walker

TOONDAH HARBOUR

CHAPTER 27
MORETON BAY RAMSAR SITE IMPACT ASSESSMENT

saunders havill group

27. Moreton Bay Ramsar Site Impact Assessment

27.1. Definition and Scope

This chapter provides a summary of the assessment carried out on the potential for the Project to have a significant impact on the MBRS[1]. The full technical report is included as Appendix 3-B.

To determine if an action is likely to have a significant impact on a MNES, the Commonwealth Government has produced a series of guidelines. Most relevant for Ramsar wetlands are the Significant Impact Guidelines 1.1, which are used determine if an action is likely to have a significant impact on a MNES. These guidelines state that:

An action is likely to have a significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:

- *Areas of the wetland being destroyed or substantially modified;*
- *A substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland;*
- *The habitat or lifecycle of native species, including invertebrate fauna and fish species dependent upon the wetland, being seriously affected;*
- *A substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health; or*
- *An invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland.*

The EPBC Act assessment process conforms to the approach recommended by the Ramsar Convention when considering how particular developments may impact upon the wetland. Importantly, under the EPBC Act, a significant impact is a threshold for further assessment to identify whether those impacts are considered acceptable. It is not a threshold for refusal of a Project.

A significant impact on a Ramsar wetland as defined by the EPBC Act also does not necessarily result in a change to the ecological character of the wetland as defined by the Ramsar Convention, which identifies ecological character as *the combination of the ecosystem components, processes, benefits and services that characterise the wetland at a given point in time* (Ramsar Convention 2005). Intuitively, a change in ecological character would only occur if ecosystem components, processes, benefits and services are considerably impaired by an action. Impacts that do not result in a change in ecological character may still be both significant and acceptable.

This is evidenced by a range of developments carried out within Ramsar sites both nationally and internationally. For example, the Riverwalk development (EPBC 2006/3176) in Victoria was approved to deliver 2,200 residential lots and

[1] Wetlands of international importance are those wetlands nominated and listed under the *Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971*. This convention is also known as the 'Ramsar Convention on Wetlands' using the protocol of naming international agreements after the city in which it was first formulated. The convention was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975. In line with this nomenclature, wetlands listed under the Convention are referred to as Ramsar wetlands.

other urban uses over a 197 ha area within the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site. While the development is within the boundaries of the Ramsar site, the area was considered degraded, and approval conditions required a range of measures to be implemented to protect the ecological character of the site including improving habitat values for the Growling Grass Frog.

Internationally, Ramsar sites include a range of tourism and urban infrastructure within their boundaries including marinas, apartments and hotels within the Etang de Salses-Leucates Ramsar site in France, and a resort and mixed-use residential development within the Sungai Pulai Ramsar site in Malaysia.

While development has previously been approved in Ramsar sites there is little guidance on how to assess impacts, in particular for spatially large and ecologically diverse sites such as the MBRS. Due to a lack of clear guidance on identifying and assessing impacts on ecological character for large Ramsar sites with diverse ecological values, processes and human interactions, a method was developed by Adaptive Strategies (2021) and reviewed by a range of subject matter experts through the Project's Independent Advisory Panel (IAP). The method is summarised in this chapter and provided in full in Appendix 3-B. In accordance with the legal requirements, the method focusses on determining the scale, intensity and significance of any impacts to the ecological character of the MBRS.

The objective of the ecological character impact assessment is to:

- Identify the critical components, processes and services that contribute to the ecological character of the MBRS;
- Identify the presence or absence of these components, processes and services within the 'Zone of Influence' of the Project; and
- Assess the potential for the development to impact on these critical components, processes and services, and therefore the ecological character of the MBRS.

The Project's EPBC Act Draft EIS guidelines further define the requirements for analysing impacts on the ecological character of the Ramsar Site:

- Adequately describe in a substantive manner all aspects of the proposed development that may impact on the ecological character. This includes aspects associated with construction and ongoing operation and those facilitated by the proposed development;
- To quantify, where possible, the extent and importance of those impacts on the particular components, processes and services that make up the ecological character;
- Describe the mitigation measures that allow a robust and defensible decision to be made on their efficacy; and
- Describe the extent and importance of residual impacts (if any).

This assessment is designed to meet the requirements of the Draft EIS guidelines and provide an understandable and robust analysis of actual or potential impacts to the MBRS that may result from the Project.

27.1.1 Ramsar Convention on Wetlands

As a contracting party to the Ramsar convention Australia has made a commitment to:

- Designate suitable wetlands for inclusion on the List of Wetlands of International Importance;
- Formulate and implement planning to promote conservation of listed wetlands and as far as possible the wise use of all wetlands;
- Arrange to be informed at the earliest possible time if the ecological character of any listed wetland has changed, is changing or is likely to change as a result of technological developments, pollution or other human interference, and report any such changes to the Ramsar Convention;
- Promote the conservation of wetlands and waterfowl by establishing nature reserves on wetlands;

- Encourage research and exchange of data and publications;
- Promote the training of personnel in the fields of wetland research and management;
- Consult with other contracting parties to the Convention to review and promote the implementation of the Convention; and
- Represent Australia at the triennial Conference of the Contracting Parties, collating the National Report for these meetings and other reporting to the Convention

In Australia there are currently 66 wetlands listed under the Ramsar Convention the management of which falls primarily to the relevant state or territory government. The Ramsar Convention requires the development of a Ramsar Information Sheet (RIS) describing the critical features of the wetland to accompany the nomination of a site to the List of Wetlands. The RIS is to be updated at least every six years, or more frequently if there are significant changes in the site's ecological character.

In addition to the RIS, the Convention encourages the development of key documents once a site has been listed to assist in the management and increase awareness about the wetland. These documents include:

- An ecological character description (ECD) which describes the ecological character of the Ramsar Site; and
- Management plans, which are used to formulate and implement planning to promote the wise use and conservation of listed wetlands.

Under the Ramsar Convention a significant impact as defined by the EPBC Act does not necessarily equate to a change or likely change in ecological character. Ramsar Handbook 19: Addressing Change in Wetland Ecological Character outlines a process for detecting change in the ecological character of a Ramsar site, which can include natural change, positive human induced change and negative human induced change.

Further, the Ramsar convention does not prohibit development in Ramsar wetlands, but they must demonstrate that they maintain or enhance the ecological character of the site and be in accordance with the principles of wise use. The wise use of wetlands is *the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development* (Ramsar Convention 2005). The wise use concept requires ecological character to be maintained, while at the same time delivering services and benefits now and into the future for human well-being. Wise use of Australia's wetlands involves achieving a balance of uses which will deliver ecosystem, economic and social/cultural benefits over the long term.

27.1.2 Assessment Requirements

Schedule 6 of the *Environment Protection and Biodiversity Conservation Regulations 2000* (EPBC Regulations) outlines the impact assessment and approval process for actions that are likely to have a significant impact on the ecological character of a Ramsar wetland (whether the action is to occur inside the wetland or not). The process includes the following steps:

1) Before the action is taken, the likely environmental impact of the action on the wetland's ecological character should be assessed under a statutory environmental impact assessment and approval process.
2) The assessment process should:
   a) identify any part of the ecological character of the wetland that is likely to be affected by the action; and
   b) examine how the ecological character of the wetland might be affected; and
   c) provide adequate opportunity for public consultation.
3) An action should not be approved if it would be inconsistent with:
   a) maintaining the ecological character of the wetland; or
   b) providing for the conservation and sustainable use of the wetland.
4) Approval of the action should be subject to conditions, if necessary, to ensure that the ecological character of the wetland is maintained.

5) The action should be monitored by the authority responsible for giving the approval (or another appropriate authority) and, if necessary, enforcement action should be taken to ensure compliance with the conditions.

The assessment of potential impacts to ecological character of the Project on the MBRS addresses steps 1 and 2 in this process. The assessment will be subject to statutory public notice as part of the EPBC Act approval process providing adequate opportunity for public feedback.

27.2. The Moreton Bay Ramsar Site

Moreton Bay was declared a Ramsar Wetland of International Importance in 1993. The listing covers an area of 120,654 ha which includes a semi-enclosed bay bounded by Mulgumpin (Moreton Island), Minjerribah (North Stradbroke Island) and Garadgi (South Stradbroke Island): three of the largest natural sand islands in the world (Figure 27-1). The MBRS includes:

- Mulgumpin (Moreton Island) and parts of Minjerribah (North Stradbroke Island) and Garadgi, Bribie Island and the Southern Bay Islands;
- Pumicestone Passage;
- Intertidal and subtidal areas of the western bay, southern bay and sandy channels of the Broadwater region;
- Marine areas and sand banks within the central and northern bay; and
- Areas of ocean beach habitats.

The MBRS provides significant areas of seagrass, mangrove and saltmarsh wetland habitat for shorebirds and marine species including turtles and dugong.

The current status of MBRS Ramsar documentation is:

- The most recent version of the RIS is September 2019. The boundary of the site was last updated in December 2018 adding several thousand hectares to the MBRS through minor realignments to better reflect pre-existing boundaries (i.e., cadastre, gazetted marine parks, etc.) and data sources to define the boundary.
- A Draft ECD was completed but has not been finalised - the latest draft is dated 2008. As of September 2022, a formal ECD for the MBRS has not been published. Information on the ecological character of the site is also provided within the RIS.
- No specific management plan is in place for the MBRS. The Moreton Bay Marine Park Zoning Plan covers a similar spatial area as the MBRS and provides guidance on use, however, this is not a management plan for a Ramsar wetland.

When listed, the MBRS was identified as meeting six of the nine Ramsar listing criteria (criterion 1 through 6). The 2019 version of the RIS has been updated to now show the site meeting all nine criteria (criterion 7 through 9). A summary of features within Moreton Bay that meet the listing criteria is included in Table 27-1.

Figure 27-1: Moreton Bay Ramsar Site

Legend

Project location

Moreton Bay Ramsar site

Toondah Harbour EIS

TOONDAH HARBOUR

walker

N

0 10 20 30 km

GDA 1994 MGA zone 56

Scale (A4):1:650,000

Layer Source: © State of Queensland Datasets (Department of Natural Resources, Mines and Energy 2020)

DATE 3/03/2021

FILE REF. 9858 E Figure 11 2 Moreton Bay Ramsar A

Table 27-1: Summary of Moreton Bay Characteristics against Ramsar Listing Criteria.

Criterion Description	Moreton Bay Features
Criterion 1: the wetland contains a representative, rare or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region	Moreton Bay is one of the largest estuarine bays in Australia. The formation of large, vegetated sand dunes on the eastern side of the bay and river and creek flows entering the Bay to the west from the mainland have created a major wetland complex.
Criterion 2: the wetland supports vulnerable, endangered or critically endangered species or threatened ecological communities	The bay supports threatened turtle species including the vulnerable green and hawksbill turtles and endangered loggerhead turtles. Its intertidal habitats are particularly important for the critically endangered wintering eastern curlew. A number of threatened terrestrial flora and fauna are also present on the bay islands.
Criterion 3: the wetland supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region	The bay has a high diversity of marine plant and animal species including over 3,000 species of marine invertebrates; 40 species of shorebirds; 55 species of algae associated with mangroves; seven mangrove species and seven seagrass species. The intertidal habitats of the bay support over 28 species of migratory shorebirds.
Criterion 4: the wetland supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions	The bay is a significant feeding ground for green turtles. Dugongs also use the bay as a feeding and breeding ground. The area provides significant feeding areas for loggerhead turtles. The species is also known to nest on the bay islands. It also provides important feeding and roosting sites for 28 species of migratory shorebirds
Criterion 5: the wetland regularly supports 20,000 or more waterbirds	The bay supports greater than 50,000 wintering and staging shorebirds during the non-breeding season.
Criterion 6: the wetland regularly supports 1% of the individuals in a population of one species or subspecies of waterbird	The bay supports greater than 1% of the known flyway populations of nine migratory shorebirds including the eastern curlew and the grey-tailed tattler.
Criterion 7: A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/ or values and thereby contributes to global biological diversity.	The bay supports diverse fish fauna due to the wide variety of habitats within and adjacent to it, including mangroves, saltmarsh, seagrass, sand and mud flats, offshore channels, reef environments, estuarine creeks, freshwater lakes and streams. For fish in the waters of Moreton Bay, two interacting zones of diversity exist: an inshore estuarine-dominated system and an eastern marine- dominated system. The bay is also a meeting point for tropical northern and temperate southern faunas which, combined with the diversity of habitats, has resulted in high faunal diversity with approximately 750 fish species recorded in the bay. In addition, at least 27 species of fish are only known to occur in Moreton Bay.
Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.	Documented fish feeding habitats in Moreton Bay include saltmarshes, mangroves, intertidal flats, seagrasses as well as coral and rocky reefs. These include tidal marsh feeding habitats for commercially important species including whiting, mullet and the giant mud crab. Moreton Bay mangroves and seagrasses also provide refuge from predators and together with saltmarshes, function as nursery habitats for juvenile fish.
Criterion 9: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland dependent non-avian animal species.	The bay provides or is likely to provide habitat for >1% of the population of the following wetland dependent non-avian species: ▪ A number of acid frogs including Wallum froglet (*Crinia tinnula*), Cooloola sedgefrog (*Litoria cooloolensis*), Wallum sedgefrog (*Litoria olongburensis*) and Wallum rocketfrog (*Litoria freycineti*)

Criterion Description	Moreton Bay Features
	▪ Dugong (*Dugong dugon*) ▪ Oxleyan pygmy perch (*Nannoperca oxleyana*) ▪ Water mouse (*Xeromys myoides*) ▪ Illidge's ant blue butterfly (*Acrodipsas illidgei*) ▪ Loggerhead turtle (*Caretta caretta*) ▪ Green turtle (*Chelonia mydas*)

The EPBC Act Draft EIS Guidelines requires the Proponent to use the RIS and the 2008 Draft ECD in characterising wetland values and assessing impacts on the MBRS.

