Gladstone Ports Corporation

Growth, prosperity, community.

Long-term Maintenance Dredging Management Plan for the Port of Gladstone

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List of abbreviations and acronyms (nomenclature)	
ANC	Acid Neutralising Capacity
BIA	Biologically Important Area
BPAR	Benthic Photosynthetic Active Radiation
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CEO	Chief Executive Officer
CPM Act	*Coastal Protection and Management Act 1995* (Queensland)
CVIP	Clinton Vessel Interaction Project
DAF	Department of Agriculture and Fisheries (Queensland)
DAFF	Department of Agriculture, Fisheries and Forestry (Commonwealth) formerly Department of Agriculture, Water and Environment (Commonwealth)
DBT	Dibutyltin
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth) formerly part of the Department of Agriculture, Water and Environment (DAWE)
the Deed	Deed of Agreement relating to sea dumping of Maintenance Dredged Material at the Port of Gladstone by Gladstone Ports Corporation Limited, Commonwealth of Australia and GPC, 2015.
DES	Department of Environment and Science (Queensland)
DGPS	Differential Global Positioning System
DoEE	Department of Environment and Energy
DUKCS	Dynamic Under Keel Clearance System
EA	Environmental Authority
EBSDS	East Banks Sea Disposal Site, also known as Material Relocation Area (off-shore)
EC	Emerging Contaminants
EGM MO	Executive General Manager Marine Operations
EGM SESG	Executive General Manager Safety and ESG
EIS	Environmental Impact Study
EMP	Environmental Management Plan
EMS	Environmental Management System
EP Act	*Environment Protection Act 1994* (Queensland)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPP Water and Wetland Biodiversity	*Environment Protection Policy (Water and Wetland Biodiversity) 2019*
ERA	Environmentally Relevant Activity
ESD	Ecologically Sustainable Development
ESG	Environment, Social and Governance
EV	Environmental Value
EWMA	Exponentially Weighted Moving Average
GBR	Great Barrier Reef
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GBRWHA	Great Barrier Reef World Heritage Area
GHHP	Gladstone Healthy Harbour Partnership

List of abbreviations and acronyms (nomenclature)	
GPC	Gladstone Ports Corporation Limited
GPS	Global Positioning System
ILUA	Indigenous Land Use Agreement
IMO	International Maritime Organization
IMP	Introduced Marine Pests
LMDMP	Long-Term Maintenance Dredging Management Plan
LMDMP Guidelines	Queensland Government Guidelines for LMDMPs
London Protocol	*1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972*
LoR	Limit of Reporting
LTTMP	Long-term Maintenance Dredging Monitoring Plan
the Master Plan	Master Plan for the Priority Port of Gladstone
MBT	Monobutyltin
MD	Moderately Disturbed
MDS	Queensland Maintenance Dredging Strategy
MNES	Matters of National Environmental Significance
MRA	Material Relocation Area (off-shore), also known as East Banks Sea Disposal Site
MSES	Matters of State Environmental Significance
MSQ	Maritime Safety Queensland
NAGD	National Assessment Guidelines for Dredging
NC Act	*Nature Conservation Act 1992* (Queensland)
NEPM	National Environmental Protection Measures
NIMPIS	National Introduced Marine Pest Information System
OUV	Outstanding Universal Value
PAH	Polycyclic Aromatic Hydrocarbon
PAR	Photosynthetic Active Radiation
PASS	Potential Acid Sulfate Soils
PBPL	Port of Brisbane Pty Ltd
PCIMP	Port Curtis Integrated Monitoring Program
PFAS	per- and poly-fluoroalkyl substances
PMM	Priority Management Measure
QA	Quality Assurance
QC	Quality Control
QLD	Queensland
QPA	Queensland Ports Association
Q-SEAS	Queensland Seaports eDNA Surveillance
Reef 2050 Plan	Reef 2050 Long-Term Sustainability Plan
REMP	Receiving Environmental Management Plan
RHM	Regional Harbour Master
SAP	Sediment Analysis Plan
SARA	Queensland State Assessment and Referral Agency
Sea Dumping Act	*Environment Protection (Sea Dumping) Act 1981* (Commonwealth)
SPD Act	*Sustainable Ports Development Act 2015* (Queensland)
SPL	Strategic Port Land
SSM	Sustainable Sediment Management
TACC	Technical Advisory Consultative Committee
TBT	Tributyltin
TC	Tropical Cyclone
TECs	Threatened Ecological Communities
TI Act	*Transport Infrastructure Act 1994* (Queensland)
TMR	Department of Transport and Main Roads (Queensland)

List of abbreviations and acronyms (nomenclature)	
ToR	Terms of Reference
TPH	Total Petroleum Hydrocarbons
TSHD	Trailing Suction Hopper Dredge
TSS	Total Suspended Solids
TUMRA	Traditional Use of Marine Resource Agreement
UCL	Upper Control Limit
WICET	Wiggins Island Coal Export Terminal
WQA	Water Quality Action
WQO	Water Quality Objective

1 Introduction

Formed in 1914, Gladstone Ports Corporation (GPC) has been a vital part of the Gladstone community for a century, and the epicentre for economic growth for Central Queensland.

GPC is a Government Owned Corporation, responsible for the import of raw material and the export of finished product associated with major industries in the Central Queensland region.

GPC manage and operate four (4) Port precincts - the Port of Gladstone, Port of Rockhampton, Port of Bundaberg and Port of Maryborough. GPC play an integral role in planning the future of these Ports. In consultation with the community, industry and government, GPC undertake a strategic approach to planning, setting the vision and direction for all four (4) ports for the short and long term.

As the Authority for the Port of Gladstone, GPC's role includes:

- Facilitating appropriate levels of port security and safety with terminal operators;
- Planning, developing and operating intergenerational assets to support trade and the local, state and national populace;
- Managing tenants;
- Coordinating emergency response;
- Protecting the environment by minimising impact of development; and
- Being committed to, and having regard for the interests of the community.

Maintaining navigable port depths and pilotage is also the responsibility of GPC (GPC 2017). Channels naturally shallow over time due to siltation and sediment transport processes. Maintenance dredging involves the removal of these sediments that have built up in existing channels to maintain declared and / or design channel depths ensuring the continued efficient passage of all vessels utilising the Port.

Most ports cannot sustainably function without maintenance dredging. Maintaining navigation depths is critical to facilitate export of Queensland's (QLD's) agricultural, pastoral and mineral commodities. In addition, a range of goods on which communities rely including household goods, manufactured products, vehicles, machinery and fuel are all reliant on maintained shipping channels (TMR 2016).

This Long-term Maintenance Dredging Management Plan (LMDMP) is an integral component in GPC's commitment to create and sustain positive Environmental, Social and Governance (ESG) structures and places great value on our natural harbour and channel assets.

1.1 Objectives and Purpose

The QLD Ports Maintenance Dredging Strategy (MDS) provides a framework for sustainable, leading practice management of maintenance dredging at ports in the Great Barrier Reef World Heritage Area (GBRWHA) (TMR 2016). The objective of the framework is to ensure the ongoing protection of the Reef's Outstanding Universal Value (OUV) and the continued operating efficiency of ports within the GBRWHA. This LMDMP for the Port of Gladstone has been developed in accordance with the MDS framework (Section 1.5).

A LMDMP is used by individual ports, developed in a transparent manner and is aimed at creating a framework for continual improvement (TMR 2018a). A LMDMP is to ensure a predictable, robust long-term approach to planning, consultation, monitoring and reporting of maintenance dredging activities. The purpose of this LMDMP is to address operational needs, environmental risks, monitoring and adaptive management actions specific to the Port of Gladstone. The objective of this plan is to ensure the ongoing sustainability of maintenance dredging at the Port of Gladstone by improving whole of system understanding, the certainty of environmental outcomes and stakeholder confidence (TMR 2018a).

1.2 Scope

This LMDMP is relevant to all planned and potential maintenance dredging activities undertaken by GPC within the limits of the Port of Gladstone. This includes both the loading and dredge material placement elements of the maintenance dredging activities.

The main navigational shipping infrastructure at the Port of Gladstone typically requires maintenance dredging annually. Maintenance dredging of additional facilities such as the Gladstone Marina and Boyne River entrance are undertaken less frequently, as required.

This LMDMP has been developed to satisfy the QLD Government's Guidelines for LMDMPs (TMR 2018a) (LMDMP Guidelines) and the Commonwealth of Australia Guideline for developing Long Term Monitoring and Management Plan (DCCEEW, 2012). A LMDMP seeks to look beyond the immediate future with a focus of 10 or more years, with a continual improvement process as opportunities present nested within a minimum five (5) year review framework (Section 1.3).

1.3 Review

To facilitate the continual improvement of maintenance dredging practices that maintain and promote ecosystem health and resilience, QLD ports must review their LMDMP at least every five (5) years, and where necessary make revisions to their LMDMP to ensure they reflect the most up to date understanding of risk, sedimentation processes, options available for sediment management including re-use or relocation, and the management of any potential impacts or influence from maintenance dredging. Reviews should consider the question of whether the outcomes of managing the maintenance dredging activity are consistent with the objectives detailed in the LMDMP.

In line with the MDS Framework (TMR 2016), GPC will review maintenance dredging activities to ensure that they remain consistent with leading practice management. This process contributes to the ongoing protection of the GBRWHA and the continued operating efficiency of the Port of Gladstone. **Table 1** provides a summary of the review and improvement mechanisms that will be implemented under this LMDMP. Five (5) yearly reviews will include engagement with the Technical Advisory Consultative Committee (TACC) (Section 1.7.2) and other interested stakeholders (Section 1.7.3). GPC's continual improvement framework will also ensure that feedback received within the five (5) year time frame are considered and actioned, as appropriate.

