibility of recovering minerals such as gold, copper and pyrite from Mt Morgan again by reprocessing mine tailing and waste rock material. It is proposed to recover gold by using innovative treatment and extraction technology that will treat the acid water and remove the copper that causes high cyanide consumption. In addition the tailings will be subject to gravity and flotation treatment so that the pyrite is removed and the concentrate treated to remove the sulphur. It is proposed that these methods will reduce costs and improve gold recoveries²¹².

There are several other potential mines surrounding the Mt Morgan mine and elsewhere is Central Queensland e.g. Many Peaks which have similar resources²¹³.

Limestone

Cement Australia currently sources its limestone from the East End Mine approximately 25 km west of Gladstone where there is a resource of 120Mt²¹⁴. Marmor Mine 55km NE of Gladstone with a total limestone product of 5.2Mt currently export calcite through the Port of Gladstone. There are potential sources of limestone for export from other operating mines of Marule Lime 155km SSE of Gladstone near Childers (total limestone of 400kt) and Taragoola Mine near Calliope²¹⁵. While the limestone products of these two mines are currently consumed locally (i.e. within Queensland) it is possible that future markets for limestone products could precipitate the need for new exports. Other limestone product sources are known to occur near Raglan, Mt Perry, Mt Etna and Silica Hill which has a total limestone resource of 1.99Mt.

Kaolin

Duaringa Kaolin is located 155km WNW of Gladstone. The proved ore reserve at Duaringa is 1Mt. The raw material is crushed, screened, dried, and classified into a range of kaolin

²¹¹ Geology.com 2015, Pyrite, www.geology.com/minerals/pyrite

²¹² Norton Gold Fields Limited 2014, *Mount Morgan Mine* Project, www.nortongoldfields.com.au

²¹³ Bonzle Digital Atlas of Australia 2015, www.Bonzle.com.

²¹⁴ Queensland Minerals 2014, *Appendix 3 – Total contained metal in Queensland's major mineral deposits* calculated from reported resource/reserve figures, www.qdexquest.deedi.qld.gov.au, Appendix 3.

²¹⁵ Vizmap 2015, Limestone, www.vizmap.com.au

products for absorption applications which include pet litter, oil absorption, potting mix components and hydroponics as well as a range of industrial applications.

Nickel

Nickel is a base metal with physical and chemical properties that make it suitable for use in a wide variety of products across the commercial, industrial, construction and transport sectors. Key properties include its high strength and ductility, low thermal conductivity, resistance to corrosion and oxidation, ferromagnetism, and catalytic properties. Nickel also alloys readily with many other metals and can also be deposited by electroplating, thus imparting its favourable properties to the resulting alloy or plated product²¹⁶.

Around the world, about 68 per cent of primary nickel is consumed in the stainless steel production. It is also used in other forms of alloy steel for tools or superalloys for high stress applications e.g. aircraft engines, gas turbines, chemical processing plants etc. Plating is the other major first use for primary nickel. Carbon steel can be plated with both nickel and chromium to impact corrosion resistance for use in cars and household appliances. Nickel is also used in foundry applications while nickel and nickel chemicals are used in catalysts (primarily hydrogenation of fats and oils) and in batteries, particularly in hybrid vehicles.

Nickel is abundant in the earth's crust but is mostly at too small concentrations to make it economical to mine. Two different processes result in the two main types of nickel ore, sulphides and laterites. The processes used to recover refined nickel depend upon the ore type. Nickel reserves in Central Queensland consist of nickel laterites which require either i) ammonia leaching, (ii) ferronickel smelting or (iii) pressure acid leaching.

While there is currently no nickel trade throughput at Gladstone Port, it is possible that two projects could utilise the port over the next 50 years: the export of nickel ore from the proposed Marlborough nickel mine; and the possible development of a nickel/cobalt refinery in the Gladstone State Development Area (GSDA). The Marlborough deposits form about 13 discrete nickel laterites over 22 km. Five of the deposits contain proved and probable reserves of 48.65Mt at 0.94 per cent Ni and 0.06 per cent Co within a total resource of 70.9Mt. Nickel ore could be exported through Gladstone, Port Alma or Townsville.

There has been a proposal to process ores from the Marlborough mine at a nickel/cobalt refinery in Gladstone. The project has not proceeded however there remains a future opportunity for such a development.