The Toondah Harbour Project occurs partly within the MBRS. The proposed reclamation areas overlap the MBRS by approximately 36.4 ha and the dredge area within Fison Channel overlaps the MBRS by a further 22.3 ha. Combined this represents 0.048% of the MBRS (refer to Figure 4-1 of the draft EIS).

It is generally acknowledged that it can be difficult to accurately assess potential impacts to the ecological character of a Ramsar site without a final or up to date ECD or management plan. For example, two Ramsar sites in Victoria, Western District Lakes and Gippsland Lakes, have potentially undergone human induced change to their ecological character, however it has been difficult to assess the level of change due to a lack of up-to-date ECDs, and in particular relevant Limits of Acceptable Change (LACs) for these sites (Parliament of Victoria's Inquiry into Auditor-General's Report No. 202: Meeting Obligations to Protect Ramsar Wetlands (2016)).

As a result, the method for assessing the impacts of the Project on the ecological character of the MBRS has adopted the precautionary principle in its assessment and drawn from reviews of current best practice management of Ramsar sites, rather than relying entirely on the RIS and the draft ECD for the MBRS.

This assessment of potential for change to ecological character as a result of the Toondah Harbour Project is not a management plan for the MBRS, nor is it intended to provide management measures to address MBRS management requirements at the whole-of-site scale, given that the MBRS exceeds 120 km^2. The assessment (and the broader draft EIS) does however include management approaches and strategies to avoid impacts on the ecological character of the MBRS from the Project.

27.3. Change to Ecological Character Assessment Method

The assessment method has been developed to evaluate the context, scale and significance of the potential impacts on the ecological character of the MBRS. In doing this the method seeks to:

- Identify the critical components, processes and services of the MBRS through a desktop analysis of available information;
- Identify how the critical components, processes and services are represented at a project site level through site specific technical studies and consultation with the community and Industry bodies;
- Conceptualise interactions between the critical components, processes and services at the project site level as well as how they link into the broader scale processes of the MBRS;
- Assess the contribution the critical components, processes and services present at the project site level provide to the overall ecological character of the MBRS; and
- Provide a process for determining the significance of any impacts from a proposed activity on the ecological character of the MBRS.

A full explanation of the method is contained in Appendix 3-B.

The assessment has adopted an approach similar to that normally used under the EPBC Act. The following steps were incorporated to ensure a repeatable and consistent approach that is transparent, and evidence based:

- All aspects of the Project are considered from construction through to operation, including associated activities that may produce indirect or facilitated impacts (e.g., impacts from street and building lighting, boat traffic, etc).
- The concept of 'Zone of Influence' has been applied to determine the spatial extent required to be examined to identify relevant features. The 'Zone of Influence' varies depending on the development type, the actions being undertaken during both the construction and operational phases and the component, process or service being assessed. In particular, actions that produce noise, dust or suspended sediment plumes may extend beyond the Project footprint.
- Assessment of significance of potential impacts that may lead to a change in ecological character involves analysis to quantify potential impacts, review of the adequacy of survey data and other available information, a detailed understanding of relative habitat values at the Project and Ramsar site levels, reference to relevant EPBC Act guidelines and consideration of existing environmental management and monitoring.

27.3.1 Reliability of Information

All information sources used for the MBRS and Project footprint assessments have been evaluated for their validity, reliability and accuracy. A confidence level has been assigned to each information source based on the scale below:

- High confidence - The study, or data used within the study, is contemporary (completed in 2015 or later) and supported by robust evidence (i.e., on ground surveys carried out using published methods) and has strong agreement with the outcomes of published studies or data from other sources.
- Moderate confidence - The study, or data used within the study, was completed prior to 2015 but is supported by robust evidence and/or has strong agreement with the outcomes of published studies and/or data from other sources.
- Low confidence - The study, or data used within the study, is supported by limited evidence and/or has agreement with the outcomes of other moderate or low confidence information sources.

No 'low confidence' information sources have been used in this assessment. An assessment of the reliability of the key data sources used in this assessment is included in Appendix 3-B.

27.3.2 Critical Components, Processes and Services of the MBRS

In Australia, the National Framework and Guidance for Describing the Ecological Character of Australia's Ramsar Wetlands (DEWHA 2008) provides direction on how to identify a wetland's critical components, processes and services. The guidance identifies several categories for each (Table 27-2) and recommends as many are identified as possible under these categories, with critical ones selected using available information and expert advice.

The assignment of a given wetland component, process or service as critical is guided by the following considerations:

- It is important for supporting one or more of the Ramsar criteria under which the site was listed; or
- It is an important determinant of the uniqueness or representativeness of the site; or
- It is a component or process of high ecological value; or
- It may be subject to change that will cause potentially significant consequences (e.g., change the ecological character of the Ramsar site).

The draft Moreton Bay ECD and 2019 RIS are the two key information sources that describe the ecological character of the MBRS. The information in these two sources has been cross referenced with recent scientific studies and monitoring programs to identify the critical components, processes and services of the MBRS. While the draft ECD is more than 10 years old, no significant developments or modifications have occurred within the MBRS and no notifications of any

change to the ecological character have been published since its preparation. Occasional updates to the RIS also have not identified any change in ecological character, although this does not necessarily indicate that change has not occurred. Factors such as climate change, sea level rise, ongoing urban encroachment and impacts on migratory species in other parts of the world may all have had an effect on the character of the MBRS.

Table 27-2: Categories of Wetland Components, Processes and Services.

Component	Process	Benefits/Services
Physical form **Wetland soils** **Physicochemical water** **Biota**	Climate Geomorphology Hydrology Energy and nutrient dynamics Processes that maintain animal and plant populations Species interactions Physical processes	Provisioning services — products obtained from the ecosystem such as food, fuel and fresh water Regulating services — benefits obtained from the regulation of ecosystem processes such as climate regulation, water regulation and natural hazard regulation Cultural services — benefits people obtain through spiritual enrichment, recreation, education and aesthetics Supporting services — services necessary for the production of all other ecosystem services such as water cycling, nutrient cycling and habitat for biota. These services will generally have an indirect benefit to humans, or a direct benefit over a long period of time

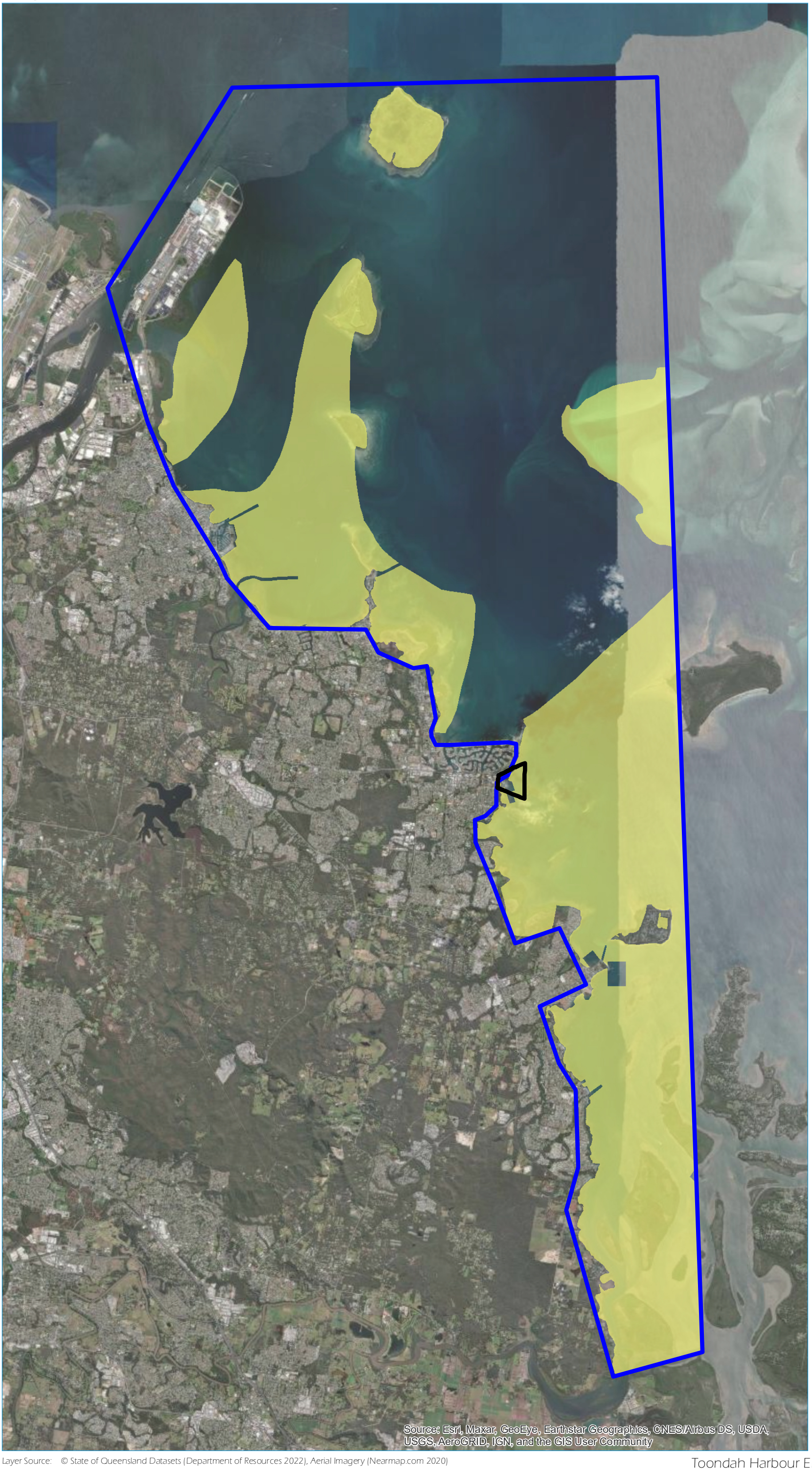
27.3.3 Identifying Critical Components, Processes and Services at the Project Site Level

The process for determining the local representation and contribution of critical components, processes and services to the ecological character of the wetland is based around understanding which are present and how important they are within the context of the wider MBRS. The process involves:

1. Identifying the critical components, processes and services that are represented within the Project footprint and local area;
2. Conceptualising interactions between the critical services, components and processes at the Project footprint level as well as how they link into the broader scale processes of the MBRS; and
3. Analysing the 'importance' of the presence within the context of the MBRS.

For the purposes of the method, the 'local area' should at least encompass the area within the Project's 'Zone of Influence'. A Zone of Influence for indirect impacts from the Toondah Harbour Project has been identified in the CIA (Chapter 26) and is shown spatially on Figure 26-2. The CIA Zone of Influence is based on potential indirect impacts from sources such as dredge plumes, noise and boating traffic as well as the potential for direct impacts to influence MNES outside of the Project footprint (i.e., consequential impacts to threatened marine species from the loss of a relatively small patch of seagrass). The 'local area' encompasses Western Moreton Bay and extends north to the Brisbane River and south to the Logan River as well as inland to include the mainland suburb of Cleveland. Areas of the MBRS within this extent make up the Zone of Influence for the analysis of critical components, processes and services represented at a Project footprint level. The Project's Zone of Influence on the MBRS is shown on Figure 27-2.

Figure 27-2: Toondah Harbour MBRS Zone of Influence



Legend

- Toondah Harbour PDA (Project Area)
- MBRS Zone of Influence
- Moreton Bay Ramsar site

TOONDAH HARBOUR

walker

0 1 2 3 4 5 Kilometers

GDA 1994 MGA zone 56

Scale (A3): 1:120,000

N

Layer Source: © State of Queensland Datasets (Department of Resources 2022), Aerial Imagery (Nearmap.com 2020)

DATE: 29/06/2022

In addition, migratory bird species can travel vast distances, therefore impacts to these species must also be considered at the East Asian and Australasian flyway level (EAAF).

As noted in the CIA, the Zone of Influence also includes a temporal component, therefore potential for changes in ecological character to occur over time will also be addressed.

27.3.3.1 *Identifying the Critical Components, Processes and Services*

Most components, processes and services are made up of multiple elements, such as various landforms, seascapes and biological entities. A biological component or process may be made up of multiple species habitats, interactions and locations (e.g., a specific migratory bird species may use several locations within the MBRS for foraging, but travel to a single location to roost at high tide).

Identification of the critical components, processes and services that occur within the local area has been based on the best available information. Technical studies carried out for the draft EIS have encompassed assessment not just at the site level, but also the broader Moreton Bay area through detailed analysis of recent scientific studies and data collected by ongoing monitoring programs such as Healthy Land and Water's (HLW) Ecosystem Health Monitoring Program (EHMP) for water quality and Seagrass Watch.

27.3.3.2 *Conceptualising Interactions*

Once the critical components, processes and services are understood this information has been used to conceptualise how they are represented and interact within the Project footprint and Zone of Influence. The conceptual representation includes:

- The relationships and dependencies between the components, processes and services and the representation of ecological character;
- Threats to the critical components, processes and services within the Project footprint and Zone of Influence that may result from the Project; and
- How, and in what ways, any changes to the critical components, processes and services may interact with the wider MBRS.

The conceptual representation can then be used as a tool to analyse the importance of the critical components, processes, and services for the MBRS and how any impacts may affect the ecological character.

27.3.3.3 *Analyse Importance*

For a critical service or process, the spatial extent may not necessarily influence importance. In these cases, presence can be interpreted in terms of the role played in maintaining the service or process. For example, a critical service of a Ramsar site may be that it supports an important population of a threatened species.

The following terms and definitions are used to classify the contribution of locally occurring critical components, processes and services to the ecological character of the MBRS:

- Not present: No evidence was available to indicate or suggest presence in the area of investigation.
- Minor contribution: Occurs in low abundance or across a small area (relative to the nature of its broader presence across the MBRS) and is not necessary for the ongoing function of a critical component, process or service. However, it is noted that a low abundant component that is rare may still be important, and the assessment reflects this distinction. Temporary fluctuations or seasonal variation have also been considered, along with natural events that may affect short-term presence (e.g., storms).

- Moderate contribution: Occurs in moderate abundance or across a moderately large area (relative to its representation across the MBRS) and contributes to the function of a critical component, process or service in the area of investigation.
- Major contribution: Present in significant abundances or represent significant examples of the relevant critical component, process or service (relative to its nature across the MBRS) and is essential for the ongoing function of a critical component, process or service.