Table 1: Review and Continual Improvement Summary

Document	Review context	Interval	Key drivers
LMDMP	Review maintenance dredging and sea placement requirements. This will take into consideration: the research and monitoring relating to the consequences of placing maintenance dredging material into the marine environment; and the possibility of avoiding or reducing the need for future placement of maintenance dredge material at sea by identifying and assessing the viability of long-term solutions and best environmental outcomes.	Every five (5) years, or as required Will be revised at the completion of the trial for the preferred option highlighted via the Sustainable Sediment Management Project (SSM Project) (Section 5.1)	Reef 2050 Long-Term Sustainability Plan 2021-25, (Commonwealth of Australia 2021) Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports (TMR 2016) Environmental Code of Practice for Dredging and Dredged Material Management (Ports Australia 2016) Guidelines for Long-term Maintenance Dredging Management Plans (TMR 2018a)

Document	Review context	Interval	Key drivers
			Long Term Monitoring and Management Plan Requirements for 10 year Permits to Dump Maintenance Dredge Material at Sea (Commonwealth of Australia 2012) National Assessment Guidelines for Dredging (Commonwealth of Australia 2009) GPC's Environmental Management System (Section 6).
LMDMP	To ensure the LMDMP reflects the most up to date understanding of risk, sedimentation processes, options available for sediment management including reuse or placement and the management of the impacts of maintenance dredging. Reviews should consider the question of whether the outcomes (of managing maintenance dredging and placement impacts) are consistent with the objectives detailed in the LMDMPs.	Every five (5) years, or as required	Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports (TMR 2016) Environmental Code of Practice for Dredging and Dredged Material Management (Ports Australia 2016) Guidelines for Long-term Maintenance Dredging Management Plans (TMR 2018a) Long Term Monitoring and Management Plan Requirements for 10 year Permits to Dump Maintenance Dredge Material at Sea (Commonwealth of Australia 2012) Checklist for Completing Long Term Monitoring and Management Plans for Dredging (Commonwealth of Australia 2012) National Assessment Guidelines for Dredging (Commonwealth of Australia 2009) GPC's Environmental Management System (Section 6).
TSHD Brisbane Schedule and Port- Specific Environmental Risk Assessment	To ensure the *Trailing Suction Hopper Dredge* (*TSHD) Brisbane's* schedule is developed to optimise environmental outcomes and operational efficiencies by: ensuring identified environmental windows as well as any restrictions imposed on permits are applied; minimising the net risk of impacts at each port by adopting site specific operating procedures and; avoiding	Every one (1) year or as required	Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports (TMR 2016). Procedure for scheduling and reporting the annual state-wide maintenance dredging program by *TSHD Brisbane* (QPA 2021) GPC's Environmental Management System (Section 6).

Document	Review context	Interval	Key drivers
	unnecessary dredger travel and relocation. In accordance with the MDS and the Queensland Ports Association (QPA) procedure, GPC will define the urgency, volume and extent of maintenance dredging required and complete a port specific environmental risk assessment for maintenance dredging.		
GPC's Environmental Management Plan (EMP)	To ensure continual improvement by updating the EMP based on the learnings of the previous campaign and ensuring that the EMP reflects the most up to date understanding of risks specific to each campaign. Reviews should consider the following: performance of the previous maintenance dredging campaign and monitoring results; the volume and extent of required maintenance dredging; an environmental risk assessment; updates to scientific research; and leading practice management and monitoring techniques.	Every one (1) year, or as required	Environmental Code of Practice for Dredging and Dredged Material Management (Ports Australia 2016) Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports (TMR 2016). Guidelines for Long-term Maintenance Dredging Management Plans (TMR 2018a) GPC's Environmental Management System (Section 6).
GPC Environmental Monitoring Procedure	To ensure that appropriate monitoring and adaptive management is in place for each campaign based on longer-term commitments made in the LMDMP and campaign specific risks and improvement opportunities identified through the EMP review process. The Monitoring Procedure outlines an adaptive management framework which ensures that risks continue to be actively managed during each campaign.	Every one (1) year, or as required	Environmental Code of Practice for Dredging and Dredged Material Management (Ports Australia 2016) Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports (TMR 2016). Guidelines for Long-term Maintenance Dredging Management Plans (TMR 2018a) GPC's Environmental Management System (Section 6).

1.4 Implementation and Release

This LMDMP will be approved by GPC's Executive General Manager Marine Operations (EGM MO) and further details of roles and responsibilities are provided in **Table 2**. GPC may seek the approval of this plan from relevant QLD and Commonwealth Government regulators to meet statutory approval requirements for management documentation.

All relevant GPC employees and contractors should be introduced to and made familiar with, the provisions of this LMDMP. This document refers to and should be read in conjunction with the relevant version of the Environmental Management Plan (EMP) and Environmental Monitoring Procedure for the maintenance dredging activity being undertaken (Section 8 and Section 9).

Following the commencement of works, significant amendments to this LMDMP that may change the environmental risk profile of the activity (Section 6) must be communicated to and re-approved by the relevant GPC employees and regulatory departments prior to the implementation of the amendments. Significant amendments will also be communicated with the TACC (Section 1.7.2).

Significant revisions requiring re-approval are to be saved as a new version and administrative revisions are to be saved as a new sub-version in GPC's document management system. Each version must be communicated to all relevant GPC employees and contractors as required and kept updated on GPC's website.

GPC will publish approved versions of the LMDMP and its associated management documents on the GPC intranet and on the internet for public access (Section 1.7.4).

1.5 Policy Context

The QLD and Commonwealth Governments developed the Reef 2050 Long-Term Sustainability Plan (Reef 2050 Plan) in response to concerns about the management of the Great Barrier Reef (GBR) by the World Heritage Committee in 2011. The Reef 2050 Plan is aimed at strengthening Australia's management of the GBR, and providing a blueprint for the continuing efforts to preserve it and its OUV (Commonwealth of Australia 2021).

The QLD Government launched the MDS for GBRWHA in 2016. This addressed requirements of Reef 2050 Plan Water Quality Action (WQA) number 16, which requires the following:

"Develop a State-wide coordinated maintenance dredging strategy which:

- *Identifies each port's historical dredging volumes and likely future requirements and limits*
- *Identifies appropriate environmental windows to avoid coral spawning, seagrass recruitment, turtle breeding and weather events*
- *Examines opportunities for the beneficial reuse of dredge material or on-land disposal from maintenance activities*
- *Establishes requirements for risk-based monitoring programs."*

The MDS presents a standardised long-term maintenance dredging management framework (MDS Framework) as per **Figure 1**.

Figure 1: MDS Framework
(Source: TMR 2016)

Principle 1 of the MDS recommends the development and implementation of LMDMPs in accordance with the MDS Framework. Action 1 of the MDS required the development of guidelines to assist each GBRWHA port in preparing a LMDMP consistent with the requirements of the QLD Government.

The LMDMP is to take into account learnings from the full cycle of the MDS Framework to determine the best way to plan and manage the port's maintenance dredging needs. Key elements from the MDS Framework should be addressed in the LMDMP, however it is not expected that all elements will be specifically covered.

A LMDMP is not a QLD statutory document and the QLD Government will not have an 'approving' role. However it is anticipated LMDMP development and the continuous improvement process they embody, will lead to greater transparency and improved environmental outcomes. Ports may use LMDMPs to support statutory processes or satisfy statutory requirements for maintenance dredging activities in consultation with the relevant QLD and Commonwealth Government regulators.

The QLD Ports Association (QPA), which GPC is a member of, will continue to support improvement by identifying and sharing best practice approaches to dredging management amongst all GBR ports.

1.6 Approvals and Statutory Obligations

The activity of dredging and the relocation or reuse of this material is subject to International agreements and a broad range of QLD and Commonwealth Government legislative requirements. This regulatory framework attempts to balance the needs of ports with economic objectives, the protection of the environment and the interests of other stakeholders (TMR 2016).

The permitting process for each activity is subject to different jurisdictional requirements by the various regulators involved, depending on the location of the activity, the way it is to be undertaken and the potential impacts associated with the activity (Section 3.3). Ports undertake a risk-based approach in managing impacts of their maintenance dredging activities in compliance with the process required by each of the regulators involved (Section 6 and Section 7).

Following regulators' assessment of the risks and impacts of a proposed activity, approvals are usually granted with conditions. Approvals typically specify details of the activity, location and volume of the material to be dredged, location of the relocation or reuse site(s), activity methodology, measures to mitigate impacts, environmental windows, environmental monitoring and reporting. Once an approval is granted, it is the responsibility of the approval holder to ensure any conditions required under the approval are incorporated into project planning and subsequent ongoing implementation of dredging activities.

Details of the specific approvals applicable to each maintenance dredging activity are included in the EMP for each maintenance dredging activity which are made available on GPC's website for the relevant period of the activity. The most common statutory processes triggered for maintenance dredging activities in the Port of Gladstone are summarised below:

1.6.1 International Agreements:

- Australia is a signatory to the ***1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972*** (London Protocol). The London Protocol is a global convention that aims to protect and preserve the marine environment from all sources of pollution and take effective measures to prevent, reduce and where practicable eliminate pollution caused by disposal or incineration of wastes at sea. Under the London Protocol, member nations may allow the dumping of certain materials in the marine environment (including dredged material) following an assessment of potential impacts and subject to certain conditions. The International Maritime Organization (IMO) hosts the

permanent Secretariat of the London Protocol and Australia reports activities involving placement of dredge material at sea to the IMO each year.

1.6.2 Commonwealth Government:

- ***The Environment Protection (Sea Dumping) Act 1981*** (Sea Dumping Act) implements Australia's obligations under the London Protocol to prevent marine pollution by dumping of wastes and other matter. Under the Sea Dumping Act, the Commonwealth Government aims to minimise pollution threats by:
    - prohibiting ocean disposal of waste considered too harmful to be released in the marine environment and;
    - regulating permitted waste disposal to ensure environmental impacts are minimised.

  Permits are required for all sea placement operations including the relocation of dredged material to approved locations at sea. Through the Sea Dumping Act, the Commonwealth Government assesses proposals, permits acceptable activities, and places conditions of approval, to mitigate and manage environmental impacts.

  This LMDMP and associated management documents may be utilised to satisfy the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) requirement for a Long Term Monitoring and Management Plan conditioned in permits issued under the Sea Dumping Act for maintenance dredging activities.
- ***The Environment Protection and Biodiversity Conservation Act 1999*** (EPBC Act) is the Commonwealth Government's central piece of environmental legislation which provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places (Matters of National Environmental Significance (MNES)).

  The EPBC Act aims to balance the protection of these crucial environmental and cultural values with our society's economic and social needs by creating a legal framework and decision making process based on the guiding principles of ecologically sustainable development.

  Under the EPBC Act, an action that is likely to have a significant impact on a MNES must be referred to the Commonwealth Government Minister for the Environment for assessment and approval. GPC undertakes assessments of potential impacts of maintenance dredging activities to determine potential impacts to sensitive receptors including those determined as MNES or Matters of State Environmental Significance (MSES). Additional maintenance dredging requirements, as a result of infrastructure projects, will be considered as part of capital dredging approval requirements.
- In addition to the above Commonwealth legislation, the Commonwealth Government has the ***National Assessment Guidelines for Dredging 2009*** (NAGD) (Commonwealth of Australia 2009). The NAGD seek to provide clear, consistent standards and criteria for assessment of dredged material, and to facilitate better decision-making by regulators, by improving the quality of information on which assessments are based.

  The NAGD are actively used by GPC and form the basis of the approvals process, particularly under the Sea Dumping Act. These require ports to demonstrate that the material to be dredged has been the subject of a detailed site-specific assessment to ensure only material considered acceptable is placed at sea.

  Importantly, opportunities for alternatives to sea placement (e.g. beneficial reuse or land based placement) must be evaluated, which includes assessment of environmental, social and economic impacts, consistent with the requirements of the London Protocol. Where appropriate alternatives exist, without undue risks to human health or the environment or disproportionate costs, these alternatives must be used. These guidelines are internationally considered to be of a world-leading standard.