10.7.2 Agricultural/Forestry Prospects

Grain is currently exported through the Port of Gladstone, a Graincorp facility being established at Auckland Point. However, there is the potential for other agricultural products grown in Central and South West Queensland to be exported via Gladstone such as cotton. Cotton seed is intermittently exported via Gladstone.

GPC has recently been able to facilitate the establishment of storage and handling facilities of logs and woodchips following the destruction of a local pine plantation by Cyclone Marcia.

²¹⁶ Wood Mackenzie for the Queensland Treasury Corporation 2015, Draft - unpublished

The new products represent 2-4 years of exports totalling up to 2 million tonnes. There is the potential for forestry product exports to be expanded to a permanent port commodity.

Gladstone is located within the Fitzroy and Central West region of the Regional Development Australia (RDA) network, a national network of 55 committees made up of local leaders who work with all levels of government, business and community groups to support the development of their regions²¹⁷. A focus of this RDA is to enhance the profitability, productivity and competitiveness of the agricultural sector in Central Queensland. The RDA's Growing Central Queensland Review April 2015 identified Gladstone as "the logistical capital of Northern Australia and the ideal setting to locate a hub looking exclusively at the value-adding field of agricultural transport and logistics"²¹⁸.

The report identified a number of potential agricultural export opportunities including:

- an inland port concept including agriculture containerisation and the coordinating of 100-200 agricultural containers with new cold storage facilities at the GSDA with container exchange matching to making shipping viable at Gladstone Port.
- new abattoirs in the region
- live cattle exports through Gladstone
- new oil seed processing industry
- horticulture and feedlots in the region.

10.7.3 Petroleum Prospects

Imports

In 2013-14 bulk fuel was imported into Gladstone from other ports in Australia (approx. 45 per cent), Korea (approx. 30 per cent) and Japan (approx. 25 per cent) by two Gladstone terminals. Gladstone fuel imports are expected to grow similarly to that forecast for Queensland i.e. a steady annual growth culminating in more than double current imports by 2044²¹⁹.

GPC anticipates an increased requirement for diesel over the next 5-10 years based upon a number of coal mining, mineral and energy developments investigating expansion or new developments within the Central Queensland Region. Current population projections for these regions provide a further economic fundamental for increased petroleum product consumption. There are a number of coal mining developments awaiting various stages of government approvals and financial investment decisions located in the Galilee Basin which may provide additional drivers for further increases in petroleum products.

Therefore, GPC has recently sought expressions of interest from the petroleum industry regarding a new petroleum import terminal in Gladstone. To date there is considerable interest in establishing a new terminal at Port Central where costs can be minimised e.g. through maximising utilisation of existing infrastructure. In the event that proposed coal

²¹⁷ Regional Development Australia 2015a, www.rda.gov.au

²¹⁸ Regional Development Australia 2015b, *Fitzroy and Central West Inc*, www.rdafcw.com.au

²¹⁹ BIS Shrapnel 2015 for Gladstone Ports Corporation – Non-Commodity Trade – Due Diligence Report – Draft - Unpublished

mines in the Galilee Basin proceed, there is the potential for a significant increase in petroleum imports being required to meet demand.

Exports

There are a number of potential new fuel export opportunities for Gladstone, most likely in the medium to long term.

The Northern Oil Refinery is situated in Yarwun near the port precinct of Fisherman's Landing. The refinery is able to process approximately 100 million litres per annum (mlpa) of waste lube oil to produce base lube oil. Most of the product is sold in Australia (transported by road); however, depending on the global prices, opportunistic international shipments via the Port of Gladstone could occur. Estimates of up to 9mlpa or 10 per cent of the plant's capacity have been forecast although any exports would be volatile/opportunistic.

The Queensland Energy Resources (QER) project, linked to the Stuart Oil Shale Deposit, represents a market opportunity to produce fuel for Australia's heavy transport sector²²⁰ and potentially for exports at the Port of Gladstone. When operating, the demonstration plant produced approximately 40 barrels per day of synthetic crude oil and high quality fuels for transport. Whilst this project has been proven and is in the financing phase for a commercial operation, future stages are described as having the potential to provide a commercial scale plant producing around 8000 barrels per day of finished fuels with a long term objective of producing 50-70,000 barrels a day of high quality transport fuel. It is understood stage 1 would provide fuel supply to the domestic market (i.e. not export) so exports are considered to be a medium to long term prospect. The timing for the delivery of this project remains unconfirmed.