Assessment of the contribution of the critical components, processes and services within the Project footprint and Zone of Influence incorporates inputs from experts who have completed technical studies for the Project. Contributors include:

- Marine ecology and water quality – Carol Conacher (frc environmental);
- Migratory and threatened shorebirds – Dr Penn Lloyd (BAAM Ecology);
- Coastal processes – Craig Witt (BMT);
- Ecosystem processes - Tom Kaveney (Adaptive Strategies); and
- Commercial and recreational fisheries – Dr Daryl McPhee (Bond University).

27.3.4 Assessment of Significance of Potential Impacts

There are two key principles that guide EPBC Act significant impact assessments for Ramsar sites:

- Maintaining the ecological character of the Ramsar site (i.e., no change) – As a signatory to the Ramsar Convention, Australia is required to manage its Ramsar sites (including the MBRS) to maintain the critical ecosystem components, processes and services that characterise the wetland at a given point in time; and
- Addressing the significant impact criteria for Ramsar Sites identified in EPBC Act Significant Impact guidelines to identify whether the action is considered likely to have a significant impact on the ecological character of a Ramsar site.

Using these criteria, along with the results of the local contribution assessment, a consistent approach to determining activities with the potential to result in a significant impact to the ecological character of the wetland has been used. The process for this assessment is as follows:

1. Using the project description, including construction methods and ongoing uses, to determine activities with potential to have direct and indirect impacts on existing environmental values;
2. Using inputs from relevant experts and EIS studies to determine the likely extent of these impacts within the Project footprint and Zone of Influence;
3. Reviewing the impacts against the critical components, processes, and services represented within the Project footprint and Zone of Influence to identify the potential for the Project to result in a change in ecological character to the Ramsar site or significant impact against the EPBC Act significant impact criteria (Table 27-3).

Table 27-3: Potential for Impacts on the Ecological Character of the MBRS.

Criteria	Local contribution of critical processes, components or services to Ecological Character			
	Not Present	Minor	Moderate	Major
Areas of wetland being destroyed or substantially modified	N/A	Unlikely	Possible if changes are permanent	Likely unless change is temporary (less than 1 year)
A substantial and measurable change in the hydrological regime of the wetland	N/A	Unlikely if not measurable or is within natural variability	Possible if change is measurable, permanent and beyond natural variability	Likely resulting in a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland
Habitat or lifecycle of native species being seriously affected	N/A	Unlikely	Possible if permanent Unlikely if temporary or in low season (e.g., outside migratory visitation)	Likely if permanent Unlikely if in low season or non-breeding (e.g., outside migratory visitation)
A substantial and measurable change in the availability or functioning of a critical process, component or service	N/A	Unlikely	Possible if change is measurable, permanent and beyond natural variability	Likely resulting in a substantial change to the quality or extent of the service or a complete loss of service
Permanent or long term substantial and measurable change in the water quality of the wetland	N/A	Unlikely	Possible	Likely
Establishment of invasive species	N/A	Likely*	Likely	Likely

* The establishment of an invasive species is likely to have broad reaching effects and so is likely to be significant in all scenarios.

Steps one and two in this process have been substantially addressed through the draft EIS technical studies (refer to Volume 2). From the analysis undertaken, activities with the potential to impact on the local presence of critical components, processes and services that contribute to the ecological character of the MBRS have been identified.

Where there is a major contribution (i.e., unique, or of notable ecological importance), it is reasonable to assume that the presence and function of that critical component, process or service is part of the ecological character of the whole wetland and any impact has the potential to affect the ecological character of the MBRS.

Where the contribution is moderate or minor, the local representation can be considered less critical to maintaining the ecological character of the MBRS. Where this occurs, impacts are considered in the context of the framework set out in the Ramsar guidelines for avoiding, mitigating and compensating wetland losses.

For impacts that are likely or almost certain, a more detailed risk assessment is carried out to identify the severity and consequence of the impacts.

27.4. MBRS and Site Level Ecological Character

27.4.1 Critical Components, Processes and Services of the MBRS

As identified in Section 27.2, two documents have been developed by the Queensland and Australian Governments to describe the ecological character of the MBRS: the RIS and Draft Ecological Character Description - Moreton Bay Ramsar Site (BMT WBM 2008).

These two documents have been reviewed extensively by the EIS Project Team to identify the critical components, processes and services for the MBRS, in accordance with direction from the DCCEEW.

A number of recent studies have also been reviewed to ensure the assessment of impacts to the ecological character of the MBRS is based on the most up-to-date information available. While these studies are not specifically targeted at describing the components, processes and services of the MBRS, they provide data on key components and processes such as wetland habitat health and extent and fauna populations. Key studies reviewed include:

- Moreton Bay Quandamooka & Catchment: Past, present, and future (Tibbetts *et. al*. 2019);
- Environmental History and Ecology of Moreton Bay (McPhee 2017);
- Managing Threats to Migratory Shorebirds in Moreton Bay (Fuller *et al*. 2021);
- Integrating outcomes of IUCN red list of ecosystems assessments for connected coastal wetlands (Sievers *et al*. 2020); and
- HLW Ecological Health Monitoring Program (EHMP) Report Cards (https://hlw.org.au/report-card/).

A list of critical services and the underpinning components identified by the Draft ECD is provided in Table 27-4. Information on the underlying components has also been augmented with data from more recent studies. Components and processes were identified as critical where they underpinned one or more of the critical services. The order of the critical services is arbitrary and does not reflect any importance or ranking.

Table 27-4: MBRS Critical Services Identified by the Draft ECD.

Critical Service	Underlying Critical Components
Contains a diversity of wetland habitat types that are representative of a major coastal wetland aggregation and in many areas show a high degree of connectivity between habitat types	22 Ramsar wetland types are represented in the broader MBRS. Of these: ▪ 11 are classified as coastal/marine; ▪ 10 are classified as inland waters; ▪ 1 is classified as manmade. Several habitat types are highly localised (i.e., rare) in the context of the bioregion and within the MBRS itself, including non-forested peatlands and permanent freshwater lakes. Of most relevance to the Project are the coastal/marine wetland types, which include: ▪ Permanent shallow marine waters (waters that are less than 6 m deep at low tide); ▪ Marine subtidal aquatic beds (i.e., seagrasses); ▪ Coral reefs; ▪ Rocky marine shores including rock offshore islands and sea cliffs; ▪ Sand, shingle or pebble shores; ▪ Estuarine waters; ▪ Intertidal mud sand or salt flats; ▪ Intertidal marshes;

Critical Service	Underlying Critical Components
	▪ Intertidal forested wetlands (mangrove forests to low closed forest on marine clays); ▪ Coastal brackish/saline lagoons; ▪ Coastal freshwater lagoons.
One of the largest estuarine bays in Australia that sits in an 'overlap zone' where both tropical and temperate species occur. It supports extensive intertidal areas of seagrass, mangroves and saltmarsh that provide vital habitat for waterbirds, including significant populations of migratory shorebirds	The MBRS contains marine, estuarine, palustrine, lacustrine and terrestrial biotopes. Several of these wetland habitats are considered, either individually or collectively, to represent particularly outstanding examples of near-natural areas within the biogeographic region. While there are examples of such habitat areas throughout the MBRS, the Draft ECD identified six key wetland representative areas. These are: 1. Seagrass and shoals in the Eastern Banks area; 2. Intertidal flats and estuarine assemblages in the Pumicestone Passage area; 3. Mangroves and saltmarsh associated with the islands in the Southern Bay 4. Coral communities of the Eastern Bay; 5. Freshwater wetlands (including wallum and peatlands) of Mulgumpin (Moreton) and Minjerribah (North Stradbroke) Islands; 6. Ocean beaches and foredunes on Mulgumpin (Moreton Island).
Site supports an assemblage of vulnerable or endangered marine/aquatic fauna	Species of note identified in the MBRS include dugongs, green turtles, loggerhead turtles, oxleyan pygmy perch and honey blue-eye, although any protected marine/aquatic species supported by the MBRS should be considered within this critical service.
Supports an assemblage of vulnerable or endangered wetland dependant terrestrial fauna species	Species of note include little tern, beach stone-curlew, water mouse, Illidge's ant-blue butterfly, wallum sedgefrog, Australian painted snipe, Australasian bittern and eastern curlew. Any protected wetland-dependant terrestrial fauna species should also be considered within this critical service.
Supports a number of vulnerable or endangered marine fauna species	Moreton Bay provides habitat for humpback whales and dolphins, as well as six of the world's seven species of marine turtles. Other threatened animals, including the grey nurse shark, dugong, wallum sedge frog, water mouse and oxleyan pygmy perch fish, also live in Moreton Bay or in surrounding waters and wetlands.
Supports an assemblage of vulnerable or endangered wetland flora species and endangered and of concern wetland regional ecosystems	The MBRS is home to five nationally threatened plant species that are wetland dependant: swamp daisy, knotweed, lesser swamp orchid, yellow swamp orchid and swamp orchid. Any protected wetland flora species and endangered and of concern wetland regional ecosystems should also be considered within this critical service.
Supports significant populations of shorebirds	Moreton Bay is one of the most important migratory shorebird sites in Australia, supporting both a large number and high diversity. During the summer months some 32 species of migratory shorebirds comprising over 40,000 individuals visit the bay. This includes significant worldwide populations, including 20% of all eastern curlews and 50% of all grey-tailed tattlers. Based on the 2016 revised EAAF population estimates, the MBRS provides habitat for >1% of the estimated EAAF population of the following species: ▪ Bar-tailed godwit (*Limosa lapponica*); ▪ Curlew sandpiper (*Calidris ferruginea*); ▪ Eastern curlew (*Numenius madagascariensis*); ▪ Grey-tailed tattler (*Heteroscelus brevipes*);

Critical Service	Underlying Critical Components
	▪ Red-necked stint (*Calidris ruficollis*); ▪ Australian pied oystercatcher (*Haematopus longirostris*); ▪ Whimbrel (*Numenius phaeopus*); ▪ Sharp-tailed sandpiper (*Calidris acuminata*); ▪ Lesser sand plover (*Charadrius mongolus*); and ▪ Double-banded plover (*Charadrius bicinctus*).
The tidal fish habitats and fish and invertebrate populations of the MBRS support valuable recreational and commercial fishing activities	Notable species include: ▪ Bream, flathead, whiting, luderick, mullet, tailor, mackerel, sharks, baitfish, eels, and pink snapper fin fish; ▪ King, tiger, endeavour, banana, greasyback and school prawns; ▪ Blue swimmer, mud, red spot, spanner and coral crabs; and ▪ Callianasid shrimp (yabbies), squid, cuttlefish, rock oysters, bivalves and beche-de-mer (sea cucumber).
The perched wetlands on Moreton Island (Mulgumpin) and North Stradbroke Island (Minjerribah), including lakes and swamps.	Perched wetlands are abundant in the coastal Wallum regions of south-eastern Queensland and northern NSW, but are scarce in most parts of the world.
Submarine groundwater discharge	Moreton Bay is subject to a large submarine groundwater discharge (SGD) rate estimated to be approximately 18 times greater than the average annual discharge of all the major river inputs into the bay. The SGD has been suggested as a major component of the hydrological and biogeochemical cycles of Moreton Bay and has a major influence on the export of alkalinity and dissolved carbon into the bay.
Has important cultural values and significance to indigenous peoples	Sites of significant Aboriginal cultural heritage are located throughout the MBRS including on Bribie, North Stradbroke (Minjerribah), Peel (Jercuruba), St Helena (Noogoon), Macleay (Janguwajah), Lamb (Ngudjuru), Karragarra and Russell (Kanaipa) Islands as well as Toorbul Point, Caboolture River and Victoria Point (Warrer Warrer). Types of sites include middens, fish traps, artefact scatters, quarries and scarred trees. Tangible evidence of past occupation is found in many forms throughout the MBRS. The archaeological heritage of the Moreton Bay islands is an extensive, rich and diverse cultural record. It comprises over 1,000 known sites, including shell middens, stone artefact scatters, stone artefact quarries, burials, scarred trees, earthen ceremonial rings, story places, pathways, and stone fish traps. Archaeological sites are found on all the Moreton Bay islands, although the type and character of the evidence varies according to a range of factors including the resource availability, accessibility, seasonal use and social factors. Contemporary cultural knowledge relating to these sites and landscapes remains strong, and is tangibly associated with living traditions, ideas and beliefs. Although there have been significant impacts on parts of the islands, much of the cultural landscape is intact and remains associated with living traditions and beliefs. There is abundant evidence of traditional human settlement, land and sea use.
Is an important site for research and education	Several of the key species and habitat types identified above have been subject to long term research and education activities.
Provides and supports significant tourism and recreational uses in the region	Specific importance is placed on the marine and estuarine waters, sandy beaches and dunes, freshwater lakes located on the bay islands, and sites located on the string of sand islands forming the eastern barrier of Moreton Bay.

While critical processes are not listed in Table 27-4, those identified as underpinning the critical services include:

- Physical coastal processes – Hydrodynamic controls on habitats through tides, currents, erosion and accretion;
- Hydrology - Patterns of tidal inundation and freshwater flows to wetland systems;
- Groundwater – For those wetlands influenced by groundwater interaction, the level of the groundwater table and groundwater quality;
- Energy and nutrient dynamics – Primary productivity and the natural functioning of carbon and nutrient cycling processes;
- Biological processes - Important biological processes such as growth, reproduction, recruitment, migration and dispersal;
- Water quality - Water quality that provides aquatic ecosystem values within wetland habitats;
- Climate – Patterns of temperature, rainfall and evaporation; and
- Geomorphology - Key geomorphologic/topographic features of the wetland.

27.4.2 Critical Components, Processes and Services Represented at the Project Site

Key components, processes and services identified as being present and contributing to the ecological character of MBRS at the Project footprint and zone of influence level are summarised in Table 27-5 and ecosystem interactions are shown conceptually in Figure 27-3 and Figure 27-4.