1.6.3 State Government

- QLD ports are required to undertake maintenance dredging to fulfil their requirement to provide and operate effective and efficient port facilities and services under the ***Transport Infrastructure Act 1994*** (TI Act).
- The ***Sustainable Ports Development Act 2015*** (SPD Act) requires master planning of the priority Port of Gladstone. Priority port master planning is in place for PoG and takes into consideration the long-term infrastructure development of the PoG including future channel and berth development and any associated changes to maintenance dredging needs (Section 2.3.1). This is complemented by the Port overlay which regulates development by exception and operates in addition to existing planning and environmental legislative requirements, where further requirements are necessary to implement the master plan.
- The ***Coastal Protection and Management Act 1995*** (CPM Act) provides for the protection, conservation, rehabilitation and management of QLD's coastal zone, including its resources and biological diversity.
- As per the CPM Act, coastal development generally requires assessment under the ***Planning Act 2016*** (or preceding legislation) to ensure it is managed to protect and conserve environmental, social and economic coastal resources and enhance the resilience of coastal communities to coastal hazards. Maintenance occurs on existing lawful structures approved at various times over the history of development of the port under current and preceding legislation. Lawful structures include shipping channels, berth pockets and swing basins and the Material Relocation Areas (off-shore and on-shore) in the PoG.
- The ***Environmental Protection Act 1994*** (EP Act) is the key piece of environmental legislation in QLD. It provides for the protection of Queensland's environment through an integrated management program that is consistent with ecologically sustainable development. Dredging is an Environmentally Relevant Activity (ERA) regulated through the EP Act.
  This LMDMP and associated management documents may be utilised to satisfy the Queensland Department of Environment and Science's (DES') requirement for a Receiving EMP (REMP) conditioned by the Port of Gladstone Maintenance Dredging Environmental Authority (EA) issued under the EP Act.

1.7 Governance

1.7.1 Roles and Responsibilities

GPC employees and contractors are responsible for the environmental performance of their activities and compliance with approvals and statutory obligations relevant to their work (Section 1.6). **Table 2** provides a summary of the environmental responsibilities and accountabilities of GPC employees associated with the implementation of this LMDMP and maintenance dredging operations at the Port of Gladstone.

Table 2: Environmental Roles and Responsibilities

Position	Responsibility	Reporting to
Chief Executive Officer (CEO)	Ensure that systems are in place to manage environmental aspects and impacts at GPC.	GPC Board of Directors
Executive General Manager Safety and ESG (EGM SESG)	Ensure that systems are implemented to manage environmental aspects and impacts of maintenance dredging.	Chief Executive Officer (CEO)
Executive General Manager Marine Operations (EGM MO)	Responsible for all aspects of marine operations including maintenance dredging. Responsible for dredge management planning and management of the dredging contracts	Chief Executive Officer (CEO)

Position	Responsibility	Reporting to
Manager Planning Environment and Sustainability	Responsible for the provision of support services for maintenance dredging activities, to implement regulatory and internal governance requirements, including Environmental Policy, Strategy and Environmental Management System (EMS) framework and provision of Regulatory Approvals.	EGM SESG
Specialist Harbours and Channels	Implementation of this LMDMP and associated management documents. GPC contact for operational issues during dredging.	EGM MO
Environment Superintendent	Preparation and development of the LMDMP and other supporting documentation in accordance with MDS and other best practice frameworks. Ensure environmental management, monitoring, reporting and auditing responsibilities are met.	Manager Planning Environment and Sustainability
Environment Specialist	Assist development, implementation and revision of LMDMP and associated documents, review of compliance, and review of management documents (e.g. EMP).	Environment Superintendent
Environment Monitoring Specialist	Responsible for the implementation of the monitoring procedure. Coordination of environmental monitoring programs and data.	Environment Superintendent

1.7.2 Technical Advisory Consultative Committee

A TACC is an important consultative mechanism intended to ensure that interested stakeholders have a forum to understand GPC's maintenance dredging activities and to assist GPC and regulatory agencies to access local knowledge and reconcile various stakeholder interests. A TACC has been established at the Port of Gladstone in accordance with the NAGD (Commonwealth of Australia 2009) and the LMDMP guidelines (TMR 2018a).

The NAGD provides guidance on the purpose, scope and membership of a TACC. In accordance with the NAGD, a TACC is intended to:

- Provide continuity of direction and effort in protecting the local environment
- Aid communication between stakeholders and provide a forum where points of view can be discussed and conflicts resolved;
- Assist in the establishment, as appropriate, of longer term permitting arrangements, including the development and implementation of LMDMPs, research, sampling and monitoring programs;
- Review ongoing management of maintenance dredging and dredge material placement activities; and
- Make recommendations to the proponent and the regulatory agencies, as necessary or appropriate.

An effective TACC is acknowledged as best practice maintenance dredging management by the MDS. The LMDMP guidelines recognise a TACC as an appropriate mechanism for Ports to engage with

stakeholders as part of the development and oversight of LMDMPs. The ongoing role of the TACC includes:

- Review of the performance and effectiveness of dredging campaigns, consideration of key learnings and the provision of advice on whether the LMDMP requires updating, enabling ports to understand from a stakeholder's perspective how effective the options chosen were, and whether there are better ways of undertaking the activities in future;
- Participation in the updating and renewal of LMDMPs to ensure LMDMPs reflect any learnings or improvements identified during dredging campaigns; and
- Consider and respond to any concerns raised following the finalisation of LMDMPs including those raised by the general public.

TACC function and effectiveness is enhanced by transparency in their membership, their mandate, their access to information during meetings and upon request, their consensus forming and reporting mechanisms, their minutes or communiques, and by the transparency of GPC's responses to TACC recommendations. This is provided for in the TACC Terms of Reference (ToR). The ToR and minutes of TACC meetings are made available on GPC's website.

To ensure good outcomes are achieved, it is important that the members of a TACC have appropriate representation with sufficient skills and expertise. In accordance with guidance provided by the NAGD and the LMDMP guidelines, TACC membership includes QLD and Commonwealth Government regulators, non-government bodies, community members and other stakeholders.

The TACC meet at least annually have been instrumental in the development of GPC's long-term monitoring schedule (Section 9, **Table 16**). Key contributions to this program are summarised in Appendix A.

1.7.3 Independent review

At the five (5) yearly review interval, the TACC, GPC employees, relevant regulatory agencies, and other interested stakeholders will be given the opportunity to review this LMDMP. While these structured reviews are undertaken at this time period, GPC's continual improvement framework (Section 1.3) will ensure that feedback received within the five (5) year time frame are considered and actioned, as appropriate.

Through effective stakeholder engagement GPC aims to:

- Engage stakeholders in discussion regarding real, perceived or potential issues relating to port operations and development;
- Invite stakeholders to openly participate in engagement;
- Facilitate the two (2) way flow of information between GPC and stakeholders;
- Take a collaborative approach towards achieving the goal of the strategy;
- Develop and enhance partnerships with stakeholders;
- Promote transparency in our operations and development;
- Balance stakeholder and operational expectations and requirements;
- Promote continual improvement of GPC's activities; and
- Educate stakeholders about ports, their role and their required developments.

GPC's Environmental Management System (EMS) (Section 6) framework provides for auditing of this LMDMP for performance monitoring purposes by suitably qualified auditors. Auditors may be internal or external third parties.

1.7.4 Access to information

GPC will publish the current approved version of the LMDMP, EMP and Environmental Monitoring Procedure on GPC's website for public access. In accordance with Principal 16 of the MDS (TMR 2016). These include:

- The final approved versions of the relevant EMP and Environmental Monitoring Procedure (Section 8 and Section 9);
- Reports prepared in accordance with statutory approval requirements for the most recent dredging campaign;
- A copy of the most recent Sediment Analysis Plan (SAP) and implementation report;
- Other key reporting outcomes of GPC's Long-term Monitoring Schedule (Section 9, **Table 16**).

GPC facilitates meetings with the TACC where the outcomes of monitoring programs are reviewed and discussed. GPC also has a data request process established for the external dissemination of environmental validated monitoring data and reports.

Additional to any statutory requirements to report to or provide information to regulatory authorities, GPC participates in comparative analysis and coordinated maintenance dredging reporting to TMR in accordance with Principal 8 of the MDS (TMR 2016). A summary of key information and accessibility is provided in Section 11.

GPC participates in the Port Curtis Integrated Monitoring Program (PCIMP) and the Gladstone Healthy Harbour Partnership (GHHP). These programs provide ambient data sets for GPC activities in the Port of Gladstone (Section 9). Data from these programs are reported by GHHP in report cards available on their website.

2 Port Locality, Setting and Shipping

2.1 Location and Environment Setting

As a Government Owned Corporation, the Port of Gladstone is the gateway for Australian trade, jobs and prosperity, focused firmly on creating prosperity for all. The Port of Gladstone is one of Australia's finest natural deep-water harbours located 525 km north of Brisbane (Figure 2), just south of the Tropic of Capricorn at Latitude of 23°49.61'S, Longitude 151°34.6'E. It has national significance as one of the few naturally sheltered, deep water ports on the east coast of Australia.

The Port of Gladstone operates within the GBRWHA, including almost 38,600 ha of marine and intertidal environs. The Port of Gladstone is a semi-enclosed estuarine environment featuring areas of high conservation value that contribute to the local expression of the OUV of the GBRWHA (Section 3.1). Land-based and marine areas within and surrounding the Port of Gladstone include environmental values (EVs) of national and state importance, and are recognised and protected through Commonwealth and state legislation (MNES and MSES respectively).

The Port of Gladstone contains important seagrass meadows (coastal and deep water meadows), reef communities and extensive intertidal habitats (including mangroves, coastal saltmarshes and tidal estuaries). These marine and intertidal habitats support a range of marine species, including dugong, inshore dolphins, marine turtles, migratory and resident shorebirds, as well as a diverse range of fish species. A diverse range of terrestrial habitats are also present within the port area and surrounds, including inshore continental islands such as Curtis and Facing Islands, rivers and wetlands, remnant terrestrial vegetation communities, and Mount Larcom which is a prominent landform adjacent to the port area.

Figure 2: Location of the Port of Gladstone
(Source: GPC 2023)

The Central Queensland region has a sub-tropical climate with hot, moist summers and warm, dry winters. Rainfall in the region is highly seasonal, with most rain (47.4%) occurring during the summer months (December – February) (GHD 2009). Drought has occurred in the Gladstone area with high temperatures and low rainfall over the past decade.

Between 1940 and 2006, 10 tropical cyclones (TCs) passed within 100 km of Gladstone. In March 2009, TC Hamish caused the temporary closure of the Port of Gladstone (GHD 2009). Significant flood events occurred in 2010-2011 (severe TC Yasi), 2012-2013 (ex TC Oswald), 2015 (TC Marcia) and 2017 (TC Debbie).