In May 2015, the United States based Eagle Ford Oil and Gas Corporation and Australia's Casper Energy announced they are investigating developing a new \$700 million oil refinery project near Gladstone. They predict the refinery would initially produce 43,500 barrels a day, turning crude oil into high quality diesel and premium gasoline. However, the approvals process for the proposal has yet to commence.

²²⁰ Queensland Energy Resources 2013, www.qer.com.au

10.7.4 Gladstone Industry Prospects

Existing industrial project proposals in the Gladstone region include a steel plant and a commercial scale oils shale production plant.

Euroa Steel Plant Project Pty Ltd

Euroa Steel, formerly known as Boulder Steel is a potential new industry proposed near Aldoga within the GSDA. The plant is designed to produce 5mtpa of high quality steel in bloom and round billet form (i.e. semi-finished steel) for export to overseas finishing plants. The EIS process for the project has commenced, however financial security for the project has yet to be obtained²²¹.

QER Commercial Scale Oil Shale Plant

QER is advancing the design of a commercial facility at its Stuart resource. The next stage of QER's program involves scaling up the technology and processes with construction and operation of the plant, designed to produce approximately 8,000 barrels a day of products (predominantly ultra-low sulphur diesel for road transport to local markets.²²²

Other industry prospects

In addition, there are a number of potential industrial prospects that have either previously commenced an EIS process or have been approved in the vicinity of Gladstone that may be developed in the future. These include the following potential activities:

- LNG facility on Curtis Island
- nickel refinery
- coal terminal at Yarwun
- Gladstone Fitzroy Water Pipeline
- oil refinery
- gas fired power stations
- fertiliser plant.

10.8 Supporting Infrastructure

According to the Gladstone Regional Industrial Land Study 2012 the Gladstone Region has existing infrastructure that provides a competitive advantage to the region in attracting a range of industry sectors. This infrastructure includes essential utilities such as water (Awoonga Dam) and electricity (Gladstone Power Station), the Port of Gladstone and access to rail infrastructure. Appropriate infrastructure promotes private sector investment and demand for industrial land. Another competitive advantage that Gladstone Port has is its deep draught capacities. Gladstone is the only port in Queensland that can accommodate Capesize vessels for commodities other than coal. All levels of Government have recognized the strategic importance of Gladstone to the industrial sector and significant government

²²¹ Boulder Steel Limited 2014, *Gladstone Steel Project*, www.bouldersteel.com.au

²²² Queensland Energy Resources 2013, <http://www.qer.com.au/our-projects/stuart-commercial-project-1>

investment is currently underway or proposed to maximize the industrial opportunities of the Region²²³.

10.8.1 Gladstone State Development Area (GSDA)

The Queensland Government has established a broad hectare GSDA to facilitate the establishment of new industries with direct links to port facilities on the Gladstone Harbour. All development within the GSDA is regulated in accordance with the GSDA development scheme.

10.8.2 Transport Infrastructure Projects

Transport infrastructure projects that have the potential to result in port trade growth include:

- GPC Fisherman's Landing Expansion Project
- Gladstone Main Channel Duplication
- Moura Link Aldoga Rail Project.

Fisherman's Landing Expansion Project

GPC has approval to expand port lands at Fisherman's Landing through reclamation and has commenced these works. This project will result in the precinct increasing in size by 264 hectares with the potential for an additional six wharves significantly increasing the potential for trade growth.

Gladstone Port Gatcombe and Golding Cutting Channel Duplication Project

GPC has commenced the development approval process for the duplication of a section of the outer harbour shipping channel into the Port of Gladstone. This project will facilitate the potential increase in port throughput into the future and mitigate the risks resulting from additional vessel movements within the port's shipping channel. It is proposed that a duplicate channel would be developed adjacent to the existing channel thereby providing a two-way passage from the outer harbour, to the western side of Facing Island where it would connect with the existing inner harbour channel.

GPC is also investigating the possibility of modifying existing port infrastructure to accommodate larger vessels including long range vessels that would be approximately double the size of most vessels that currently visit the port.