It should be noted that the Project footprint is not entirely within the MBRS with approximately 7 ha of the dredge area and 1.7 ha of the reclamation area located outside the Ramsar boundary (see Figure 27-5). This accounts for small differences in habitats such as seagrass being impacted when compared to the whole Project footprint.

A more detailed analysis is included in Appendix 3-B.

Table 27-5: Local Representation of MBRS Critical Services.

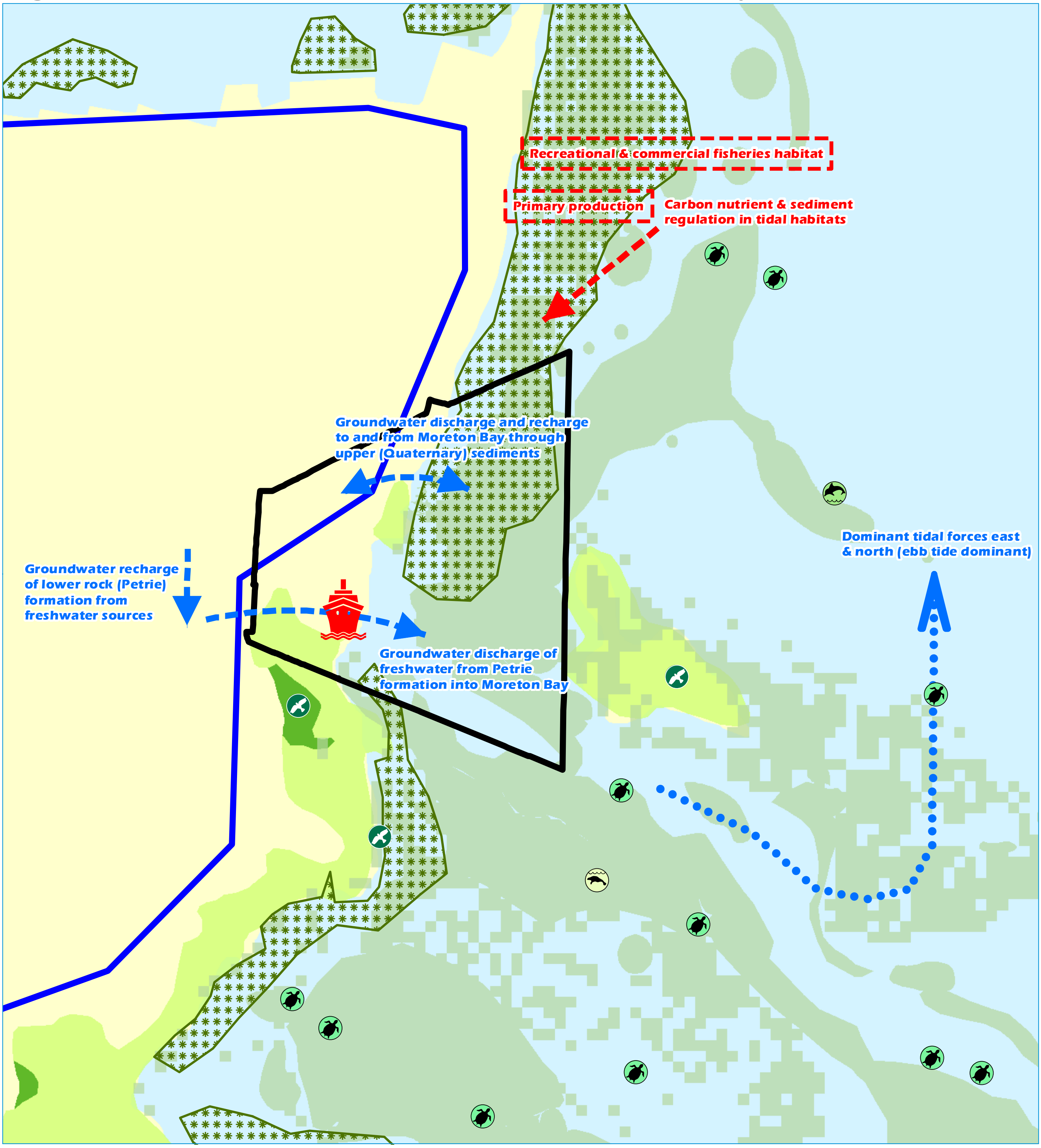
Critical process, component and service	Presence in the Project footprint and Zone of Influence
Contains a diversity of wetland habitat types that are representative of a major coastal wetland aggregation and in many areas show a high degree of connectivity between habitat types. Wetland habitats provide important primary production for a range of species including threatened species and commercially valuable fish and crab species.	The **Project footprint** contains representations of three of the 11 coastal wetland types identified by the Draft ECD: mangroves, seagrass and unvegetated sand/mud. The extent of these habitat types in the MBRS are (values sourced from the 2019 RIS): ▪ At least 11,847 ha of mangrove forest; ▪ At least 23,759 ha of seagrass; and ▪ At least 4,681 ha of unvegetated mud/sand. The habitat types present within the **Project footprint** (refer to Figure 27-5) are: ▪ 2.5 ha of mangroves (0.02% of MBRS); ▪ 34.8 ha of seagrass (0.15% of MBRS), including 10 ha in the Fison Channel, which is expected to at least partially regrow; and ▪ 7.5 ha of unvegetated intertidal sand and mudflats (0.18% of MBRS). These habitat types are also represented in the **Zone of Influence**. Broadscale mapping databases indicate the presence of: ▪ 1,336 ha of mangroves; ▪ 2,225 ha of seagrass; and ▪ 920 ha of unvegetated sand/mud. The mix of mangrove habitat fringing mudflats and sandbanks containing some seagrasses found at Toondah Harbour is not unique in Western Moreton Bay. Within just the Zone of Influence there is approximately 19.8 km of similar habitat mix. The Project footprint contains less than 0.5 km of this habitat mix.
Contains several critical wetland habitat types	The Draft MBRS ECD identified six key wetland representative areas (refer to Table 27-4). None are present within the **Project footprint** or **Zone of Influence**.
Supports an assemblage of vulnerable or endangered marine/aquatic fauna	A range of vulnerable and endangered marine and aquatic fauna have the potential to be present within the Project footprint. These include dugong, Australian humpback dolphin, and loggerhead, hawksbill and green turtles. Seagrass beds within the Project footprint provide a potential source of food for marine turtle species and dugong, although the species present are widely available through Western Moreton Bay and the site would not be considered important foraging or breeding areas for any of these species. Analysis of recent and historical literature shows dugong and marine turtle species are predominantly found in Eastern Moreton Bay as they prefer seagrass beds on the western shores of Mulgumpin (Moreton Island) and Minjerribah (North Stradbroke Island). Surveys carried out in 2014 to 2018 by Dolphin Research Australia found that areas frequented by humpback dolphins also include Pulan (Amity Point), the eastern side of Jercuruba (Peel Island), and the bottom of Bribie Island.

Critical process, component and service	Presence in the Project footprint and Zone of Influence
	Dugongs, marine turtles and Australian humpback dolphins were sighted at low densities during field surveys within and adjacent to the Project footprint. Sightings were generally offshore to the north east or south east of Cassim Island or further south of the site in the embayment south east of Oyster Point.
Supports an assemblage of vulnerable or endangered wetland dependant terrestrial fauna species	Wetland dependent vulnerable and endangered fauna species have the potential to use habitat within the Project footprint. Species that occur are generally also considered migratory shorebirds and include the critically endangered eastern curlew, great knot and curlew sandpiper; the endangered red knot and lesser sand plover and the vulnerable bar-tailed godwit and greater sand plover. Of these species, eastern curlew and bar-tailed godwit are known to regularly utilise the mudflats within the Project footprint as feeding habitat, with lesser sand plover and great knot observed infrequently in very low numbers. Bar-tailed godwits also occasionally use the adjacent Cassim Island as a high tide roost site. Shorebird use of Nandeebie Claypan and Oyster Point has significantly reduced in the last five years with no migratory shorebirds observed at the Nandeebie Claypan for several years. Eastern curlews are observed regularly on the mudflat feeding areas in low numbers (average of 3.5 and maximum of 5 birds) in the Project footprint. This is approximately 0.3% of the average number seen in Moreton Bay between 1978 and 2006. Bar-tailed godwits have also been observed consistently but in low numbers on the mudflat feeding areas (average of 10 and maximum of 19 birds) in the Project footprint. This is approximately 0.15% of the average number seen in Moreton Bay. Approximately 25.6 ha of potential feeding habitat within the MBRS will be impacted by the Project footprint. This is 0.6% of potential feeding habitat within the MBRS (RIS 2019). The **Zone of Influence** contains additional areas of feeding habitat with analysis of aerial imagery identifying an area of approximately 920 ha. Shorebird surveys carried out at feeding habitat throughout South Western Moreton Bay found eastern curlews present at a density of about 1 per 10 ha and bar-tailed godwits at a density of about 6 per 10 ha meaning these areas provide feeding habitat for hundreds of threatened wetland dependent terrestrial species.
Supports significant populations (more than 20,000 in total and over 1% of the population size) of shorebirds	The maximum number of shorebirds observed at the roost sites were: ▪ Cassim Island - 1,290 (2019) with grey-tailed tattler the dominant species (~1,000); and ▪ Oyster Point – 842 (2019) with bar-tailed godwit the dominant species (825) The maximum number of shorebirds observed on the tidal flats at Toondah Harbour at any survey was 160 with grey-tailed tattler (60) and terek sandpiper (42) the dominant species. Over 1,500 migratory birds were observed feeding at mudflats within South Western Moreton Bay.
The tidal fish habitats and fish and invertebrate populations of the MBRS support valuable recreational and commercial fishing activities	Consultation with the recreational fisheries sector found the site had little to no recreational fisheries values. Compared to current arrangements, the Project will improve opportunity and amenity for land based recreational fishers along the eastern foreshore of the Project. Commercial fisheries logbook data was reviewed as part of the fisheries assessment. Commercial fisheries such as net fishing, crab fishing and trawl fishing occur throughout Moreton Bay, however, northern Moreton Bay is more significant in terms of commercial catches than southern Moreton Bay, providing more than 75% of the total annual catch (tonnes). This is particularly the case for the trawl fishery where approximately

Critical process, component and service	Presence in the Project footprint and Zone of Influence
	99% of the trawl catch is from northern Moreton Bay. Southern Moreton Bay does provide a source of catch for several commercial net and crab fishers targeting blue swimmer crabs, and this contributes to their income.
Has important cultural values and significance to indigenous peoples in Moreton Bay	Four sites of Aboriginal cultural heritage were recorded within the Project footprint during pedestrian survey. These sites included two artefact scatters and two isolated artefacts. Five test pits were excavated to test for sub-surface deposits. One test pit in the northern part of GJ Walter Park yielded Aboriginal cultural heritage that may be significant for understanding contact sites in Moreton Bay and the initial relationships between European settlers and the Quandamooka People.
Provides and supports significant tourism and recreational uses in the region	Toondah Harbour serves as the base for water taxi, passenger and vehicle ferry services between the mainland and Minjerribah (North Stradbroke Island), as well as a public boat ramp for recreational vessels.
Provisioning services - Provides food for humans, freshwater and genetic materials	The Project footprint and Zone of Influence are entirely composed of marine or brackish water and are not a source of freshwater. In Queensland, two small but valuable fisheries exist to supply the marine aquarium and ornamental trade. The Marine Aquarium Fish Fishery (MAFF) and the Queensland Coral Fishery (QCF) operate primarily on the Great Barrier Reef. In 2018 Moreton Bay accounted for less than 2% of the Queensland MAFF (Queensland Fisheries Summary Report 2018/19 financial year). The Project footprint and Zone of Influence are not known to provide any genetic materials such as ornamental species.
Regulates hydrological regimes (groundwater discharge and recharge)	A study by Stewart *et. al.* (2015) suggests significant submarine groundwater discharge into Moreton Bay. However, Dennison and Abal (1999) previously noted that groundwater does not constitute a major flow or nutrient contributor into Moreton Bay and, as such, is likely to have minimal impact on wetland functions. The horizontal and vertical groundwater flow direction in Petrie Formation shows that lateral groundwater flow is towards the coast and vertical contribution moving upwards. This indicates that groundwater discharges into the shallow marine environment at Toondah Harbour. Groundwater from the site was considered unlikely to provide significant inputs to existing uses (agricultural bores, etc) or groundwater dependent ecosystems and any potential changes as a result of the Project would be highly localised.
Stabilises the shoreline through erosion protection and hazard reduction including storm protection, flood storage and regulation of coastal processes	Toondah Harbour has very little influence on the dominant drivers of coastal processes in Moreton Bay. The current patterns in the vicinity of the Project footprint are complex and influenced by the presence of Cassim Island and surrounding intertidal shoals. Cassim Island itself provides a local shadowing effect on the general southwards and northwards flood and ebb tide currents respectively.
Regulates water quality by transforming and retaining nutrients and sediment	Seagrass beds are important sites for fixing nitrogen via nitrogen-fixing bacteria, with 0.2 to 0.4knN/Ha/Day being fixed in Moreton Bay seagrass sediments (Clouston 2002). Mangrove forests have also been shown to play an important role in nitrogen fixation and de-nitrification (Adame and Lovelock 2011). The Project footprint represents less than 0.03% of mangroves and 0.2% of seagrass in Moreton Bay.