2.2 History

GPC acknowledges the First Nation peoples Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda, Darumbal, Kabi Kabi and Butchulla whose original land we all share, live, work and play on. GPC acknowledge and pay our respect to all Elders of past, who have made the many sacrifices, contributions and paved the way for us all to be here today. GPC acknowledge our present and emerging Leaders who will continue the fight for a better and united Australia for all our generations of today, tomorrow and in the future. GPC also extend this respect to other Aboriginal, Torres Strait Islander and Australian South Sea Islander Elders and peoples within our operating footprint.

The first major wharf was built in Gladstone in 1885. The formation of the Gladstone Harbour Board occurred in 1914. The first exports through the port, included meat, butter, wool, sugar, horses and cattle. Coal was first handled at Auckland Point in 1925. During the 1950s, the port pioneered bulk coal handling in QLD.

There is a long history of dredging and dredged material beneficial reuse and placement in land-based, reclamation and at sea locations in the Port of Gladstone, with dredging for both capital and maintenance works occurring since the 1960s in response to industry demand, and to ensure the operational efficiency of the harbour.

2.3 Current and Future Use

Located 525 kilometres (km) north of Brisbane, the Port of Gladstone covers 5,408 hectares (ha) of land including seabed and reserves. There are eight main wharf centres, comprising 21 berths. The Port of Gladstone is QLD's largest multi-commodity port. The Port of Gladstone has a total throughput of more than 119.41 million tonnes per annum. This was primarily led by coal, LNG, alumina and associated products (GPC 2022).

The Port of Gladstone is internationally recognised as a major bulk port. The Port of Gladstone Marina also provides a comprehensive support base to the commercial marine industry and also offers ferry service, charter boats, island tourism and private cruising yacht moorings.

2.3.1 Key Commodities

- Coal — in 2021/22, the coal industry accounted for 55 per cent of GPC's total throughput, with total exports of 66.37Mt reflecting down 5.3 per cent on 2021/22 and 11.4 per cent under budget. The reduction in coal exports, are generally attributed to a number of COVID-19 influences, mine related supply issues including weather related disruption events.
- LNG — GPC is one of Australia's largest LNG ports. In 2021/22 GPC recorded 23.50Mt of total through put.
- Bulk liquids (not including LNG) — GPC handled a variety of bulk, liquid products during the financial year including liquefied petroleum gas, liquid ammonia, caustic soda, and sulphuric acid.
- Dry bulk (not including coal) — aluminium, alumina, bauxite, calcite, cement, grain, sugar, petroleum coke, fly ash, gypsum, limestone, silica sand, and wood pallets are among the dry bulk products handled across GPC's port precincts during 2021/22. Alumina, bauxite and associated trade account for 25.6Mt of our total throughput. Alumina trade was relatively consistent however there were some variations due to seasonal impacts and COVID-19 related influences.
- General cargo — general cargo product handled by GPC included explosives, scrap metal, heavy equipment, machinery, forestry products, and breakbulk (bagged products).

The Port of Gladstone is strategically located to capture economic growth associated with the Green Energy Hub and expansion of the resource sector, including the coal seam gas and metallurgical coal sectors. There is a significant opportunity for the Port of Gladstone to continue to develop as a logistical hub for both port and rail with the import and export of a wide variety of commodities to and from the Central Queensland region and beyond. As a result, the Port of Gladstone underpins the growth and prosperity of both the immediate Gladstone region and the broader Central Queensland region.

The Fitzroy and Central Queensland region is endowed with natural resources and significant established regional transport networks that support market access, trade and regional exports. Bowen Basin coal reserves will continue to contribute significantly to export commodities through the Port of Gladstone into 2050. Other new industries and the expansion of existing industries and associated import and export products will also contribute to the growth of the port. With a global shift away from non-renewable energy resources, the Port of Gladstone will focus on developing trade pathways for agricultural, containerised and general cargo type trades to ensure the sustainability of its operations (TMR 2018b).

2.3.2 Master Planning for the Priority Port of Gladstone

The Port of Gladstone is identified as one (1) of the five (5) priority ports under the SPD Act. These ports are the major regional bulk commodity ports operating in or adjacent to the GBRWHA. The QLD Government is undertaking master planning for the priority ports of Gladstone, Abbot Point, Townsville, and Hay Point / Mackay.

Master planning for priority ports is one of the port-related actions of the Reef 2050 Plan and is mandated under the SPD Act. Priority port master planning has a timeframe up to 2050 to align with the Reef 2050 Plan (TMR 2018b). Through port master planning, the QLD Government is seeking to effectively manage the land and marine areas needed for the efficient development and operation of the priority ports, while ensuring that the OUV of the GBRWHA is an intrinsic consideration in port development, management and governance (TMR 2018b). The QLD Government recognises the Port of Gladstone as an important economic hub that contributes significantly to regional employment opportunities. Through master planning, the government has demonstrated a commitment to support the Port of Gladstone's ongoing sustainable development and in turn, support jobs and growth in the entire region.

Master planning establishes a long-term vision for the future development of priority ports operating within the GBRWHA consistent with the principles of ecologically sustainable development (ESD). Long-term planning for priority ports will provide a strategic and coordinated approach to managing economic and EVs, including natural, cultural and social values in the GBRWHA.

Under the SPD Act, the master plan includes an environmental management framework which identifies and maps EVs, and states the objectives and measures to minimise impacts from port operations and development consistent with the principles of ESD. The implementation of the master plan will be through a port overlay, a statutory instrument required by the SPD Act which will operate in the regulatory planning framework for priority ports. The Master Plan for the Priority Port of Gladstone (the Master Plan) was released in 2018 and is available on TMR's website. The Port overlay is the regulatory instrument that implements the Master Plan under the *Sustainable Ports Development Act 2015*.

2.4 Navigational Infrastructure

There is approximately 50 km of shipping channel at the Port of Gladstone from the Fairway buoy to Fisherman's Landing with a tidal range of up to 5.1 m. The shipping channels and their design depths are provided and shown in **Figure 3**: Maintenance Dredging below. These channels provide access to the Port of Gladstone wharf centres.

There are a number of additional navigational facilities provided within the port for smaller scale private and commercial uses such as boat harbours and ramps, marinas, anchorages and river access channels. Some of these are also shown in **Figure 3**: Maintenance Dredging as they may require maintenance dredging within the currency period of this LMDMP, subject to regulatory processes.

The depths of GPC's navigational infrastructure are determined through their design and declared by the Regional Harbour Master (RHM) from Maritime Safety Queensland (MSQ) to ensure the safe and effective navigation of vessels within the port. In addition, hydrographic surveys are undertaken annually at the Port of Gladstone.

Table 3: Port of Gladstone Shipping Channels and Design Depths

(Source: TMR 2023 and GPC 2023)

Channel	Design depth (m LAT)
Outer Harbour	
Wild Cattle Cutting	-16.1
Boyne Cutting	-16.1
Golding Cutting	-16.1
Golding Bypass	-7.3
Gatcombe Channel	-16.3
Gatcombe Bypass	-12.5
Inner Harbour	
Auckland Channel	-15.8
Auckland Bypass	-6.8
Clinton Channel	-16.0
Clinton Bypass	-13.0
Targinnie Channel	-10.6
Jacobs Channel	-13.0
WICT departure channel	-16.0
Tug Base	-7.5
Marina	-5.0

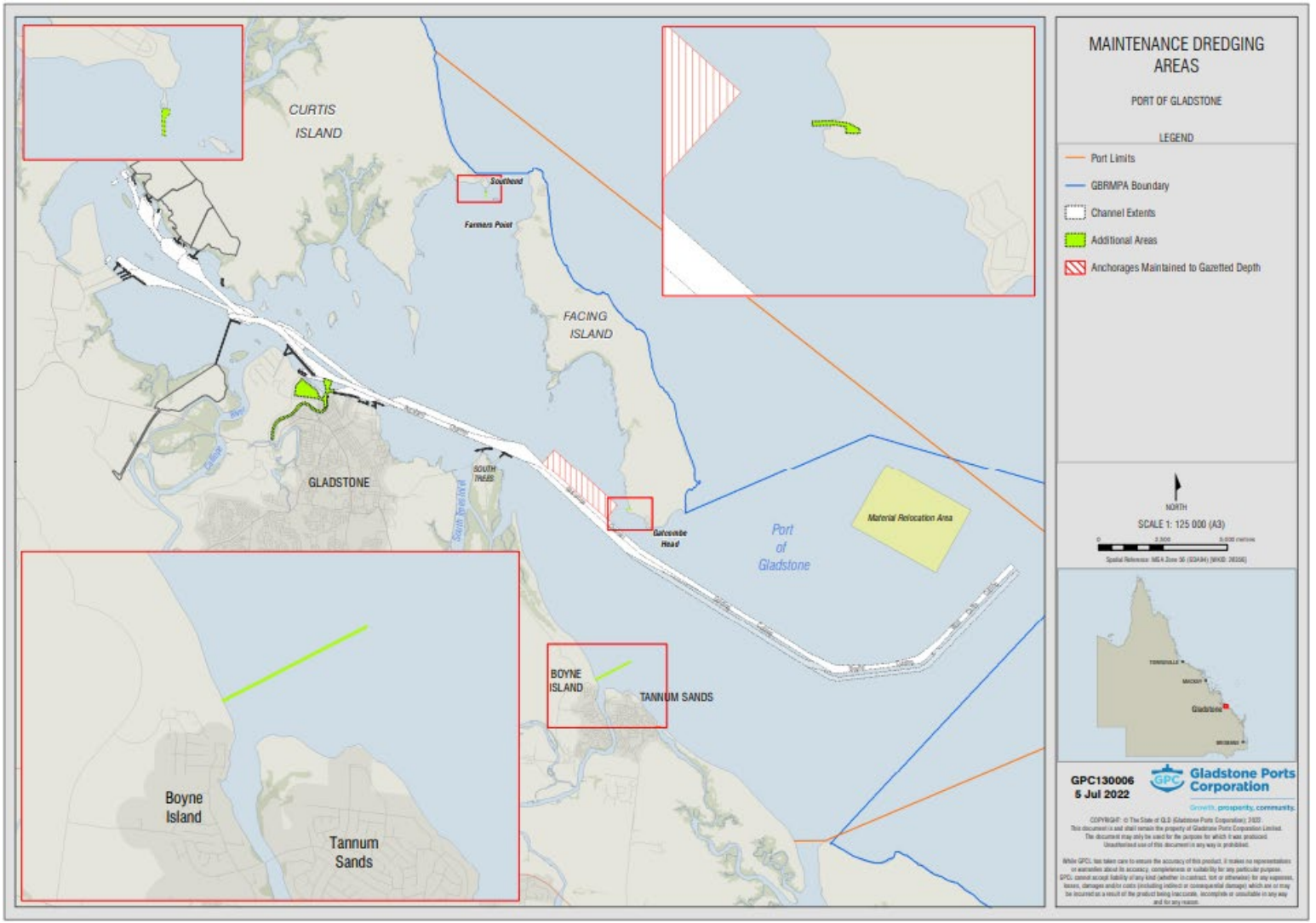

Figure 3: Maintenance Dredging Areas

3 Port Environmental Values

3.1 Great Barrier Reef World Heritage Area Outstanding Universal Value

The GBRWHA was inscribed as World Heritage in 1981 in recognition of the range of natural and cultural heritage that contributes to the OUV of the area (Commonwealth of Australia, 2014). The four (4) natural heritage criteria that the GBRWHA satisfy are: geological phenomena; ecological and biological processes; its aesthetics and natural beauty; and biological diversity, including the threatened species it supports.