Moura Link Rail Project

Aurizon has been granted approval for a major rail network expansion project in the Gladstone region which will facilitate increased exports at the Port of Gladstone. The project includes improving rail access for existing and potential coal mines in the Surat Basin to the south west of Gladstone. The proposal includes a new rail line to carry Moura/Surat traffic arriving via the Moura Short Line (MSL) in the south to the North Coast Line (NCL) southeast

²²³ SGS Economics and Planning 2012b, Gladstone Region Industrial Land Strategy Final Report – Update July 2012, Gladstone Regional Council.

of Mount Larcom. It is intended that the Moura Link will connect the MSL to the NCL, via the East End Mine Branch Line²²⁴.

The existing Moura rail system is a non-electrified line that connects the Moura, Callide and Boundary Hill mines to the RG Tanna and Barney Point export terminals at Gladstone. It also links the three mines with domestic coal users such as QAL and the Gladstone Power Station.

The Surat Basin Rail Joint Venture, of which Aurizon is a member, is also currently investigating a possible rail link from the southern end of the Moura System, south to the Surat Basin i.e. Southern Missing Link (SML). This link would serve existing and proposed mines in this region, and provide a direct link to Gladstone's coal port facilities for major new coal tonnages from the Surat Basin. Currently, mines in the Surat Basin are served only by the main western line from Brisbane.

Other Rail Projects

Port of Gladstone is serviced by the Blackwater and Moura rail systems which have respective nominal capacities of around 68mtpa and 18mtpa. Both the Blackwater and Moura systems will require upgrades in order to meet the increase in exports from WICT. Aurizon is undertaking the Wiggins Island Rail Project at a cost of A\$900 million to upgrade the two main rail systems plus the North Coast rail line and Bauhinia rail line that services the Rolleston mine. Further upgrades in the Moura and Blackwater rail systems are currently being investigated by Aurizon.

10.8.3 Transport Infrastructure Required to Grow Central Queensland

The Growing Central Queensland Review April 2015 identified a variety of transport and logistics impediments to and opportunities for growth in the Central Queensland agricultural export sector²²⁵. Transport infrastructure that would benefit agricultural exports included:

- Port Access Road Stage 2 and 3
- second bridge constructed across the Calliope River
- specific road construction as identified around grain transport and management areas and around potential water infrastructure
- linking some existing regional roads
- sealing some existing regional roads
- increasing road train access to specific areas.

10.9 Queensland and Australian Ports

The Port of Gladstone has been identified as one of 17 nationally significant ports by the Bureau of Infrastructure, Transport and Regional Economics. In 2012/13 Gladstone Port handled the fifth largest volume of cargo in Australia²²⁶.

²²⁴ www.dsdip.qld.gov.au, Moura Link-Aldoga Rail Project Initial Advice Statement 2007

²²⁵ www.rdafcw.com.au

10.9.1 Australian Ports

There are 47 ports in Australia including the Port of Gladstone (Table 49). Table 49 also shows the ports with the greatest throughput by mass tonnage for each state. In 2012/13 Australian ports handled a total of 1.13 billion tonnes of cargo made up of 0.99 billion tonnes of exports and 0.14 billion tonnes of imports. Western Australia handled the most cargo (550 million tonnes) followed by Queensland (287 million tonnes) (Table 49). These states also handled the most exports (530 and 239 million tonnes respectively). Queensland however imported the greatest volume of cargo in 2012/13 (48 million tonnes) followed by Victoria (29 million tonnes).

Table 49 Australian Port Throughput Statistics by State for 2012-2013

State	Number of Ports	Total Mass Tonnage Throughput by State	Port with Highest Mass Tonnage by State	Mass Tonnage handled 2012-13 (million)
Queensland	17	286,799,271	Hay Point	96
New South Wales	6	198,701,775	Newcastle	149
Victoria	4	55,234,906	Melbourne	35
Tasmania	4	11,223,040	Burnie	3.5
South Australia	7	22,948,510	Port Adelaide	15
Western Australia	8	549,831,147	Port Hedland	288
Northern Territory	1	4,299,008	Darwin	4.3
Total	47	1,129,037,657		

(Sourced from Ports Australia Association, 2013)

Port Headland (288 million tonnes), Dampier (180 million tonnes) and Newcastle (149 million tonnes) had the three largest total trade throughput by mass tonnage for individual ports in 2012-13 followed by Hay Point (96 million tonnes) and Gladstone (85 million tonnes).