Critical process, component and service	Presence in the Project footprint and Zone of Influence
Purifies and dilutes wastewater	At least 35 wastewater treatment plants (WWTP) ultimately discharge into Moreton Bay. Five of these discharge within the **Zone of Influence**: Wynnum, Thorneside, Capalaba, Cleveland and Victoria Point. The closest discharge points to Toondah Harbour is the Cleveland WWTP, which is released into Moreton Bay via Hilliards Creek approximately 5 km north of the Project footprint, and Victoria Point, which releases into Eprapah Creek approximately 4.5 km south of the Project footprint. Significant investments have been made to upgrade sewage and wastewater treatment plants in the past decade to reduce nutrient loads and associated phytoplankton blooms in the western embayments and water quality in Moreton Bay is in excellent condition (EHMP 2020) with nutrient levels reducing over the past several years. All discharge points are several kilometres from the Project footprint and any pollutants would have assimilated into the bay before reaching Toondah Harbour.
Regulates climate through greenhouse gases, temperature, precipitation, and other climactic processes	Mangrove forests are known to play an important role in the carbon cycle by sequestering and storing carbon dioxide (Lovelock *et al*. 2014). Wetlands are also known to play a role in localised climate regulation (Marsden *et al*. 2012). Wetland soils hold 35% or more of the estimated 1,500 gigatons of organic carbon that is stored in soils even though they only cover 5% to 8% of the earth's surface. In particular saltmarsh, mangroves and seagrass have a high ability to act as a carbon sink for carbon and greenhouse gases (Ramsar Briefing Note 10 – Wetland restoration for climate change resilience). The Project footprint represents less than 0.03% of mangroves and 0.2% of seagrass in the MBRS. The Zone of Influence contains less than 11% of mangroves, 12% of seagrass and 16% of saltmarsh in Moreton Bay.

Figure 27-3: : Toondah Harbour Conceptual Ecosystem Interactions



Toondah Harbour EIS

Legend

- Toondah Harbour PDA (Project Area)
- MBRS Zone of Influence
- Land/Sea

Processes

- Groundwater processes
- Coastal processes

Services

- Tourism & Recreation Hub
- Carbon nutrient & sediment regulation

Components

- Mangrove
- Saltmarsh
- Mud Flat / Shorebird feeding habitat
- Seagrass
- Dugong
- Humpback dolphins
- Turtle sp.
- Shorebird hightide roosting habitat

N

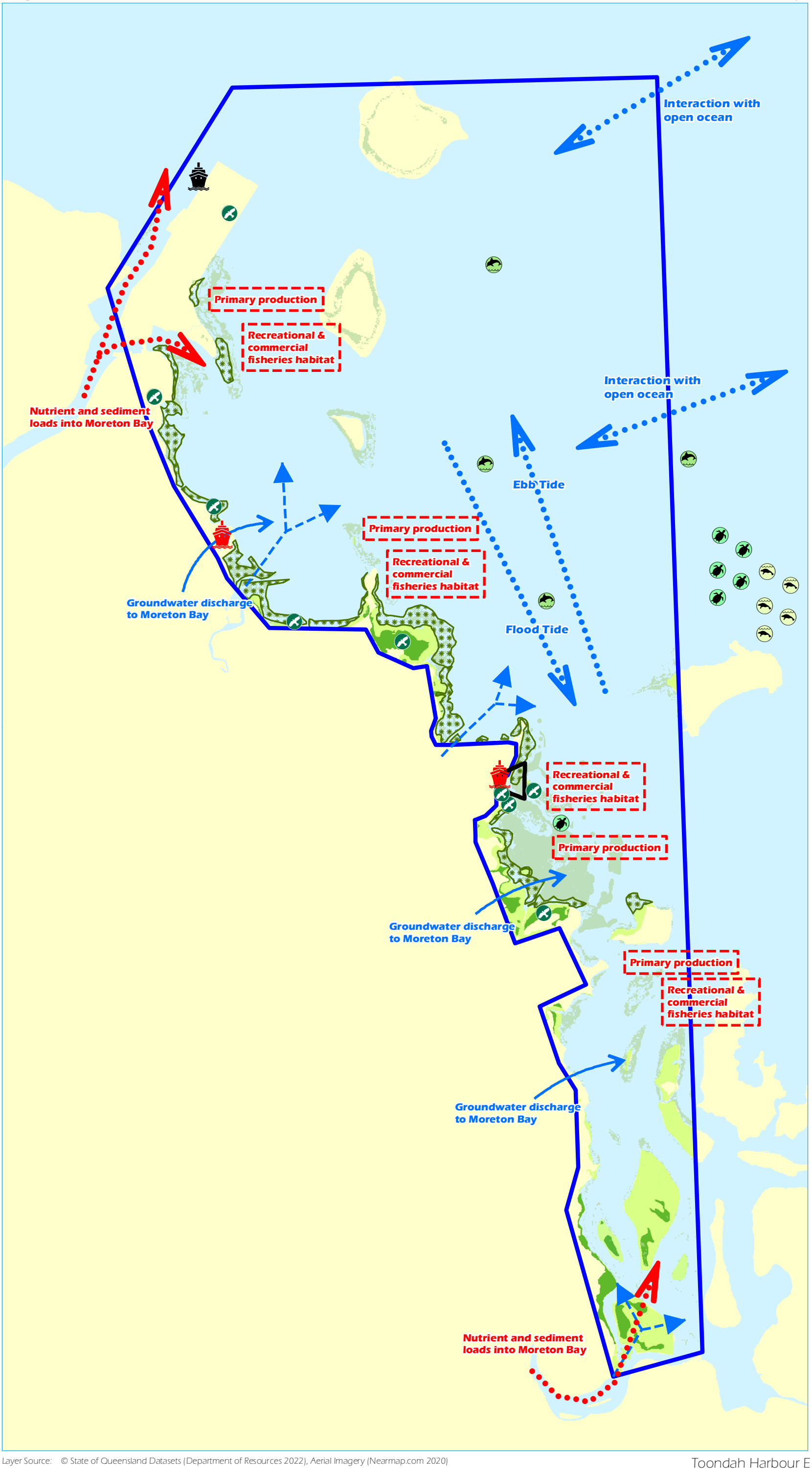
0 200 400 600 m

GDA 1994 MGA zone 56 Scale (A4):1:15,000

TOONDAH HARBOUR

walker

Figure 27-4: Toondah Harbour Zone of Influence Conceptual Ecosystem Interactions



Legend

- Toondah Harbour PDA (Project Area)
- MBRS Zone of Influence

Processes

- Groundwater disharge to Moreton Bay
- Dilution of Waterwater Releases

Services

- Tourism & Recreation Hub
- Port of Brisbane Industry Hub

Components

- Mangrove
- Saltmarsh
- Mud Flat
- Seagrass
- Shorebird hightide roosting habitat
- Dugong
- Humpback dolphins
- Turtle sp.

TOONDAH HARBOUR

walker

0 1 2 3 4 5 Kilometers

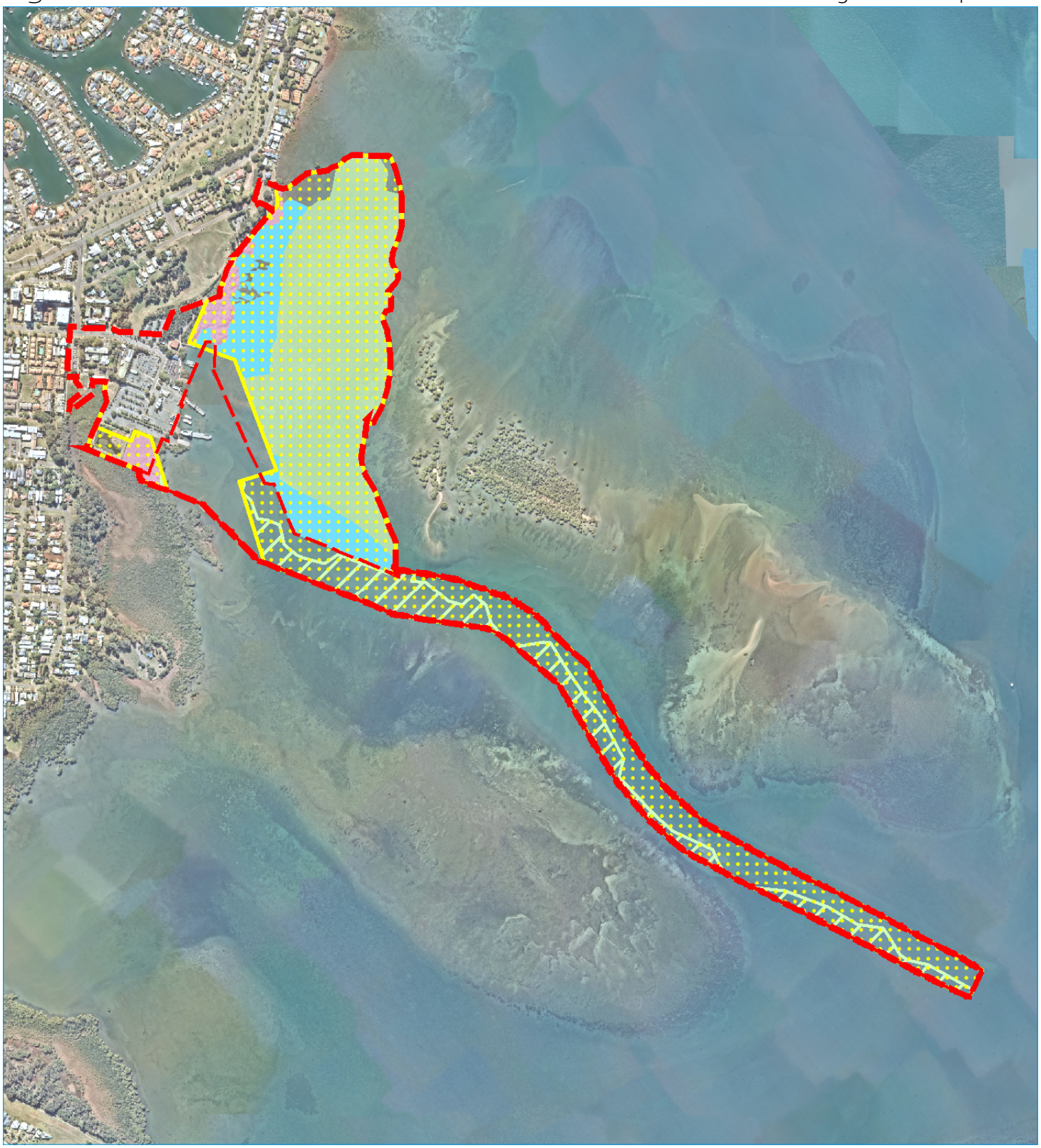
GDA 1994 MGA zone 56

Scale (A3): 1:120,000

N

Layer Source: © State of Queensland Datasets (Department of Resources 2022), Aerial Imagery (Nearmap.com 2020)

Figure 27-5: Marine Wetland Habitats within the MBRS and Project Footprint



Toondah Harbour EIS

Legend

- Project Footprint
- Dredge boundary
- Ramsar within development footprint (58.7 ha)

Reclamation Significant Residual Impacts

- Mangrove - 2.5ha
- Unvegetated Sand/Mud - 7.5ha
- Seagrass - 24.8ha

Dredging Significant Residual Impacts

- Seagrass - 10ha

TOONDAH HARBOUR

walker

N

0 100 200 300 400 Meters

GDA 1994 MGA zone 56

Scale (A4): 1:14,000

Layer Source: © State of Queensland Datasets (Department of Resources 2022), Aerial (Nearmap 2020)

DATE 26/09/2022

FILE REF. 9858 E Figure 27 5 Marine Wetland Habitats in MBRS and Project A

27.5. Assessment of Potential Impacts to the MBRS

Critical components, processes and services of the MBRS present in the Project footprint and Zone of Influence, and their contribution to the ecological character of the MBRS are summarised in Table 27-6. A conceptual flowchart showing how these components, processes and services interact at the Project footprint level is included as Figure 27-6.

The flow of impacts is represented by the red arrows connecting the components, processes and services. Broadly, the Project can impact directly on critical components, processes and services, however, impacts to services and components may also occur through indirect means, for example a change in the regulation of coastal processes (service) may indirectly impact on seagrass beds (component). Impacts to components may also indirectly affect biological services which may also then impact on services. To further the previous example, loss of seagrass may impact on primary productivity for fish species (process), which would in turn impact on commercial and recreational fisheries (service).

Table 27-6: Critical Services of the MBRS Present in the Project Footprint and Zone of Influence.

No.	Critical process, component or service	Contribution in Project footprint	Contribution in Zone of Influence
1	**Wetland habitats and primary production**		
1a	mangroves	minor	moderate
1b	saltmarsh	minor	moderate
1c	seagrass	minor	moderate
1d	unvegetated sand/mud	minor	moderate
2	**Critical wetland habitat types**	NP	NP
3	**Threatened marine fauna**	minor	minor
4	**Threatened wetland flora species**	NP	NP
5	**Threatened wetland fauna and Migratory Shorebirds**		
5a	feeding habitat	minor	major
5b	roosting habitat	major	major
6	**Recreational and commercial fisheries**	minor	moderate
7	**Indigenous cultural heritage**	major	major
8	**Research and education**	NP	NA
9	**Tourism and recreation**	moderate	moderate
10	**Source of Food, freshwater and genetic material**	NP	NP
11	**Regulation of hydrological regimes**	minor	minor
12	**Regulation of coastal processes**	minor	minor
13	**Regulates water quality by transforming and retaining nutrients and sediment**	minor	moderate
14	**Wastewater dilution**	NP	minor
15	**Regulates Climate**	minor	moderate