The GBRWHA listing document identifies specific examples of values / attributes underpinning each criterion for OUV. Generally, the examples of values / attributes identified in the EPBC Act referral guidelines for the OUV of the GBRWHA are not location-specific and therefore, do not specifically define marine ecological values / assets supported in the Port of Gladstone.

A summary of the attributes that contribute to the local expression of the OUV of the GBRWHA, and their relative contribution to the overall value of the GBRWHA, is provided in **Table 4** and **Table 5**. Many of these EVs are MNES and MSES. Map of MSES is provided in BMT (2021) available on GPC's website and additional information is available in the Master Plan (TMR 2018b) (Section 2.3.1).

Table 4: Key local attributes and environmental values that contribute to the OUV of the GBRWHA (Source: Aurecon 2017, TMR 2018b)

Local attribute	Key environmental values
Coral reefs	**Minor contribution to the OUV of the GBRWHA** Fringing and inshore turbid reefs are present within and surrounding the master planned area, including on the seaward side of Curtis Island and Facing Island, coral reefs associated with Seal Rocks, Turtle Island Reef, Bushy Reef and Manning Reef. Several reef communities within the Port of Gladstone exist within naturally (and anthropogenically affected) high ambient turbidity conditions and light-limited environments. Coral species diversity in and surrounding the Port of Gladstone are generally limited to those coral taxa tolerant or semi-tolerant to turbid conditions such as faviids, *Turbinaria*, poritids, acropora and soft corals. These species are typical of fringing and turbid coral reefs of the southern inshore GBR.
Marine water quality	**Moderate contribution to the OUV of the GBRWHA** The marine and estuarine waters of the Port of Gladstone and surrounds are predominantly described as 'moderately disturbed' (in terms of management intent / level of protection), with the exception of the coastal waters which are described as 'slightly to moderately disturbed', and The Narrows which are of 'high ecological value'. Although the marine water quality is slightly to moderately disturbed, it is critical to support and sustain the local expression of several attributes contributing to the OUV of the GBRWHA, including reef communities, seagrass meadows, fish species diversity and habitat, marine mammals, marine turtles, migratory shorebird habitat, and the total diversity of marine life.
Fish	**Minor contribution to the OUV of the GBRWHA** The Port of Gladstone and surrounding areas provide a diversity of important fish habitat (for example reefs, mangroves, seagrass meadows). There are two (2) declared fish habitat areas adjacent to the master planned area: Dē-răl-lĭ (Calliope River) and Colosseum Inlet. Estuarine and coastal fish species are known within the Port of Gladstone, including potential habitat for conservation significant fish species. However, the Port of Gladstone is not currently recognised as critical habitat for any threatened fish species.
Marine megafauna	**Minor to significant contribution to the OUV of the GBRWHA** Dugongs, Australian humpback dolphins, and humpback whales have all been recorded within and / or surrounding the master planned area in varying numbers and often on a seasonal basis. The Port of Gladstone supports a resident population of dugong (estimated in the low hundreds). Seagrass meadows within the Port of Gladstone and surrounds provide important connectivity habitat between larger dugong habitat areas at Shoalwater Bay to the north and

Local attribute	Key environmental values
	Hervey Bay to the south. The area between Rodds Bay and The Narrows is a declared dugong protection area, in recognition of the importance of the seagrass meadows to dugong populations. The Australian humpback dolphin is known to frequent the port and is considered to be one (1) of the important locations for this species within the context of the GBRWHA. The Australian snubfin dolphin is considered unlikely to inhabit the Port of Gladstone but has been recorded around Port Alma, approximately 35 km north of the Port of Gladstone. Humpback whales and calves are known to utilise the port and surrounding offshore waters during seasonal migrations. The Port of Gladstone is not recognised as critical or protected habitat for this species.
Marine turtles	**Minor to moderate contribution to the OUV of the GBRWHA** Several marine turtle species have been recorded within the Port of Gladstone. Of these, flatback and green turtles are the most commonly recorded. Nesting beaches are present on Facing, Curtis and Wild Cattle islands, Boyne Island Beach, Hummock Hill Island and Tannum Sands, with South End Beach on Curtis Island identified as an index nesting beach. Curtis Island provides an important nesting beach for the flatback turtle, which is endemic to the east Australian continental shelf. South End beach is listed as one (1) of four (4) key rookeries for this species.
Seagrass and macroalgae	**Minor to moderate contribution to the OUV of the GBRWHA** Coastal and deep water seagrass meadows are present within the Port of Gladstone, representing seven (7) different species of seagrass. Seagrass meadows in the region are ephemeral and changes in seagrass abundance, species composition and biomass will occur over different seasons. Key seagrass meadows are located at Pelican Banks, Pelican Banks, Facing Island and Quoin Island. Seagrass and macroalgae, including beds of *Halimeda* algae, provide important habitat for a range of marine fauna in the Port of Gladstone, including dugong, inshore dolphins, marine turtles and fish species.
Shorebirds and migratory birds	**Minor to significant contribution to the OUV of the GBRWHA** The Port of Gladstone contains large areas of potential habitat for both resident and migratory shorebirds, including foraging and roosting habitat in intertidal and subtidal areas along the coastline. There are several important roost sites within the Port of Gladstone (which vary from year to year), including the Kangaroo Island wetland and important shorebird roosting habitat at Friend Point, North Passage and South Passage islands, Boyne Island Beach, shorebird habitat associated with Curtis Island, Facing Island and the other inshore islands. Several threatened migratory shorebirds are known to frequent the area. Marine waters within the Port of Gladstone provide potential foraging habitat for a range of migratory seabirds, however the area is not recognised as critical habitat for seabirds. No breeding habitat for migratory shorebirds or seabirds is present within the Port of Gladstone or surrounds.
Flora, fauna and ecological communities	**Minor to moderate contribution to the OUV of the GBRWHA** Several conservation significant flora and fauna species are known or highly likely to occur within the Port of Gladstone. These species are known from terrestrial, intertidal and marine habitats. Key conservation significant species occurring or potentially occurring in the master planned area and surrounds include: water mouse (*Xeromys myoides*), yellow chat (*Epthianura crocea macgregori*), cassowary (*Casuarius johnsonii*), and quassia (*Samadera bidwillii*). All of these species are listed under the provisions of the EPBC Act and / or the *Nature Conservation Act 1992* (NC Act). Three (3) threatened ecologically communities (TECs) are present within and surrounding the Port of Gladstone and are associated with intertidal areas, coastal dunes and watercourses. The Subtropical and Temperate Coastal Saltmarsh TEC covers the largest area (approximately 2282 ha within the port), and is associated with intertidal areas, often in areas adjacent to mangrove communities. This community is listed as vulnerable under the provisions of the EPBC Act. Intact, remnant mangrove forests are important habitats and ecosystems within the Port of Gladstone, with key forests located in The Narrows, along the coastline between Fisherman's Landing and Wiggins Island, South Trees Inlet, Boyne Island Beach, and along the coastline of the continental islands. The Port of Gladstone supports a diverse range of mangrove species, with 13 species recorded within the Port.

Local attribute	Key environmental values
Continental islands	**Moderate to significant contribution to the OUV of the GBRWHA** There are a number of continental islands within the Port of Gladstone, including Curtis and Facing islands, and several smaller inshore islands such as Quoin, Compigne, Turtle, Diamantina, Witt, Tide, Picnic, She Oak, Rat and Garden islands, and Bushy Islet. Curtis Island is the largest continental island in the GBRWHA (by land area) and is recognised as having high terrestrial flora species diversity with more than 500 species. Curtis Island is important as it contains a high level of flora species diversity, and represents a key example of the unique island vegetation communities on islands in the GBRWHA. Other islands in the Port of Gladstone and surrounds are likely to support the similar floristically diverse communities, however there is limited available and relevant information for these islands. The continental islands also provide unique habitats within the Port of Gladstone, such as beaches, cliff and shoreline platforms, beach ridges, swale systems, parabolic dunes and coral reef platforms.
Geomorphology	**Minor contribution to the OUV of the GBRWHA** Features such as beaches, dune systems, and river deltas are important geological features within the Port of Gladstone and surrounds. The Narrows is a key example of cross-shelf connectivity. It is one (1) of only four (4) tidal passages in Australia and separates Curtis Island from the mainland. The only other tidal passage in the GBRWHA is the Hinchinbrook Channel (approximately 800 km north of Gladstone). The parabolic dunes near Cape Capricorn on Curtis Island are viewed as regionally significant examples of landscape formation and evolution and include a natural sand blow at Yellow Patch (north eastern Curtis Island). Marine tidal sand deltas at the mouth of the Boyne River and Colosseum Inlet are local examples of the fine sediments transported along the coast by longshore drift, and deposited at the mouth of estuaries.
Cultural heritage	**Moderate contribution to the OUV of the GBRWHA** The Port of Gladstone and surrounds contain a number of culturally significant sites, and provide access to areas enabling traditional Aboriginal use of land and sea. There may also be other sites not yet recorded. The Bailai, Gurang, Gooreng Gooreng and Taribelang Bunda Peoples have native title of lands and islands in the Port of Gladstone. Additionally, they have formalised their aspirations for sea and country through entering into a Traditional Use of Marine Resource Agreement (TUMRA) which encompasses the master planned area, as well as the Capricorn-Bunker Group of reefs, cays and islands.
Marine fauna	**Minor to moderate contribution to the OUV of the GBRWHA** A diverse range of marine fauna species occur in the Port of Gladstone and surrounds, including marine mammals, marine turtles, and estuarine and reef fish communities. A range of habitats support the diversity of marine species present, including seagrass meadows, reefs, soft sediment habitats, mangrove communities, estuaries, deep water habitats and intertidal areas.
Total species diversity	**Moderate contribution to the OUV of the GBRWHA** Diversity of available habitat types contribute to the diversity of marine species within the Port of Gladstone and surrounds. Marine habitat areas include coral reefs, seagrass meadows, mangrove communities, hard and soft benthic substrates and beach habitats. Although the marine habitats within the Port of Gladstone are not considered to be individually unique in the context of the whole GBRWHA, they do collectively represent a unique inshore system, supporting fauna species considered to significantly contribute to the OUV of the GBRWHA (that is, dolphins and migratory shorebird species).