In terms of growth for the bulk ports²²⁷ for the ten years between 2001/02 and 2011/12, Gladstone, Newcastle and Dampier demonstrated an average throughput growth of around five per cent to six per cent. This was out performed by the large scale Pilbara ports of Port Walcott and Port Headland, with growth rates 11.2 per cent and 12.4 per cent respectively.

²²⁶ Australian Government Department of Infrastructure and Regional Development 2013, Australian Sea Freight 2011-12, Statistical Report, http://bitre.gov.au/publications/2013/asf_2011_12.aspx.

²²⁷ DIRDD, 2014

10.9.2 Queensland Ports

Queensland has 17 trading ports, the most of any state in Australia and double the next highest state, Western Australia with eight ports. Trade statistics indicate that total throughput for Queensland ports in 2012/13 was 286.8 million tonnes (Table 50). This represented a 9 per cent increase on the previous year. Coal export remains the largest traded commodity, accounting for 62.8 per cent (179.9 million tonnes) of total Queensland trade, followed by bauxite with a total throughput of 45.24 million tonnes.

Table 50 Queensland Ports Throughput Statistics 2012-2013

Ports with Highest Throughput	Imports Mass Tonnage	Exports Mass Tonnage	Total Throughput Mass Tonnage
Hay Point	0	96,540,226	96,540,226
Gladstone	20,650,809	64,642,951	85,293,760
Brisbane	18,158,429	19,404,992	37,563,421
Weipa	116,964	28,924,608	29,041,572
Abbot Point	0	17,744,621	17,744,621
Townsville	6,671,391	5,434,413	12,105,804
Mackay	1,592,937	1,677,030	3,269,967
Cape Flattery	0	1,678,060	1,678,060
Cairns	647,717	407,891	1,055,608
Others	339,341	2,166,891	2,506,232
Total	47,177,588	238,621,683	286,799,271

(Sourced from Ports Australia Association, 2013)

Hay Point handled the greatest volume of trade (96.5mtpa or 38 per cent) compared to 85mtpa (34 per cent) at Gladstone and 37.5mtpa (15 per cent) at Brisbane. Similarly Hay Point and Gladstone handled the two largest volumes of exports, however, Weipa handled the third largest export volume (28.9mtpa). Gladstone handled the highest volume of imports (20.6mtpa or 44 per cent) followed by Brisbane with 18mtpa or 39 per cent in 2012-13 (Table 50).

It is important to recognise that some ports in Queensland which handle small volumes of cargo fulfil a specialist role in terms of cargo types. This includes:

- Port Alma (Rockhampton) – imports a number of commodities including ammonium nitrate, explosives and general cargo, reported as 350,000 tonnes in 2012/13
- Bundaberg - exported 205,000 tonnes of sugar in 2012/13

- Cairns – caters for cruise shipping, naval shipping and fishing fleets as well as a range of bulk and general cargo, with 1 million tonnes of total trade in 2012/13.

Figure 34 below illustrates that there has been gradual increase in throughput (mtpa for all ports).