NP = Not present; NA = Not applicable

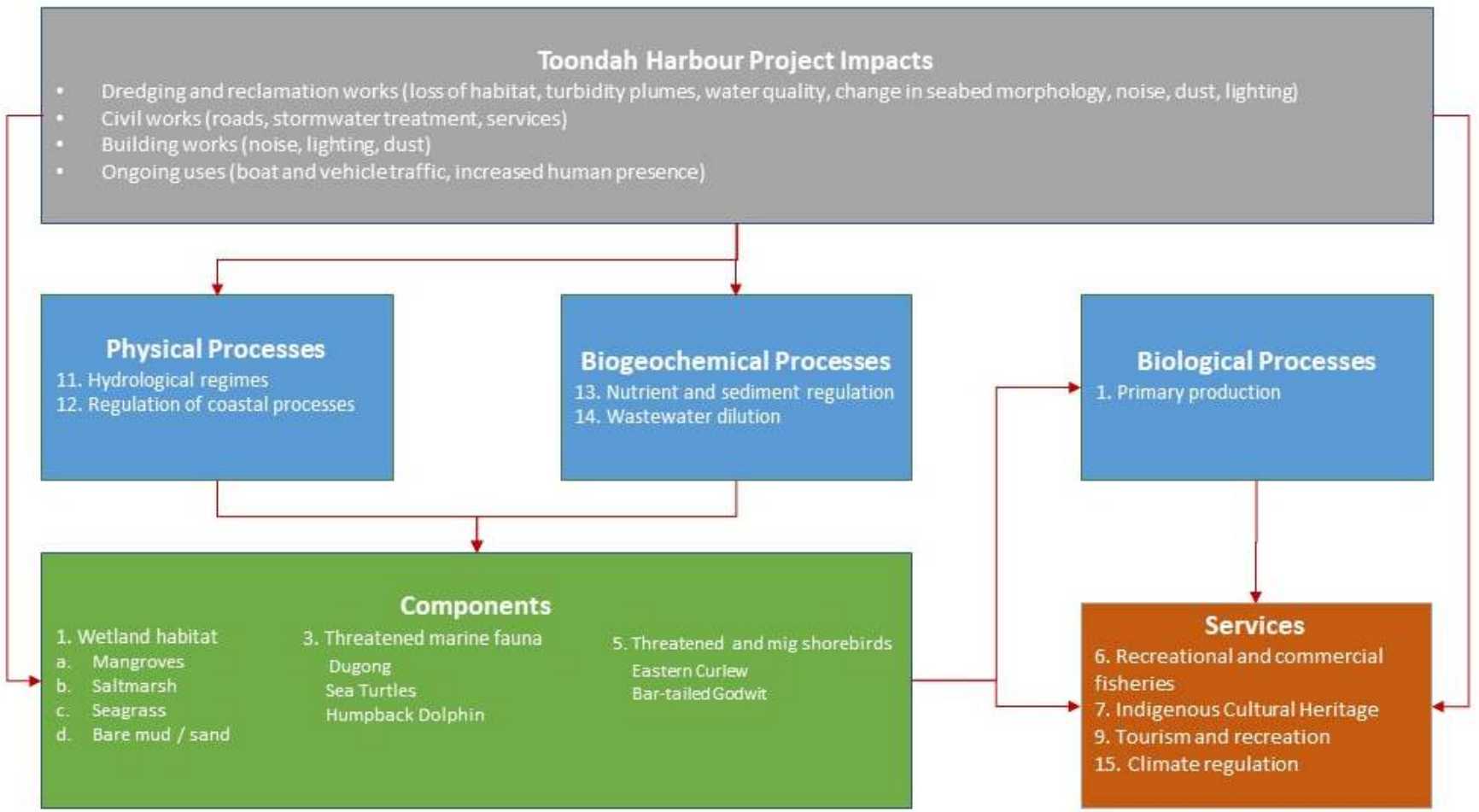


Figure 27-6: Conceptual Flowchart of Impact Pathways to MBRS Components, Processes and Services.

Impacts to specific components, processes and services have been addressed through the draft EIS technical studies (Volume 2). A summary of the relevant potential impacts is provided below. The description of impacts is structured to follow the interactions shown in Figure 27-6.

27.5.1 Impacts to Critical Physical and Biogeochemical Processes

Impacts to critical processes resulting from the Project will include changes to groundwater flows from the reclamation and sheet piling, changes to coastal processes from reclamation of marine intertidal areas and reduction in water quality (increase in sediments and nutrients) from stormwater runoff and dredge plumes. Even though it would occur within the Zone of Influence, wastewater dilution would not occur within the Project footprint therefore the Project would not impact on that process.

27.5.1.1 *Hydrological Regime (Groundwater Quality and Quantity)*

Background sampling and conceptual modelling was carried out to identify existing groundwater values at the Project footprint. Key potential impacts to groundwater and management measures include:

- Installation of a sheet pile wall has the potential to cause a build-up of groundwater (mounding) behind the inland side of the wall. Without mitigation, this may cause impacts such as further saturation and mobilisation of metals within the rehabilitated landfill in GJ Walter Park. Impact analysis found that any mounding would be highly localised in areas adjacent to the sheet pile walls which could be dealt with easily through ongoing monitoring and immediate remediation in response to any exceedances.
- Dewatering of the reclamation can potentially lower the groundwater table and thus desaturate the Quaternary sediments and Petrie Formation. The extent is anticipated to be minimal and localised to underneath the reclaimed areas of the Toondah Harbour PDA, as groundwater availability is primarily controlled by replenishment from seawater. The sheet piling and bund wall will contain any impacts and ongoing monitoring will be implemented to ensure impacts do not occur outside the footprint.

Modelling shows that impacts to the hydrological regime are expected to be minimal and highly localised around the Project footprint.

27.5.1.2 *Coastal Processes*

Numerical modelling was carried out to assess any changes to coastal processes resulting from the Project. The model was calibrated using a substantial quantity of site and Project specific data covering waves, current wind speed and direction, and suspended sediments. Key outcomes included:

- Current patterns in the vicinity of the Project will be modified, with the diversion of tidal flows generating higher velocity magnitudes to the east of the Project footprint, most notably on spring ebb tides. While localised areas of higher ebb tide velocities are predicted between the Project footprint and Cassim Island and extending to the northeast following construction of the Stage 1 bund, these velocities are reduced following construction of the Stage 2 bund (and in particular the rockwall breakwater). There is a general reduction in ebb tide velocities immediately to the north of the Project. Importantly, these localised velocity changes are not expected to have any significant effect on Cassim Island.
- The significant wave height magnitude is generally reduced in most areas surrounding the Project due to sheltering provided by the new reclamation. However, there are some small areas where the model indicates that wave heights may increase slightly. Wave energy in Toondah Harbour is already dissipated significantly by the shallow areas to the north and east of the Project footprint, so the additional sheltering effect of the new landform is not considered to be a major change to existing conditions.
- Some areas of net erosion or sedimentation are expected to result from the changes to currents and wave patterns. However, these are expected to be minor and the modelled impact to Cassim Island is negligible.

Where additional areas of erosion have been identified, it is expected that the seabed morphology will adjust, and the erosion rate will reduce over time as a new equilibrium is established.

- No major changes to shoreline alignment or position are expected because of the Project, however, there may be some accumulation of sediment on the protected beach immediately to the north of the Project footprint. Sediment already accumulates in this area and the Project is not expected to significantly add to sediment accumulation in this area.
- The model indicates that the Project will not increase the water level or wave impacts associated with extreme events at the site. The Project is however likely to provide some benefits to adjacent areas during extreme storm events due to reduced wave height in the lee of the Project footprint.

Impacts to coastal processes are expected to be highly localised around the Project footprint with even minor effects unlikely outside of the immediate area.

27.5.1.3 *Water Quality (Nutrient and Sediments)*

Receiving water quality modelling was carried out including existing and future stormwater treatment to assess potential impacts to water quality at the Project footprint and MBRS scales. The outcomes of the modelling indicate that:

- The marina and internal waterways created by the Project are likely to be well flushed, and it is unlikely there will be phytoplankton blooms or eutrophication within these waterways.
- While there may be slight increases in the concentration of total nitrogen and phosphorous in the marina and internal waterways, these increases are very small compared to current concentrations.
- In wet weather conditions, there is likely to be a reduction in the concentration of total suspended solids, total nitrogen and total nutrients in the intertidal area southwest of the ferry terminal, due to an increase in the proportion of treated stormwater flows.

Dredge plume modelling was also carried out and indicates that dredging-related turbidity and deposition rate impacts are relatively small compared to the natural variation in the ambient turbidity. Impacts are limited to areas in close proximity to the Project.

A combination of regional and local tidal dynamics results in the net northward transport of the dredge sediment plume, particularly over the ebbing tide phase. Plumes reach as far north as Cleveland Point; however, turbidity levels are very low (less than 10 NTU above ambient levels) outside of the immediate Project footprint. Other key outcomes from the modelling include:

- During the dredge campaigns most of the increases to turbidity are confined to the Fison Channel. There are likely to be some minor increases in turbidity to the north of the channel, over seagrass and unvegetated sand/mud and in mangroves to the south of the ferry terminal.
- Increases in sediment deposition are largely confined to the entrance channel. In the first dredging campaign sediment is also likely to be deposited:
    - slightly to the north of the channel, over seagrass and unvegetated sand/mud; and
    - a small increase in the deposition rate leading to a build-up of sediment (2 to 3 mm) during the dredging campaign in an area to the north-east of the project, over unvegetated sand/mud, seagrass, macro-algae and hard corals.
- Increases in deposition rates are lower in the second dredging campaign than in the first dredging campaign. In the second dredging campaign there were some brief increases in deposition rates over the seagrass and algae on sand close to the channel area being dredged.
- In the context of existing regularly high turbidity in the vicinity of the proposed works, changes to the concentration of turbidity and sedimentation due to dredging are likely to be brief (in the order of days), short

term (in that they are predicted to only increase during the dredging activity) and will not result in increases significantly greater than existing conditions.

It is of note that dredge plume and sedimentation modelling assumed no use of silt curtains to provide an indication of the 'worst case' impacts. Silt curtains will be used whenever conditions and dredge location allow, therefore actual impacts are expected to be significantly less than shown in the modelling.

27.5.2 Impacts to Critical Components

Potential impacts to critical components of the MBRS present at Toondah Harbour include direct loss of wetland habitat from dredging and reclamation works, disturbance of protected marine fauna during construction and ongoing operations (e.g. from boat strike or elevated noise), and disturbance of threatened and migratory shorebird species (due to noise, light, increased human activity). Indirect impacts may also have an effect on critical components including turbidity and sedimentation impacting on habitat outside of the Project footprint.

27.5.2.1 *Wetland Habitat*

There will be a direct loss of wetland habitat within the MBRS due to the Project, comprising:

- 2.5 ha of mangroves;
- 34.8 ha of seagrass, including 10 ha in the Fison Channel; and
- 7.5 ha of unvegetated sandbanks and mudflats, excluding 16.2 ha in the Fison Channel which will be retained as unvegetated mud/sand post dredging.

Some seagrass is likely to regrow in the Fison Channel once dredging has been completed, as it did after the maintenance dredging event in 2019.

The areas of clearing represent 0.03% of mangroves, 0.15% of seagrass and 0.18% of unvegetated sand/mud in the MBRS.

The mix of mangrove habitat fringing mudflats and sandbanks containing some seagrasses found at Toondah Harbour is not unique in Western Moreton Bay or the Redlands Coast. Within the Zone of Influence there are approximately 19.8 km of similar habitat mix. The Project would result in the removal of less than 0.5 km of this habitat mix, or about 2.5%. A significant area of this habitat mix is also present in the northern reaches of the MBRS, north of the Redcliffe peninsula and within Pumicestone Passage.

27.5.2.2 *Threatened Marine Fauna*

Five threatened marine fauna species use the area and are likely to be impacted by the proposed works: loggerhead turtles, green turtles, hawksbill turtles, dugongs and Australian humpback dolphins. While dugong and marine turtles feed on seagrass, the Project footprint does not contain significant habitat for them, with population densities far higher on the Eastern Banks of Moreton Bay. While Australian humpback dolphins are found throughout Moreton Bay, Toondah Harbour is not part of their core habitat. Consequently, the direct loss of 34.8 ha of seagrass in the MBRS is unlikely to have a significant impact on threatened marine fauna species. It is noted that approximately 10 ha of the seagrass lost will be removed as a result of the expansion of Fison Channel. Seagrass has recolonised the existing dredge area within two years of maintenance dredging events and therefore would also be expected to regrow in the future channel.

There is a risk that fish, turtles, dugongs and dolphins may be trapped within the reclamation areas as they are bunded off. However, this risk will be considerably reduced by:

- Installing barriers at low tide;
- Capturing fish and crabs and releasing them outside the area;
- Using trained marine megafauna spotters and removalists to ensure no megafauna are trapped within the bunded areas; and
- Using mechanical noise and boat activity to deter marine mammals from entering areas.

While the Project is not expected to result in the generation of significant additional boat traffic in the vicinity of Toondah Harbour or in the broader MBRS (refer to Section 3.1), there is a risk that a small increase in boating activity in the area may result in more collisions with threatened marine species. During dredging operations this will be mitigated through a comprehensive management plan that includes fauna spotters, restrictions on vessel movement when marine megafauna are sighted, vessel exclusion zones around megafauna, and adherence to speed limits.

In the longer-term educational signage, explicitly stating the risk to wildlife of travelling too fast, and establishing go slow areas in the shallow waters surrounding the Project footprint will mitigate risk of vessel strike in the Project's operational phase. Sea-life friendly propellers are commercially available, and their use will be encouraged under the management plan for marina operations.

Other potential risks, such as disturbance of ASS, spills of hydrocarbon and other contaminants, introduction and spread of pest species and increased litter, are relatively low and can be reduced through appropriate site management.

27.5.2.3 *Threatened and Migratory Shorebirds*

Loss of Feeding Habitat

Dredging and reclamation within the Project footprint will result in a permanent direct impact on 25.6 ha of tidal flat habitat within the MBRS that provides feeding habitat for migratory shorebird species. While the loss of habitat will adversely affect feeding habitat and area of occupancy for a number of species including the critically endangered eastern curlew and vulnerable bar-tailed godwit, it corresponds to only 0.29 % of the approximately 10,000 ha of tidal flat habitat within Moreton Bay or 0.6% of the approximately 4,681 ha of habitat in the MBRS. As noted previously this area also represents less than 1% of unvegetated mud/sand within the Zone of Influence, which would make up most of the feeding habitat within this area.

A key question in the assessment of the impact of the loss of a small area of tidal flat feeding habitat on threatened and migratory shorebird species is the extent to which migratory shorebird numbers in Moreton Bay are currently regulated by local density-dependent factors, such as food availability, that set a ceiling on the carrying capacity. If Moreton Bay was currently operating at carrying capacity, then the loss of an area of feeding habitat would be predicted to result in a reduction in the numbers of migratory shorebirds in direct proportion to the area of habitat lost. The birds displaced from the lost habitat would move into the remaining habitat creating competition for limited food resources with birds already using that habitat, eventually resulting in a loss of birds from the area due to density-dependent factors. Alternatively, if Moreton Bay is not at carrying capacity, the displaced birds would move to other feeding habitat with little disturbance to shorebirds already using those areas as there would be sufficient resources to avoid competition. While there is little published data that specifically tests this prediction, the studies outlined below suggest feeding habitat has significant remaining carrying capacity within Moreton Bay.