Separate to the OUV of the GBRWHA, there are a number of other EVs within the Port. **Table 5** summarises the other EVs within and surrounding the Port that do not contribute to the OUV of the GBRWHA.

Table 5: Other Values Within and Surrounding the Port
(Source: Aurecon 2017)

Environmental value	Description
Water quality	Sources of fresh water and groundwater, their quality and the ecosystem services they support (e.g. watercourses providing habitat for flora and fauna species).
Terrestrial flora and fauna Intertidal flora and fauna Marine flora and fauna	Flora and fauna species and ecological communities not contained within the GBRWHA or not considered to contribute to the OUV of the GBRWHA (e.g. vegetation communities or fauna habitat located outside of the GBR coastal zone, such as flora and fauna habitat within the Aldoga area).
Protected areas	A range of protected areas (e.g. National Parks and Conservation Parks) are present within the area as listed under the provisions of Commonwealth and state legislation.
Heritage properties	World, Commonwealth and National Heritage Places. State and local heritage places.
Social	Community infrastructure and facilities, local workforce, housing and accommodation.
Recreational opportunities and natural scenic amenity	Areas utilised for conservation, environmental management, tourism, open space, and sport and recreational uses. Also includes areas that provide natural scenic amenity.
Cultural heritage	GPC has an Indigenous Land Use Agreement (ILUA) with the First Nations Bailai, Gurang, Gooreng, Taribelang Bunda People Aboriginal Corporation, as the traditional owners of the lands and waters where GPC undertakes its operations within the meaning of the *Native Title Act 1993*. The Port of Gladstone is located on the lands of the First Nations Bailai, Gurang, Gooreng, Taribelang Bunda People The First Nations people monitor the culturally significant wetlands surrounding the Port of Gladstone. Significant cultural sites are located on GPC-owned land and within the vicinity of the port.
Commercial value	Additional commercial opportunities including commercial fishing, tourism and maritime industries.

3.2 Community Environmental Values

In QLD, EVs and Water Quality Objectives (WQOs) are established under the *Environment Protection Policy (Water and Wetland Biodiversity) 2019* (EPP Water and Wetland Biodiversity) which is subordinate legislation under the EP Act. An EV is the value placed on a waterbody by the community. EVs are essentially the goals that the community wants to achieve for their waterways. WQOs are based on local historic data, the condition of the waterway, and are developed in close consultation with the local community in order to protect the relevant EVs. The water quality objectives have been refined from national and state water quality guidelines. EVs relating to main maintenance dredging regions within the Port of Gladstone are summarised in

Table 6. The EPP Water and Wetland Biodiversity describes all of the Port of Gladstone regions listed in the tables below as being moderately disturbed (MD) waters (State of Queensland 2014b).

Table 6: Relevant EVs in the Port of Gladstone
(Source: BMT WBM 2017, State of Queensland 2014b)

Port of Gladstone (model output points)	Aquatic ecosystems	Irrigation	Farm Supply / use	Stock water	Aquaculture	Human consumer	Primary recreation #	Secondary recreation #	Visual recreation	Drinking water ^	Industrial use	Cultural and spiritual values
Western Basin inc. Boat Ck and Lower Calliope – MD2421 (1, 2, 3, 4, 10)	✓					✓		✓	✓		✓	✓
Inner Harbour inc. Auckland Inlet – MD2422 (5, 6, 7)	✓					✓	✓	✓	✓	✓	✓	✓
Mid Harbour inc. Lower Boyne – MD2423 (8, 9)	✓					✓	✓	✓	✓	✓	✓	✓
Outer Harbour inc. MRA – MD2424	✓					✓	✓	✓	✓	✓	✓	✓

MD = moderately disturbed waters as per EPP Water and Wetland Biodiversity, number is location designation
# The selection of recreation EVs for waters does not mean that these waters are free of dangerous aquatic organisms, for example venomous organisms (e.g. marine stingers including box jellyfish, Irukandji jellyfish), crocodiles and sharks. Direct contact with dangerous aquatic organisms should be avoided. Refer to DES CrocWatch, council, www.health.qld.gov.au, www.beachsafe.org.au, www.marinestingers.com.au and other information sources for further details on swimming safety and information on specific waters.
^ Waters in which desalination for drinking water may apply.

3.3 Impact Assessment

To determine the sensitive receptors relevant to annual maintenance dredging activities, impact assessments are undertaken in relation to the dredging footprint, adjacent to the dredging footprint and Material Relocation Area (MRA) to determine the possible Zones of Impact and Influence associated with the activity. Impact assessments include desktop assessments involving the review and analysis of existing information, as well as hydrodynamic modelling.

A summary of the model validation process that has been undertaken by GPC to date is provided in Appendix B.

GPC commissioned BMT to undertake the most recent impact assessment for maintenance dredging at the Port of Gladstone in 2021. The aim of the assessment was to evaluate the effects of maintenance dredged areas within the Port of Gladstone, including newly created dredged areas in the Clinton Vessel Interaction Project (CVIP) channel footprint. The assessment will also assist the review of GPC's monitoring framework used to test impact hypotheses and predictions (Section 9).

A summary of the key findings of this assessment is provided in the sub sections below. A copy of the full report is available on GPC's website. The report also provides detailed information about the key EVs that are relevant to maintenance dredging activities (Section 3). The most significant receptors that are sensitive to the effects of this annual dredging are seagrass meadows and reef habitats and their communities. Their significance relates to the fact that they support diverse flora and fauna communities and habitat for threatened and listed migratory marine species and species of fisheries significance.

3.3.1 Modelling Results

In this section, the modelling results for a simulated 340,000 m^3 maintenance dredging campaign in the main channels and dredge material placement at sea at the MRA also known as East Banks Sea Disposal Site (EBSDS) **(Figure 3)** are analysed and discussed as this is the largest campaign that will be potentially undertaken under this LMDMP. All of the volumes modelled by BMT (2021) are displayed below in **Table 7**.

Table 7: Simulated Maintenance Dredging Campaigns
(BMT 2021)

Simulation	Volume (m^3)	Duration
1	260,000	5.3 weeks
2	340,000	6.8 weeks

The modelled impacts to the 50th and 95th percentile turbidity for a simulated 340,000 m^3 maintenance dredging campaign are shown in **Figure 4**. Sustained increases to the turbidity are only significant in the vicinity of the LNG terminals on Curtis Island (Jacobs Channel). This was similar to the other modelled campaign (260,000 m^3). Short-term increases in the turbidity are noted in both Jacobs Channel, in the vicinity of the MRA and the outer parts of the shipping channel. These were more extensive than the 260,000 m^3 campaign. The modelled impacts to the deposition rate percentiles for the 340,000 m^3 campaign are shown in **Figure 5**. The modelled increases are very similar for both campaigns, with slightly more extensive deposition rate increases near the MRA for the larger campaign.

3.3.1.1 Threshold Values and Zones of Influence and Impact

As the long-term data shows variability in turbidity among sites during the same time period, site-specific thresholds were derived which reflect the natural variability of the turbidity in that location.
To determine initial impact threshold values, a 13-month baseline water quality monitoring dataset, collected as part of the Gatcombe and Golding Cutting Channel Duplication Project Environmental Impact Study (EIS), was analysed and percentile curves were produced. These percentile curves provide an indication of magnitude of turbidity and combined duration / frequency metrics for a range of conditions. Threshold values were derived from these percentile curves based on the natural variability around the 50th percentile (average conditions), 20th percentile (good conditions – neap tides / low winds and waves) and the 80th percentile (poor conditions – spring tides / moderate to high wind and waves). Therefore, this method considers both short term and sustained impacts.

The modelled impacts to the turbidity were compared to these threshold values to assess the potential impacts to marine water quality and ecologically sensitive areas and to define the bounds of the following impact severity zones. These are presented as Zones of Impact, in accordance with standard industry practice such as the WA EPA (2016) dredging environmental assessment guidelines. Four (4) zones were defined in accordance with WA EPA (2016). A description of the threshold values for the three (3) zones of impact and how they relate to the natural variability is provided in **Table 8**. The Zones of Impact and Influence for the 340,000 m^3 campaign are shown in **Figure 6**.

3.3.1.2 Results

The Zone of Influence and Impact for each campaign was calculated according to the methodology outlined in BMT (2021). Apart from the area of direct impact (within the channels where dredging occurs), there was no Zone of Impact for either modelled campaign. The Zone of Influence was very similar in extent for both campaigns (since there is no cumulative build-up of sediment between dredging runs) and therefore a single Zone of Influence for both campaigns is provided in Figure 6. The Zone of Influence (the area where plumes are expected to have a measurable effect on the turbidity statistics, but cause no ecological impact) is limited to areas near the LNG facilities on Curtis Island (Jacobs Channel), a small area between the Clinton Channel and Clinton Bypass, and a very small area adjacent to the MRA. This is consistent with the results of the previous assessment (BMT WBM 2017a).

Time series of dredging-related changes to turbidity and deposition rate determined that the deposition rate is very small at all of the output locations.