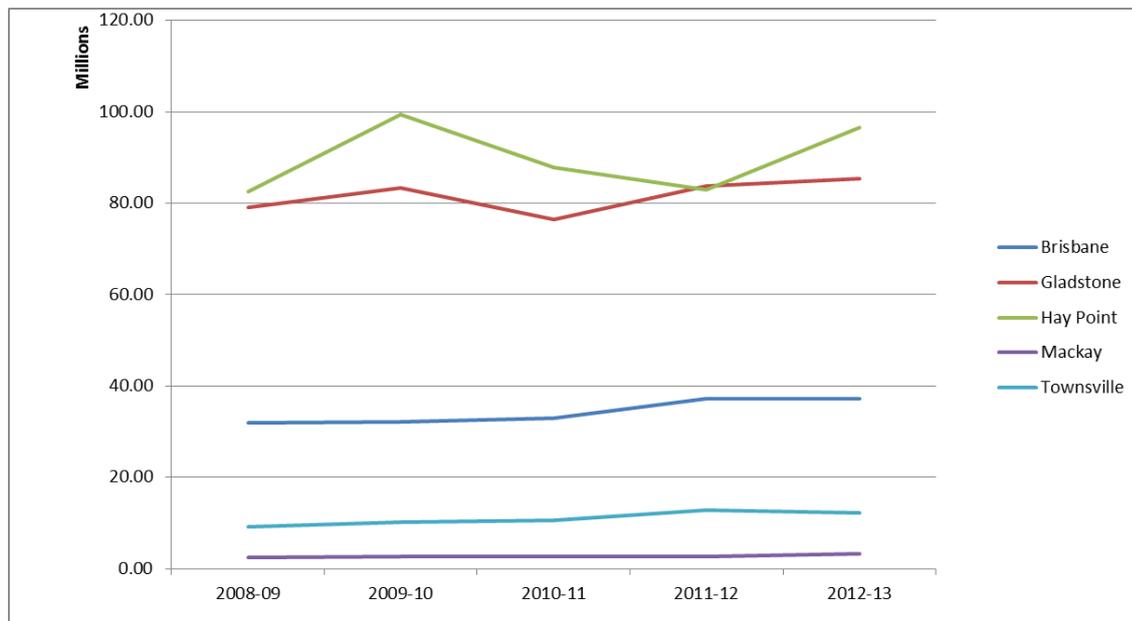


Figure 34 Change in total throughput by Port (mtpa)

A comparison of vessel movements as recorded for 2012/13 is provided in Table 51. It is noted that the Port of Gladstone and Port of Brisbane have a high proportion of vessel calls, two to three times higher than Hay Point which handles the largest throughput by volume. This is likely to reflect the multiple commodities being handled at Brisbane and Gladstone Ports compared to the Port of Hay Point which is a single commodity, coal.

Table 51 Comparison of total vessel visits for Queensland Major Ports

Financial Year	2012-2013	Percentage
Total Vessels		
Port of Abbot Point	201	3%
Port of Brisbane	2,669	41%
Port of Gladstone	1,869	29%
Port of Hay Point	883	13%
Port of Mackay	209	3%
Port of Townsville	721	11%
Total	6,552	

10.9.3 Competitiveness of the Port of Gladstone

A 2011/12 Bureau of Infrastructure, Transport and Regional Economics (BITRE)²²⁸ report referenced the findings of the 1991 Productivity Commission regarding factors influencing ships visiting Australian Ports. These findings, some of which apply particularly to containerised cargos, included:

- availability of high technology cargo handling equipment
- sufficient areas of cargo storage and assembly activity
- good interfaces with no congestion in the connecting rail and road networks and / or the land transport modes (freight trains and trucks)
- one stop advanced port information systems: good coordination in planning and timely information exchange of supply chains by cargo owners
- government policy settings and operational regulations (noise, light and weight).

The Port of Gladstone is well placed to facilitate exports from Central Queensland and to some extent from southern and northern Queensland regions as well. Gladstone offers transport routes with less congestion and fewer population conflict issues than the Port of Brisbane. New expansion areas e.g. the Fisherman's Landing precinct in conjunction with the GSDA offer opportunities to develop state of the art technology cargo handling equipment at greenfield sites.

A distinct advantage of the Port of Gladstone is its ability to handle Capesize vessels with Abbott Point and Hay Point/Dalrymple Bay being the only other ports in Queensland capable of handling vessels of this size. Furthermore, it is understood that the other priority ports may be subject to greater limiting factors than Gladstone in relation to future development. The Hay Point and Abbott Point facilities have offshore wharves which may reduce the potential for these terminals to expand to other products. The Port of Brisbane and Townsville may also be limited in their capacity to be deepened and widened for the handling of Capesize vessels.

Due to these limitations, the Port of Gladstone has the greatest potential for expansion to cater for the long term development of the Queensland economy. Significant land banks around the port allows for development of a variety of products and trades, industry and the supply chain interface. The Port of Bundaberg and the Gulf ports are located outside of the GBRWHA and may accommodate future growth; however, they have limited development capacity or are primarily dedicated to single commodities.

Planning at state and local government levels has established priority industrial development areas near the port together with transport corridors linking directly with port facilities including rail, road and other transport methods such as pipelines and conveyors. In addition, the deep draught available at the Port of Gladstone facilitates the use of larger vessels to improve economies of scale.