Several migratory shorebird species are known to have suffered severe population declines across the flyway population, including within Moreton Bay, due to factors operating outside of Australia. This is expected to have reduced their feeding densities in suitable feeding habitat across Moreton Bay to the point where their current populations are well below the original carrying capacity of Moreton Bay. Thompson (1990) conducted a single survey on 10 February 1990

of all migratory shorebirds foraging along the mainland coastline from Eprapah Creek to Redland Bay. This survey area incorporated the same length of mainland coastline from Point O'Halloran to Redland Bay that has been surveyed during the EIS surveys, and an additional 38 ha of tidal flats between Eprapah Creek and Point O'Halloran and between the boat ramp and ferry terminal at Victoria Point. A comparison between the survey results of Thompson (1990) and the EIS survey 30 years later (refer to Section 8.2.7.6), shows there has been a substantial reduction in the density of eastern curlew in particular foraging in this area, from a density of 6.2 birds per 10 ha 30 years ago to an average density of 1.7 birds per 10 ha today. The overall feeding density for all declining species has similarly decreased from an observed density of 26.2 birds per 10 ha 30 years ago to an average density of 9.7 birds per 10 ha currently, whereas the overall feeding density for all species that have not declined showed little change (17.8 birds per 10 ha 30 years ago versus an average of 17.2 birds per 10 ha currently). The extent of foraging habitat has remained unchanged over this period.

A further consideration when assessing the risk of impact is the relatively low numbers of threatened shorebird species that utilise feeding habitat at Toondah Harbour. Eastern curlews are observed regularly on the mudflat feeding areas in low numbers (average of 3.5 and maximum of 5 individual birds) which is approximately 0.3% of the average number seen in Moreton Bay between 1978 and 2006 (1,299) and 0.02% of the estimated EAAF population of 35,000.

Bar-tailed godwits are also observed consistently using foraging habitat at Toondah Harbour in low numbers (average of 10 and maximum of 19 birds). This is approximately 0.15% of the average number seen in Moreton Bay between 1978 and 2006 (6,018) and 0.005% of the estimated EAAF population of 325,000.

Disturbance from Recreational Activities

Some Project construction activities (dredging, reclamation sheet piling and installation of the rockwall breakwater) are proposed to be undertaken at distances of 50 m to 130 m from the closest edges of the Cassim Island and Nandeebie Claypan roost sites, which is within the flight initiation distances for some shorebird species. However, the critically endangered species eastern curlew does not roost at Cassim Island and has not been observed at Nandeebie Claypan for several years. Similarly, the vulnerable bar-tailed godwit has only been observed in small number at Cassim Island and has not been observed at Nandeebie Claypan for several years. Construction activities will be short term and implemented during periods when the majority of migratory birds are not roosting within Moreton Bay (i.e. March to November).

No dwellings or retail areas will be located within 200 m of the roost site however, the completed development will house an estimated 5,700 to 5,800 new residents, which is expected to increase public use of the existing public walkway/cycleway alongside Nandeebie Claypan and Oyster Point Park recreational facilities. It is noted that no migratory shorebirds have been observed at the Nandeebie Claypan for several years and the roosting site is considered to be abandoned due to mangrove encroachment. Consequently, there is potential for the Project to increase the risk of disturbance to shorebird species using the Oyster Point roost site. However, migratory shorebirds are expected to habituate to some repetitive activities over time since they will be non-lethal. The potential for disturbance will be further minimised through careful placement of designated walking tracks, use of exclusion fencing and educational signage and materials.

Noise Disturbance

Without mitigation, noise from Project activities has the potential to disturb shorebird species using the Cassim Island and Nandeebie Claypan roost sites. High noise generating activities will only occur during construction periods and will be short term and carried out during periods when the majority of migratory birds are not roosting within Moreton Bay (i.e. March to November), minimising risk of impacts to these species.

Light Disturbance

The lighting strategy proposed for the Project will minimise light spill to the receiving environment to less than 1 lux (refer to Chapter 13). Consequently, there is low potential for Project lighting to have impacts on migratory shorebird use of roosting and feeding habitats adjacent to the Project footprint.

The Project is not predicted to have significant residual impacts on migratory shorebirds using roost sites adjacent to the Project footprint.

27.5.3 Impacts to Critical Biological Processes and Services

Impacts to the critical services and biological processes provided by the MBRS include direct impacts from the loss of wetland habitats. There is minimal risk of change from indirect impacts given critical components are unlikely to be impacted by changes in the physical and biogeochemical processes.

27.5.3.1 *Recreational and Commercial Fisheries*

Recreational fishing is the dominant activity within Moreton Bay, which is also the most important commercial fishing region in the state by volume and value of fish per unit area. Indigenous fisheries are important for the Traditional Custodians, the Quandamooka People. A variety of limited entry commercial fisheries are licenced to operate within Moreton Bay. The potential impacts of any coastal development on fisheries includes two main considerations:

- Potential impacts to access by fishers; and
- Loss or modification of habitats that may alter populations of fished species.

Through discussion with representatives of peak commercial fishing bodies, it was identified that the eastern and northern side of Cassim Island is utilised by commercial tunnel net fishers and there is some utilisation by commercial blue swimmer crab fishers of the area. The area is not utilised by commercial otter trawl fishers. There is some boat-based access by recreational fishers around Cassim Island and some land-based access at GJ Walter Park but neither of these two locations are identified as important locations for recreational fishing activities.

The Project will result in the removal of up to 34.8 ha of seagrass and 2.5 ha of mangroves, some coral rubble and shallow unvegetated habitats from the MBRS. Partly in place of this habitat will be artificial habitats including rock walls and marina infrastructure such as pontoons and deeper unvegetated habitat. Impacts during construction on areas adjacent to the Project footprint will be minimised or eliminated through standard procedures. Rock walls can be engineered to enhance them as fisheries habitat, while still remaining fit for purpose, as well as incorporating small patches of oyster reef which was one of the dominant habitats in western Moreton Bay at the time of European arrival. The loss of seagrass habitat is expected to have local impacts on the abundance of some fished species that utilise this habitat in preference to other types, including garfishes and tiger prawns. It is highly unlikely that these localised impacts will have impacts on these species at the population level or on their overall spatial distribution within Moreton Bay. Other fished species such as yellowfin bream adapt readily to artificial habitats and can become abundant in them.

The Project will result in the closure of the current public boat ramp at Emmett Drive, which is underutilised. Within the Project footprint a launching point for non-powered vessels (e.g., kayaks and dinghies) will be constructed, with associated parking. The Proponent has agreed to make a financial contribution to the upgrade of the William Street boat ramp at Cleveland Point to compensate for the reduced access for motorboats as a result of the closure of the Emmett Drive boat ramp. Compared to current arrangements, the Project will improve opportunity and amenity for land based recreational fishers along the eastern foreshore of the Project.

In summary, the three main potential impacts on fisheries from the Project are:

- Construction-related impacts on habitats that can be effectively managed using standard procedures;
- Minor loss of fishing access which, for the recreational fishing sector will be addressed by enhanced facilities and amenities, and for the commercial sector through further discussion and offsets; and
- Loss of habitat, which will not impact all harvested species equally and does not represent a risk to the populations of fished species.

27.5.3.2 *Indigenous Cultural Heritage*

Six locations within the Toondah Harbour PDA were identified as being of risk to Aboriginal cultural heritage (i.e. having the potential to contain further sub-surface cultural heritage). Two areas of 'high risk' were identified along the foreshore/intertidal resource zone where Aboriginal cultural heritage exists. Four areas of 'moderate risk' were identified in the least disturbed portions of the PDA and the intertidal resource zone that offers pedestrian access to Cassim Island. The remainder of the cultural heritage study area has been assessed as being of 'low risk' for Aboriginal cultural heritage. Importantly, even where areas are identified as 'low risk', the Proponent's cultural heritage duty of care remains.

The Project will address potential impacts to Indigenous heritage by implementing the following recommendations from QYAC:

- Registration of identified cultural heritage sites on the Queensland Government's Aboriginal and Torres Strait Islander Cultural Heritage Database and Register (in progress); and
- Negotiation of a cultural heritage management plan (CHMP) under the ACH Act, which will detail the procedures and protocols to avoid harm to Aboriginal cultural heritage.

The Project will also interpret Aboriginal cultural heritage through the incorporation, in consultation with QYAC, of educational signage, place naming, wayfinding and public art in open space areas and providing a mainland location for delivery of cultural and nature-based tourism activities.

27.5.3.3 *Tourism and Recreation*

The Project will improve existing facilities and access to Moreton Bay and Minjerribah (North Stradbroke Island) from the mainland, increasing the contribution of this service to the character of the MBRS.

The revitalisation of Toondah Harbour will support the economic transition of Minjerribah from sand mining towards a sustainable cultural and nature-based tourism-based economy and provide an enhanced gateway to the broader natural attractions of Moreton Bay. The delivery of a dedicated tourism precinct at Toondah Harbour is a key action in RCC's Tourism Strategy and Action Plan.

The proposed new ferry precinct will replace the existing dilapidated, industrial facilities. The master plan for the proposed development includes:

- Three roll on/roll off vessel berths (same number as the existing facility);
- Vehicle queuing areas;
- Two passenger ferry berths;
- Integrated ticket and tourist information centre;
- 1,010 public ferry car parks with capacity for RCC to provide a further 500 car parks in a multi deck structure if demand warrants it;
- Public plaza;
- Bus-ferry interchange;
- Marine services building; and
- Opportunity for charter boat berthing to facilitate new tourism operations.

The Project will improve community access to the foreshore and Moreton Bay by delivering new public open space and community amenities. These include:

- A new 3.5 ha foreshore parkland providing open space, water park, artificial beach and landside opportunities for recreational fishing;
- Marine recreational facilities including a ramp for non-motorised vessels (kayaks, canoes, etc.), trailer parking and other amenities;
- A public pontoon;
- An education centre, which will operate as a focal point for promoting environmental awareness and culture and nature-based tourism experiences;
- A range of boardwalks, plazas, and neighbourhood parks integrated throughout the development; and
- Minor embellishments to GJ Walter Park, the existing public park, which will be retained. Importantly, there will be no net loss of green space in GJ Walter Park.

The Project will contribute to realising the potential for Minjerribah and Moreton Bay to become great Australian tourism assets by enhancing and future proof the regional gateway to Minjerribah and Moreton Bay with modern, safe port facilities and a vibrant mainland destination, including hotel and conference facilities, that will grow visitation to Cleveland and the Redlands Coast.

Economic analysis found the additional tourism expenditure to be facilitated by the Project is estimated to result in the following beneficial impacts:

- For Minjerribah, the following increases by 2030:
    - $152 million in additional gross output;
    - $83 million in added Gross Regional Product;
    - Additional employment of 357 FTEs; and
- For the rest of the Redland City LGA (i.e., Toondah Harbour and other locations), the following total impacts, based on projected increased in tourist visitations and expenditure from 2026 to 2041:
    - $440 million in additional gross output;
    - Additional employment of up to 135 FTEs.

The Project provides a tourism gateway to the southern Moreton Bay and the establishment of a tourism precinct on the mainland at Toondah Harbour. The key characteristics of the Project that are expected to attract visitors to the region are:

- A comprehensive, well-connected tourism offering with high amenity, that offers good access to Brisbane and destinations in SEQ. The tourism-based harbour, coastal open space, hotel and conference facilities, recreational marina and retail and dining precinct represent an attractive proposition to a range of tourist types, including holiday makers, people visiting friends and relatives, cultural and eco-tourists, and organisers of corporate events and private functions.
- The provision of a mainland base for cultural and eco-tourism operators providing services throughout southern Moreton Bay, including Minjerribah, which will create a new market for day-trippers seeking to access ecotourism services on the mainland and in southern Moreton Bay.
- An offering that complements the other major tourism projects throughout the region, including the Queen's Wharf Development, the Brisbane Airport Parallel Runway, and International Cruise Terminal at the Port of Brisbane. These developments are focused on increasing Brisbane's profile as an international tourist destination, in particular targeting high-growth Asian markets.

The beneficial impacts outlined above are particularly significant given the importance of facilitating the growth of a sustainable eco-cultural tourism industry for southern Moreton Bay following the cessation of sand mining on

Minjerribah in 2019 and the limited alternative drivers of employment growth in the Redland City LGA. These are also important outcomes for SEQ, which is in a significant 'region shaping' period afforded by the staging and legacy of the 2032 Brisbane Olympic and Paralympic Games and the announcement of the SEQ City Deal to be delivered by 2042.