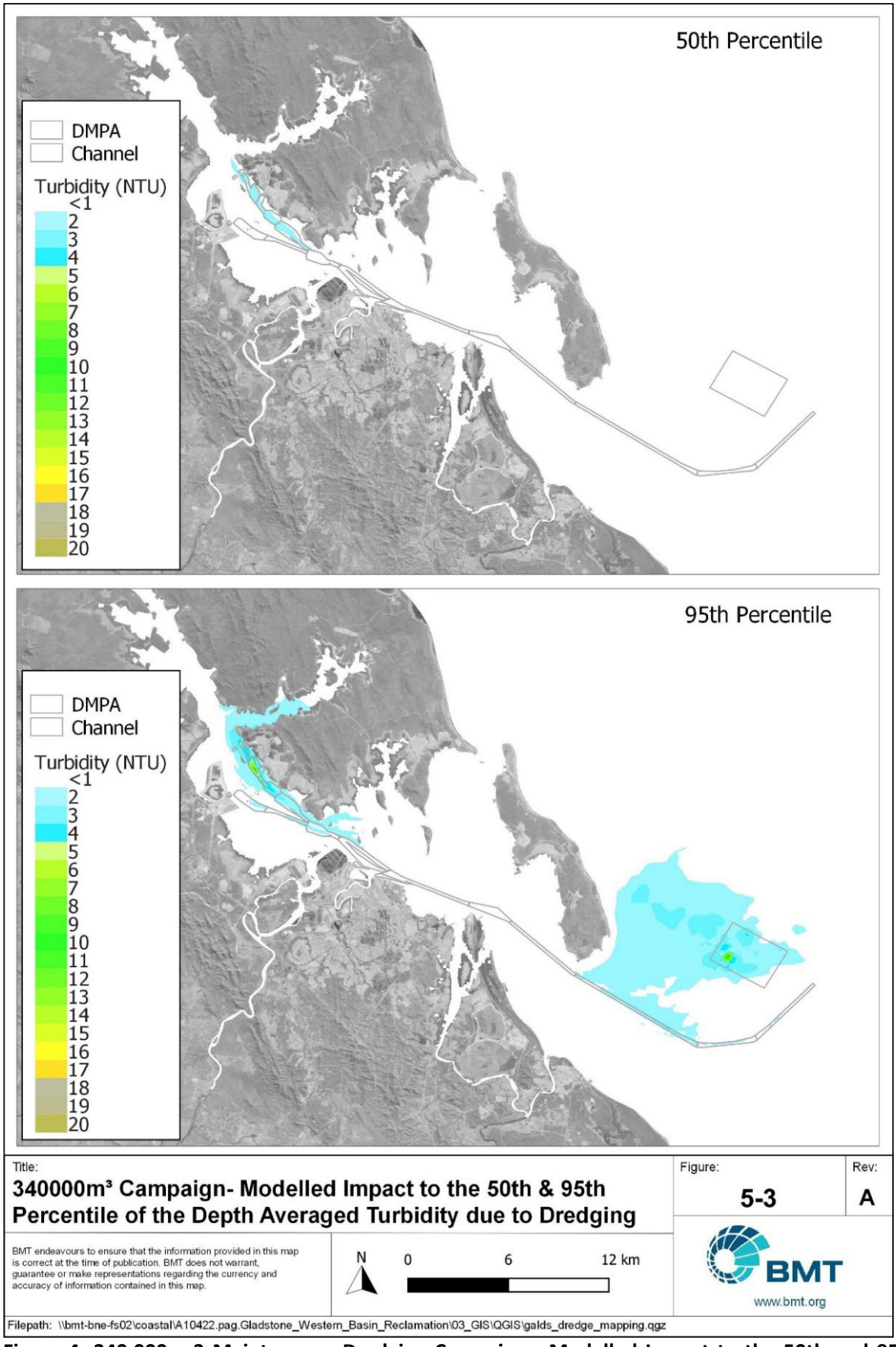

Figure 4: 340,000 m3 Maintenance Dredging Campaign - Modelled Impact to the 50th and 95th Percentiles of the Modelled Depth Average Turbidity due to Dredging

(Source: BMT 2021)

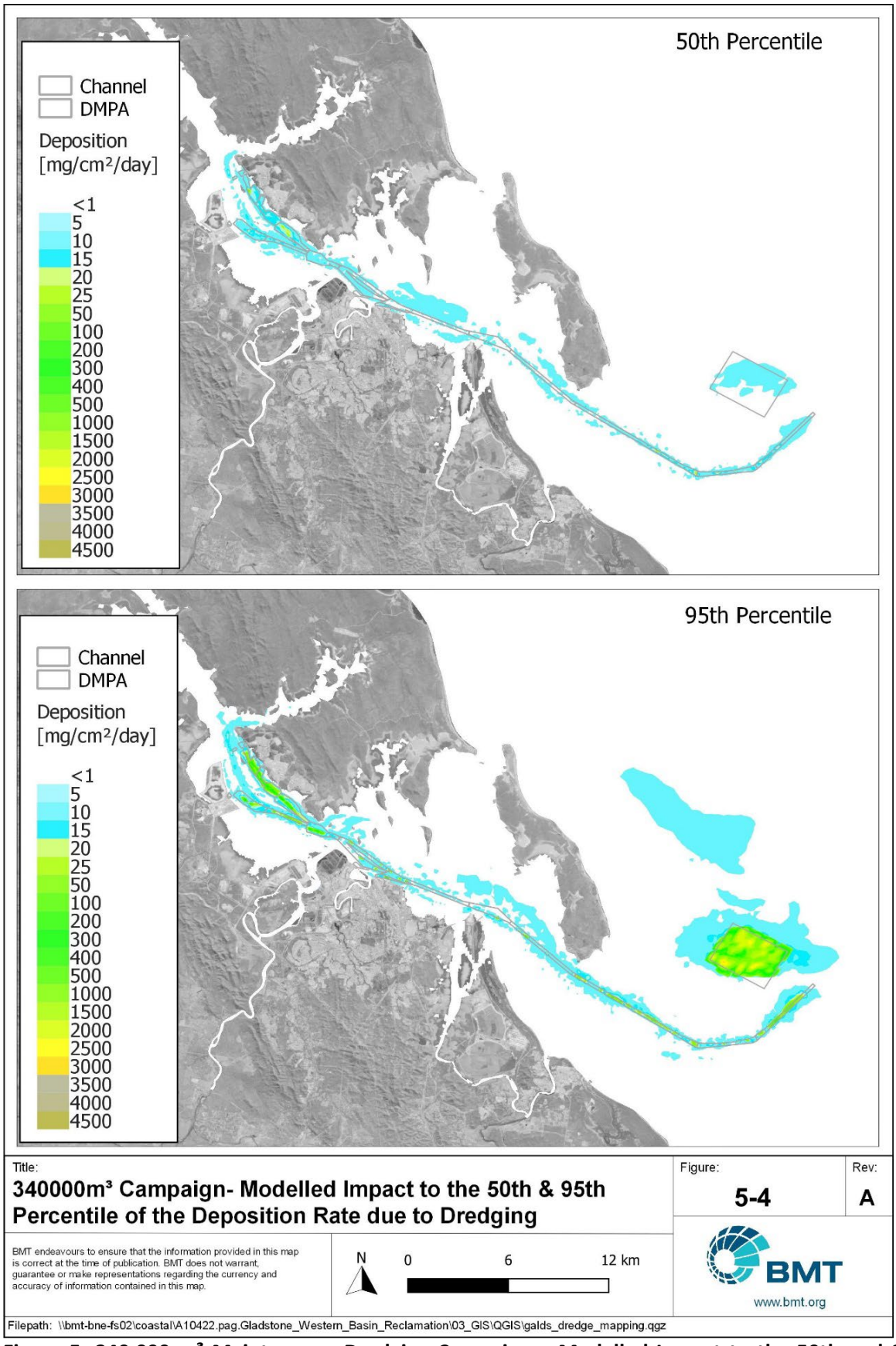

Figure 5: 340,000 m³ Maintenance Dredging Campaign – Modelled Impact to the 50th and 95th Percentiles of the Deposition Rate due to Dredging

(Source: BMT 2021)

Table 8: Description of Threshold Values

(Source: BMT 2021)

Impact Zone	Referential (Water Quality)
Zone of High Impact	Excess turbidity most likely to cause total turbidity to go beyond natural variation Threshold value = excess turbidity greater than three (3) standard deviations from the natural background mean
Zone of Moderate Impact	Excess turbidity likely to push total turbidity beyond natural variation Threshold value = excess turbidity greater than two (2) standard deviations from the natural background mean
Zone of Low Impact	Excess turbidity may push total turbidity beyond natural variation Threshold value = excess turbidity greater than one standard deviation from the natural background mean
Zone of Influence	Extent of detectable plume (as measured by instrumentation) but no predicted ecological impacts Turbidity related to dredging activities exceeds: - 0.5 NTU above 50th percentile conditions - 2 NTU above 80th percentile conditions - 5 NTU above 95th percentile conditions - 10 NTU above 99th percentile conditions

3.3.2 Other Water Quality Parameters

The effect of maintenance dredging and disposal on other water quality parameters was considered based on a review of previous water quality monitoring programs (BMT WBM 2017; BMT 2021). Overall, monitoring results suggest that nutrients, chlorophyll-a, metals / metalloids and other physio-chemical parameters (including pH, dissolved oxygen) in dredge plumes represent a low environmental risk.

3.3.3 Ecological Implications

Table 9 summarises marine communities in the dredging and MRA footprint and immediate surrounds (project area), and key impact pathways.

Table 9: Marine Communities in the Dredge Placement Footprint and Immediate Surrounds and Potential Impact Pathways

(Source: BMT 2021)

Communities	Direct effects	Indirect effects
Soft-sediment benthic invertebrates	• extraction of benthos living in the channel • smothering of benthos at the placement site	• physiological impairment by sediment • liberation of nutrients and food resources at the dredge and placement sites
Plankton and nekton in the water column	• potential fauna injury by the dredge head • entrainment of plankton and small fish in the dredge	• physiological impairment by sediment • liberation of nutrients resulting in increased algal production
Seagrass	• smothering of seagrass at the placement site	• reduced light resulting in impaired energy production and growth

Communities	Direct effects	Indirect effects
Reef communities	• not applicable (outside impact footprint)	• physiological impairment by sediment • reduced light resulting in impaired energy production and growth

3.3.4 Direct Effects

3.3.4.1 Benthic Flora and Fauna in the Dredge Footprint

Dredge material deposition can affect benthic flora and fauna through smothering, contamination and changes to sediment condition resulting in reduced diversity, abundance and altered species composition (Bolam et al. 2016; Do et al. 2012). The dredger will extract benthic fauna from the dredge areas. The fate of fauna extracted by the dredger is unknown, although it is possible that some surviving fauna may colonise the MRA. Benthic fauna will begin to recolonise the dredge areas shortly after dredging is completed. The dredge areas are regularly disturbed by maintenance dredging and in some areas propeller wash. Benthic communities in affected areas therefore remain in a state of flux, resulting in localised changes to community structure.

Benthos at the MRA could be smothered by dredged material disposal. Monitoring of benthic communities within and adjacent to the MRA by BMT WBM (2012b) indicate benthic macroinvertebrate communities are resilient to changes associated with maintenance material placement, and the long history of dredged material placement activities has created a change in community structure within and adjacent to the MRA. Within the MRA sediments are coarser and support more attached sessile forms, while adjacent communities are dominated by deposit feeders over softer sediments.

No seagrass meadows, reef-building coral assemblages, macroalgae beds or mangroves occur in the dredge footprint.

3.3.4.2 Marine Megafauna Interaction

Marine animals that swim near the water surface, such as whales, dolphins, dugongs and turtles, could interact with the dredger. A dredger is slow-moving, which would provide marine fauna time to evade the approaching vessel. Turtles are also highly mobile and will tend to avoid the dredger. When active, sea turtles must swim to the ocean surface to breathe every few minutes, however, they can remain underwater for as long as two (2) hours without breathing when they are resting. There are recorded incidences of turtles being killed or injured by trailer suction hopper dredgers. Cutter suction and back-hoe dredgers pose a low risk to turtles as they do not have trailing suction dragheads (Dickerson et al. 2004).