In addition to the points above, clearly there will be other market factors that will influence throughput at the Port of Gladstone, particularly in relation to exports or imports of bulk liquid

²²⁸ Australian Government Department of Infrastructure and Regional Development 2013, Australian Sea Freight 2011-12, Statistical Report, http://bitre.gov.au/publications/2013/asf_2011_12.aspx.

and solid materials. These include availability and proximity to resource projects and other industries that generate a demand for import / export of cargo. Where the geographic relationship between the product source and the port is not the determining factor due to transport costs, competition is likely to be significant between ports with superior access to efficient supply chain options and improved ability to access intended markets. However, improvements or upgrades to road and rail transport routes that connect regional areas to port nodes is largely the domain of the state government.

10.10 Conclusions

In summary, the Port of Gladstone is a major centre for the import and export of products for the manufacturing, mining and process industries. Handling more than 1800 vessels annually, it is one of the busiest ports in Australia and plays a vital role in the local, state and national economies. It is the largest multi-commodity port in Queensland with established bulk material handling facilities and container and general cargo facilities. Key conclusions that have been drawn from the economic assessment are summarised below:

- The volume of throughput at the Port of Gladstone is influenced by the two main functions of the port i.e. the export of resources from the Central Queensland region and the import of raw material and the export of finished products associated with major industries in Gladstone. Both of these functions are driven by global and local economic factors.
- The continued attraction of industry with import and/or export requirements is recognised as a strong growth opportunity for the Port of Gladstone. Future production industries are able to be located close to port export/import facilities.
- In relation to exports, overall, even with a minimal growth projection it is expected there will be larger export volumes mainly driven by the dominant commodity, coal, as well as LNG as facilities commence exporting. For medium and high growth projections a more favourable trend is anticipated.
- In relation to imports, overall even with a minimal growth projection it is also expected that there will be larger volumes. This is because bauxite consumption will increase in line with the anticipated expansion of Yarwun and petroleum consumption will increase mainly driven by mining demand and also transport sector demand.
- There is significant potential to expand upon existing bulk materials handling at Gladstone Port, particularly at Port Central and Fisherman's Landing. In addition, Gladstone is in a position to facilitate new exports or imports of new or temporary commodities at short notice at Port Central due to the winding down of the construction phase of the LNG facilities on Curtis Island.
- There are several large industry projects proposed for the Gladstone region in various stages of approval listed on the Queensland Government's Department of State Development website.
- The Gladstone Region has existing infrastructure that provides a competitive advantage to the region in attracting a range of industry sectors. This infrastructure includes essential utilities such as water (Awoonga Dam) and electricity (Gladstone Power Station), the Port of Gladstone and access to rail infrastructure. Appropriate infrastructure promotes private sector investment and demand for industrial land.

11 | Summary of Conclusions



11.0 Summary of conclusions

This report has provided a detailed desktop analysis of the land use, environmental, social and cultural heritage values within the proposed Gladstone port master planned area. The key findings from each section that will be used to inform the preparation of the Master Plan are summarised below.

11.1 Land use summary

The preparation of a master plan for the Gladstone Port provides an opportunity to coordinate a holistic approach to land use planning matters within the boundary of the proposed master planned area. The following key points have been derived from the land use assessment:

- The fragmented nature of planning jurisdictions covering the Gladstone Port and its surrounds creates a complex setting for coordinating appropriate land use planning outcomes. The preparation of a master plan for the Gladstone Port provides an opportunity to coordinate a holistic approach to land use planning matters within the boundary of the proposed master planned area.
- Activities and supporting infrastructure critical to the function of the port need to be protected from incompatible development and the future capacity of supply chain and supporting infrastructure needs to be safeguarded through appropriate land use designations within the master plan.
- Each of the land use planning instruments operating within the proposed Gladstone port master planned area includes areas either set aside for environmental purposes or to ensure appropriate separation between incompatible developments (e.g. between residential and heavy industry). These buffer areas need to be retained and reinforced within the master plan.
- There are some instances where land use planning instruments do not provide adequate separation distances between incompatible land use interfaces. This is highlighted in the context of the residential interfaces of Barney Point and Gladstone Central with port development.