27.5.3.4 *Climate regulation and primary productivity*

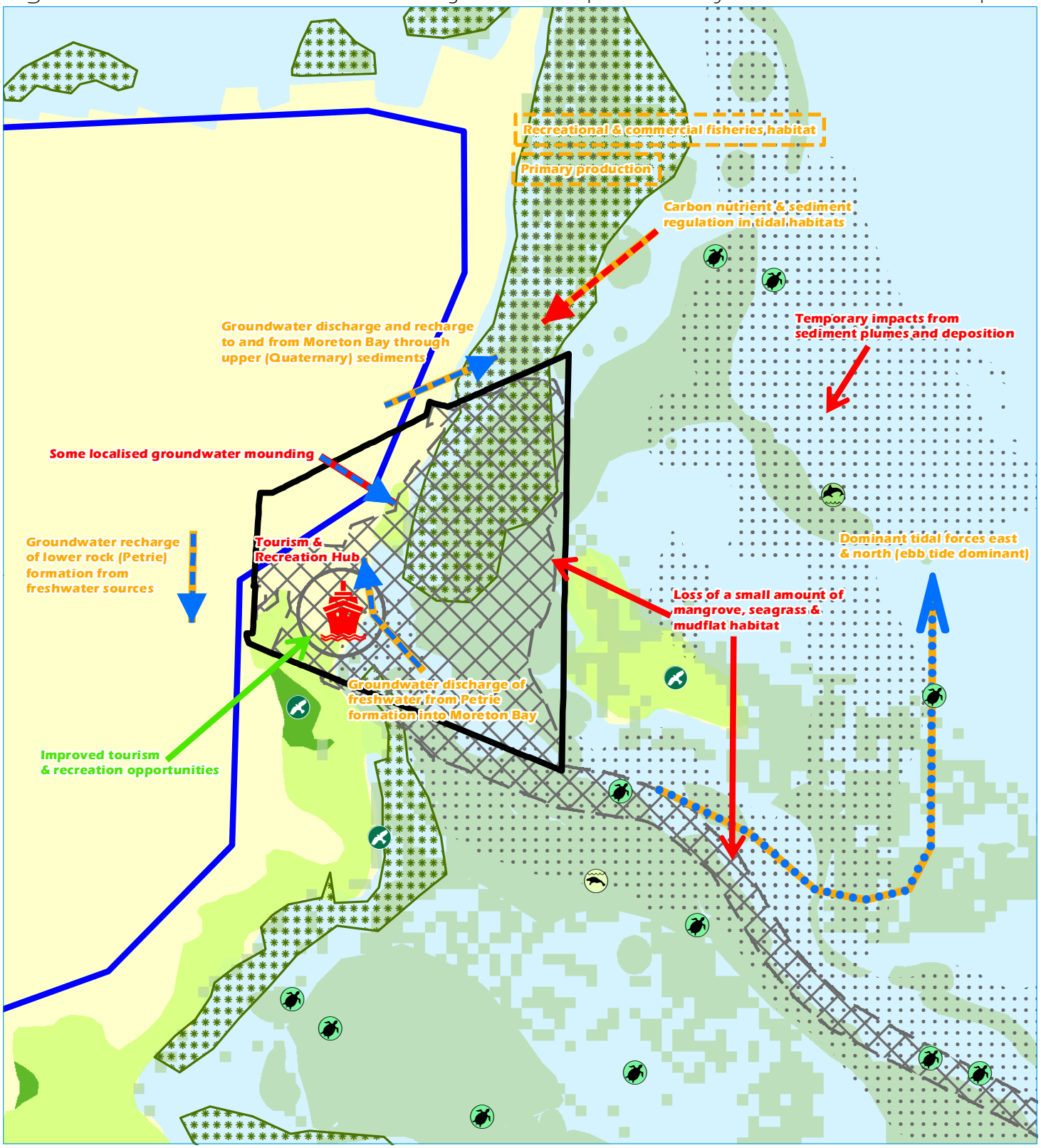
Potential impacts to climate regulation and primary production are difficult to quantify. Key drivers of these processes at the Project footprint-scale are wetland habitats, including seagrass and mangroves. Given the proportionally small area of seagrass and mangroves being impacted by the Project (0.2% of seagrasses and 0.03% of mangroves in Moreton Bay) impacts to these services and processes are considered to be negligible.

27.5.4 Summary of Potential Impacts

As the Project is unlikely to have any significant impact on critical services and components outside of its footprint, impacts to services will only occur at the site level. Impacts to recreational and commercial fisheries are expected to be minor and will not impact on broader fisheries in Moreton Bay. The Project is expected to improve access and the existing facilities at Toondah Harbour for recreational fishers. The Proponent will work with QYAC, as the registered cultural heritage body for the area, to identify, protect and manage the Aboriginal cultural heritage values of Toondah Harbour under a cultural heritage management plan (CHMP) for the Project. Indigenous heritage will also be highlighted through cultural heritage interpretation and awareness raising, land and sea country management activities and opportunities for cultural and nature-based tourism to be provided out of the education centre. The Project will dramatically improve the existing tourism and recreational services Toondah Harbour provides to the MBRS and will add significantly to the Redlands' economy.

Impacts from the Project on the critical components, processes and services of the MBRS are represented visually in Figure 27-7. Impacts are shown at the Project-footprint scale as no impacts are predicted to occur to the broader Zone of Influence.

Figure 27-7: : Toondah Harbour Project Conceptual Ecosystem Interactions Impacts



Toondah Harbour EIS

Legend

- Toondah Harbour PDA (Project Area)
- MBRS Zone of Influence
- Land/Sea

Impacts

- Project area (loss of some seagrass & mudflats)
- Sediment plumes (temporary impact)

Processes

- Groundwater processes
- Coastal processes

Services

- Tourism & Recreation Hub
- Carbon nutrient & sediment regulation

Components

- Mangrove
- Saltmarsh
- Mud Flat / Shorebird feeding habitat
- Seagrass
- Dugong

- Humpback dolphins
- Turtle sp.
- Shorebird hightide roosting habitat

N

0 200 400 600 m

GDA 1994 MGA zone 56 Scale (A4):1:15,000

TOONDAH HARBOUR

walker

Layer Source: State of Queensland Datasets (© State of Queensland 2022), Aerial (© Nearmap 2020), Fauna records (© State of Queensland 2020) DATE 29/06/2022 FILE REF. 9858 E Figure 27 7 Ecosystem Impacts Toondah Habour Concept A

27.6. Potential for Change in Ecological Character or Significant Impact to the Ramsar MNES

To determine if significant impacts to the ecological character of the MBRS are likely, two levels of assessment have been carried out:

- Review of the impacts against the critical components, processes and services represented within the Project footprint and Zone of Influence and assess the contribution to the ecological character of the MBRS (refer to Table 27-3); and
- Assessing the impacts against the EPBC Act significant impact criteria for wetlands of international importance.

Based on the findings of this assessment, an analysis of the potential for the Project to change the ecological character of the MBRS or result in an impact on the Ramsar wetlands of international importance MNES has been carried out and the results summarised in Table 27-7.

The Project will result in the loss of wetland habitat including mangroves, saltmarsh, seagrass and unvegetated mud/sand. The area of wetland habitat being lost is relatively small and are well under 1% of comparative habitats in the MBRS.

Potential for impacts outside of the Project footprint, including on adjacent high tide roost sites, is considered to be minimal with any minor impacts expected to be short term (e.g. construction noise) or activities that shorebirds will habituate to over time (e.g. increased pedestrian use of foreshore public open space and walking/cycle paths). The potential for disturbance will be further minimised through careful placement of designated walking tracks, use of exclusion fencing and educational signage.

As the Project is unlikely to have any significant impact on critical components and processes outside of its footprint, impacts to services will only occur at the local scale. Impacts to these services are expected to be minor and the Project will provide a range of benefits in the context of sustainable development to balance these minor impacts including:

- Creation of approximately 1.5 km of rockwall that will be designed to provide fish habitat and roosting habitat for a number of migratory bird species, including grey-tailed tattler, ruddy turnstone and terek sandpiper.
- Marine structures such as piles and jetties will provide habitat for fish species.
- Creation of oyster reefs within the Project footprint will provide further habitat for fisheries species.
- Stormwater treatment will reduce nutrient loads released into Moreton Bay during storm events given that the existing harbour currently has no treatment measures.
- The upgrade of the ferry terminal, turning basin and Fison Channel, and the provision of an education centre as well as a visitor information centre, will add significantly to the recreational, tourism and educational values of Moreton Bay, both of which are considered critical services of the MBRS.
- The interpretation and awareness raising of Aboriginal cultural heritage values through signage, public art and opportunities for land and sea country management and cultural and nature-based tourism activities will promote the Indigenous cultural heritage of Moreton Bay, which is considered a critical service of the MBRS.
- A 3.5 ha foreshore park including an education centre, providing for a range of recreational activities and community engagement with Moreton Bay.

Accordingly, a change in ecological character of the MBRS as defined by the Ramsar Convention will not result from the Toondah Harbour Project. While impacts will be localised and not result in a change to the ecological character of the MBRS, a small area of the wetland (less than 0.02%) will be substantially modified resulting in a significant impact to a wetland of international significance under the EPBC Act.

While the Project is considered likely to have a significant impact as defined by the EPBC Act, avoidance and management measures will ensure impacts are contained to the Project footprint. The habitats impacted are not considered to provide significant or unique values in comparison to other similar areas with the MBRS.

Unavoidable residual impacts to wetland habitats within the MBRS resulting from the Project are:

- 2.5 ha of mangroves;
- 24.8 ha of seagrass, excluding 10 ha in the Fison Channel which are likely to recolonise; and
- 7.5 ha of unvegetated intertidal sandbanks and mudflats.

These residual impacts will be offset through the implementation of a fund that will deliver $4.75 million of beneficial projects in the Redland LGA and broader MBRS providing an overall benefit to migratory birds and wetland habitats in the MBRS. The offsets strategy is outlined in Chapter 29 of the draft EIS.

Table 27-7: Potential for Project Impacts to Result in a Change in Ecological Character of the MBRS or Significant Impact on MNES.

EPBC Act Sig Impact Criteria	Summary of Impacts to Critical Components, Processes and Services	Potential for change in Ecological Character	Potential for significant impacts on MNES
Areas of wetland being destroyed or substantially modified	▪ The Project will result in a small area of the MBRS being substantially modified through reclamation the area impacted represents less than 0.02% of the entire 120,000+ ha of the MBRS. ▪ Most of the critical processes, components and services that contribute to the ecological character of the MBRS provide only a minor contribution at the Project footprint scale. ▪ While the Project will have a direct impact on wetland habitat, the area of impact is very small when viewed in the context of the whole MBRS and even the Zone of Influence, which encompasses a large portion of south western Moreton Bay. ▪ The habitats present are not considered to be core or of high value to any threatened marine fauna species. ▪ While the Project footprint provides feeding habitat for a small number of threatened and migratory shorebird species, recent studies have shown Moreton Bay contains an abundance of feeding habitat available for shorebirds. ▪ Indirect impacts to adjacent high tide roost sites will be avoided through implementation of a range management measures. ▪ The Project's environmental offsets strategy outlined in Chapter 29 will provide an overall benefit to migratory birds and wetland habitats in the MBRS.	While a small area of the Ramsar site will be substantially modified as a result of the Project, these areas do not provide a major contribution to the ecological character of the wetland therefore no change is likely.	Likely – the project will result in a small area of the MBRS being substantially modified.
A substantial and measurable change in the hydrological regime of the wetland	▪ The Project footprint was assessed as providing a minor contribution to the regulation of coastal processes for the MBRS. ▪ Detailed modelling identified impacts to coastal processes are expected to be highly localised around the Project footprint with even minor changes unlikely outside of the immediate area. ▪ Changes are not expected to have any impact on nearby features such as Cassim Island.	Unlikely	Unlikely
Habitat or lifecycle of native species being seriously affected	▪ The Project footprint was assessed as having a minor contribution to threatened marine fauna, minor contribution to threatened and migratory bird feeding habitat and a major contribution to threatened and migratory bird roosting habitat.	Unlikely	Unlikely

EPBC Act Sig Impact Criteria	Summary of Impacts to Critical Components, Processes and Services	Potential for change in Ecological Character	Potential for significant impacts on MNES
	▪ Five threatened marine fauna species are known to use habitats within and surrounding the footprint: loggerhead turtles, green turtles, hawksbill turtles, dugongs and Australian humpback dolphins. ▪ While dugong and marine turtles feed on seagrass, the Project footprint does not contain significant of high value habitat for them, with population densities far higher on the Eastern Banks of Moreton Bay. ▪ Australian humpback dolphins are found throughout Moreton Bay, Toondah Harbour is not part of their core habitat. ▪ Dredging and reclamation to accommodate the Project footprint will result in a permanent direct impact on 25.6 ha of tidal flat habitat within the MBRS that provides feeding habitat for migratory shorebird species. This corresponds to only 0.18% of the approximately 4,681 ha of habitat in the MBRS. ▪ Potential for impacts outside of the Project footprint, including on adjacent high tide roost sites, is considered to be minimal. Any minor impacts are expected to be short term (e.g. construction noise) or activities that shorebirds will habituate to over time (e.g. increased pedestrian use of foreshore).		
A substantial and measurable change in the availability or functioning of a critical process, component or service	Change to critical components, processes or services that contribute to the ecological character of the MBRS within the Project footprint and the larger Zone of Influence have been assessed within this chapter. All impacts are considered to be minor.	Unlikely	Unlikely
Permanent or long term substantial and measurable change in the water quality of the wetland	Receiving water quality modelling was carried out to assess potential impacts to water quality at the Project footprint and whole-of-Moreton Bay scales. The outcomes of the modelling indicate that: ▪ The marina and internal waterways within the Project are likely to be well flushed, and it is unlikely phytoplankton blooms or eutrophication will occur within these waterways. ▪ While there may be slight increases in the concentration of total nitrogen and phosphorous in the marina and internal waterways, these increases are very small compared to current concentrations.	Unlikely	Unlikely

EPBC Act Sig Impact Criteria	Summary of Impacts to Critical Components, Processes and Services	Potential for change in Ecological Character	Potential for significant impacts on MNES
	▪ In wet weather conditions, a reduction in the concentration of total suspended solids, total nitrogen and total nutrients in the intertidal area southwest of the ferry terminal is likely due to an increase in the proportion of treated stormwater flows. Dredge plume modelling was also carried out and indicates that dredging-related turbidity and deposition rate impacts are relatively small compared to the natural variation in the ambient turbidity and impacts are limited to the areas in close proximity to the Project footprint.		
Establishment of invasive species	Marine pests are introduced invasive, non-native plants and animals that damage the health of the native marine environment. They often reproduce quickly, in large numbers and can spread rapidly. Once established, they are difficult to eradicate and can kill or out-compete native plants and animals for space and food. Marine pests can be introduced via ballast water and hull fouling. While this risk is predominantly from vessels that have been in international waters, there is also a risk of boats spreading pests established in other ports. At Toondah Harbour, the risk from the introduction of marine pests is low, where appropriate management measures are taken.	Unlikely	Unlikely