11.2 Summary of environmental values

This report provides a high level review of environmental values in the proposed Gladstone port master planned area primarily using state and Commonwealth environmental databases. Detailed information exists in specific places within the proposed master planned area, often associated with development proposals. Ongoing site based specific surveys would be required to confirm local environmental values pertaining to any particular area and assessment of impacts on water and air quality values as set out under the relevant Environmental Protection Policies.

11.3 Summary of social values

The Port of Gladstone master planned area and its surrounds contain significant features of social amenity and cultural importance for both the local community and the traditional owners of the land. The following key points have been derived from the assessment of social values:

- Gladstone is one of the fastest growing LGAs in Queensland with strong non-resident population increases supplementing steady residential growth. The estimated resident population of the Gladstone LGA is forecast to nearly double from 65,845 in 2014 to 121,266 in 2036 (Queensland Government medium series population projections, 2013 edition).
- Population growth derived from major infrastructure projects and port expansion will be difficult to project into the future and will place pressure on the provision of trunk infrastructure, accommodation/housing and key social services. The Social Infrastructure Strategic Plan (SISP) and Needs Assessment undertaken for the Gladstone region found that significant investment in social infrastructure would be required to meet the needs of Gladstone's projected population growth to 2031. This included the identified need for a significantly larger hospital and higher service levels by 2031.
- The construction and manufacturing industry together account for approximately 30 per cent of the Gladstone LGA's workforce and are strongly aligned with the operation of the Port of Gladstone. The management and sustained growth of these industries within the proposed Gladstone port master planned area is therefore an integral consideration in supporting the continued economic performance of the wider Gladstone area.
- The Gladstone region has a number of features of environmental, recreational, social and economic importance to the surrounding community. These include:
 - Environment:
 - the biodiversity and natural values of the environment
 - protection of the Great Barrier Reef.
 - the protection of areas with high visual amenity
 - minimising noise, dust and degradation to air and water quality
 - Recreation and social:
 - the water-based recreational value of the harbour and its surrounds, particularly for boating and fishing
 - Maintained wellbeing and amenity in the context of industrial development and growth
 - the social benefits of national parks and state forests aesthetically, health-wise and recreationally
 - access and use of the harbour including the foreshore, beaches, boat ramps and viewing facilities
 - access to an adequate provision of social and community infrastructure
 - recognition of Indigenous heritage
 - Economic:
 - tourism
 - affordability
 - job opportunities
 - access to high quality transport infrastructure including roads and public transport
 - access to education and training facilities.

11.4 Summary of cultural values

The proposed Port of Gladstone master planned area contains a range of significant heritage features of Indigenous and non-Indigenous cultural importance for the community of Gladstone. These sites identified within Section 8 need to be need to be recognised, considered and appropriately managed.

It should be noted that there is still potential for currently unknown sites to exist in the area, particularly in undisturbed contexts. Previous studies in the region suggest that archaeological sites are most likely to be found near waterways and coastal areas, and are most likely to be evidenced by collections of stone tools and discarded shells.

Further consultation with the Gidarjil Cultural Heritage Corporation will need to be undertaken for planned future development activity.

11.5 Summary of economic factors

The Port of Gladstone is a major centre for the import and export of products for the manufacturing, mining and process industries. Handling more than 1800 vessels annually, it is one of the busiest ports in Australia and plays a vital role in the local, state and national economies. The following key points have been derived from the economic assessment:

- The continued attraction of industry with import and/or export requirements is recognised as a strong growth opportunity for the Port of Gladstone. Future production industries are able to be located close to port export/import facilities.
- In relation to exports, overall, even with a minimal growth projection it is expected there will be larger export volumes mainly driven by the dominant commodity, coal, as well as LNG as facilities commence exporting. For medium and high growth projections a more favourable trend is anticipated.
- In relation to imports, overall even with a minimal growth projection it is also expected that there will be larger volumes. This is because bauxite consumption will increase in line with the anticipated expansion of Yarwun and petroleum consumption will increase mainly driven by mining demand and also transport sector demand.
- There is significant potential to expand upon existing bulk materials handling at the Port of Gladstone, particularly at Port Central and Fisherman's Landing. In addition, Gladstone is in a position to facilitate new exports or imports of new or temporary commodities at short notice at Port Central due to the winding down of the construction phase of the LNG facilities on Curtis Island.

12 | References



12.0 References

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