The TSHD Brisbane, undertaking maintenance dredging in Gladstone, has reported capturing five (5) turtles in the 10-year period between 2005 and 2015 (Haskoning Australia 2016). No turtle strikes have been recorded in the Port of Gladstone since 2015, during maintenance dredging activities.

Given the relatively low numbers of turtles captured by dredgers compared to other activities, and the use of effective management and operational practices to reduce the potential for turtle capture, it is not considered that the proposed dredging will have a significant impact on turtle populations in the study area. Direct effects of loading (dredger interaction) will be mitigated using existing practices aboard the TSHD Brisbane as a part of their EMP and in accordance with GPC's permit conditions and adaptive monitoring and management framework.

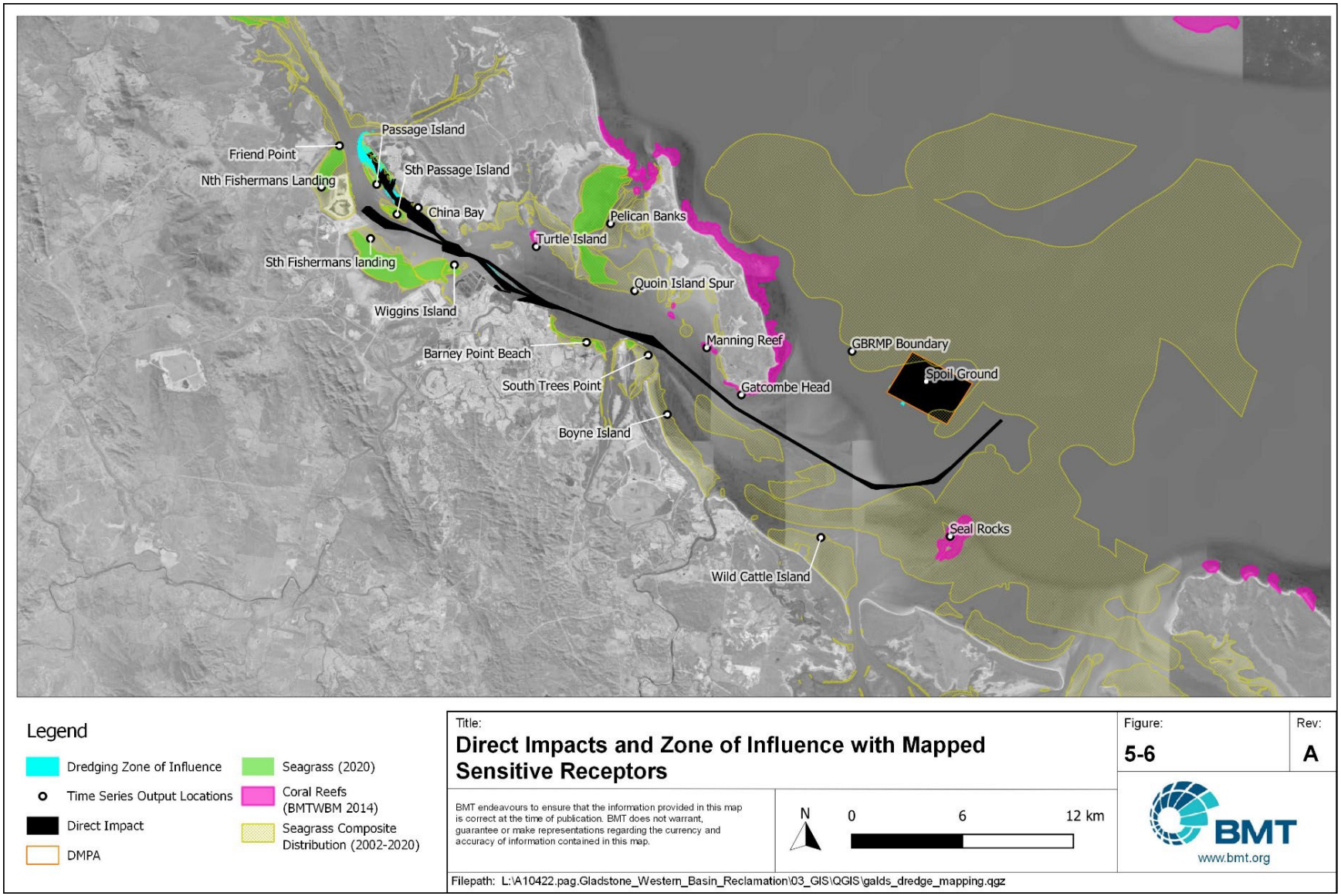

Figure 6: Zone of Impact and Zone of Influence for 340,000 m3 Maintenance Dredging Campaign

(Source: BMT 2021)

3.3.5 Direct Effects

3.3.5.1 Nutrients and Algae

The 2021 maintenance dredging environment impact assessment (BMT 2021) describes the effects of maintenance dredging and placement on nutrient concentrations and algae biomass (chlorophyll-a) in the water column. The dredge and disposal scenarios considered in the present study (2021) are expected to result in similar effects to the previous study conducted in 2017. The results indicated that most nitrogen and phosphorus in dredge plumes was particulate-bound forms contained in organic matter. While the present study (2021) represents a snap-shot and was replicated in time and space, the data shows that nutrients in plumes generated by dredging and disposal did not persist for more than one (1) hour.

The study found that overall, these monitoring results suggest that nutrients, chlorophyll- a, metals / metalloids and other physio-chemical parameters (including pH, dissolved oxygen) in dredge plumes represent a low environmental risk (BMT 2021).

3.3.5.2 Sediment Impacts to Soft Sediment Benthos

Soft sediment benthos occurs within the Zone of Impact, and may be indirectly affected by dredging as a result of:

- Increasing food resources availability in the form of suspended sediments and benthic fauna;
- Increasing sediment deposition levels, resulting in burial of sessile fauna; and
- Increasing suspended sediment concentrations causing the interference or blocking of respiratory and feeding structures.

There is a lack of information on critical levels of sedimentation or suspended sediment concentrations that would result in smothering, clogging of the filtering apparatus or other deleterious effects to benthic macroinvertebrates. The benthic macroinvertebrate communities regularly experience total suspended sediment (TSS) concentrations greater than 70 mg/L, and it is therefore unlikely that species that are highly sensitive to sediment loading would occur here. Previous investigations demonstrate that dredged material placed at the existing offshore EBSDS rapidly settles and tends to have little short-term effect on areas outside the EBSDS (BMT WBM 2012a).

The effect of placement within the EBSDS is heavily dependent on the volume of material relocated. The 2011 macrobenthic monitoring campaign was demonstrated that while placement effects were benign after disposal of 126,000 m3 of maintenance material, the placement of 600,000 m3 of capital material resulted in markedly decreased abundance and richness (BMT WBM 2012a). Previous investigations demonstrate that dredged material placed at the existing offshore MRA rapidly settles and tends to have little short-term effect on areas outside the MRA (BMT WBM 2012a).

Therefore, future campaigns are likely to result in similar effects on the EBSDS and surrounding soft sediment to what has been observed previously (assuming “clean” material continues to be placed, and that these effects are largely related to physical burial) (BMT 2021).

3.3.5.3 Sediment Impacts to Seagrass and Reefs

As discussed in Section 3.3.4.1, no seagrass meadows or reefs occur in the Zone of Impact. The Zone of Influence extends to a mapped seagrass meadow at Passage Island in the Western Basin (**Figure 6**). By definition, impacts to seagrass and other sensitive receptors are not expected to occur in the Zone of Influence although a visible plume may be present. While impacts to these (and other) seagrass meadows are not expected, an adaptive monitoring framework (Section 9) will be followed to manage unanticipated dredge plume risks.

The Zone of Impact and Zone of Influence for turbidity do not extend to fringing / coral reefs. Impacts to these communities due to dredging-related turbidity are therefore not expected. Analysis of the time series of deposition rate (Section 3.3.4.1) indicates that the dredging-related contribution to the total deposition rate at reef sites is very low, and therefore there are not expected to be any impacts to these communities due to dredging-related increases to sediment deposition.

3.3.5.4 Sediment Impacts to Fish and Shellfish

Fish and invertebrates that inhabit Port Curtis regularly experience periods of tidally driven turbidity. Fish have a lateral line system that it used to detect prey, which allow many fish species to feed in highly turbid waters. However, physiological effects to fish can occur at very high suspended sediment concentrations. For example, Jenkins and McKinnon (2006) suggested that TSS concentrations of 4,000 mg/L could block gills, eventuating in fish mortality. There are very few documented cases of fish kills resulting solely from turbid plumes, and predicted TSS levels are not predicted to approach these levels.

Prawns and portunid (mud and sand) crabs represent key species of commercial significance, and utilise both nearshore and offshore waters (including parts of the study area) as part of their lifecycle. These species primarily inhabit turbid water environments, and are tolerant of a wide range of turbidity conditions. These species are also highly mobile and actively burrow into soft sediments, and are therefore tolerant of high rates of sediment burial. Therefore, indirect impacts to prawns and crabs as a result of high suspended sediment concentrations and sedimentation from maintenance dredging are not expected.

3.3.5.5 Sediment Impacts to Marine Megafauna

The highest recorded stranding rates for turtles and dugongs were documented 2011 and 2012 across the entire Queensland coast, as a result of habitat loss (seagrass) associated with flooding, high turbidity and low visibility. These conditions make fauna more susceptible to starvation and boat strike.

Maintenance dredging plumes are not expected to significantly impact on seagrass meadows or reef communities (Section 3.3.5.3), nor are major changes to benthic macroinvertebrate communities expected. It is therefore highly unlikely that dredging would result in a loss of food resource availability to the extent where flow-on effects to turtles and dugong would occur.

The sediment plumes created by dredging will temporarily reduce visibility. The dolphin species found in the study area are capable of successfully foraging in turbid waters. Dolphins often stir up bed sediments when foraging for benthic prey, resulting in limited to no visibility for prey detection. It is thought that dolphins detect prey using echolocation rather than visual cues (Mustoe 2006, 2008). Dugongs have poorly developed eyesight and rely on bristles on their upper lip, rather than visual cues, to detect seagrass food resources. Therefore, high suspended solid concentrations generated by dredging and dredged material placement are not expected to adversely affect foraging success for cetaceans or dugongs. Sea turtles generally have good eyesight and rely on visual and olfactory cues to detect prey and other food resources (e.g. Swimmer et al. 2005). Flatback turtles are known to feed in turbid shallow waters (Robins 1995) and may not be directly affected by turbid plumes generated by dredging. Other species such as the green turtle, which is common in the Port of Gladstone, feed on seagrass and / or in reef environments, may avoid areas affected by turbid plumes. It is noted however that the key feeding areas for these species are not predicted to be exposed to highly turbid dredge plumes.

3.3.6 Summary of potential impacts to Matters of National and State Environmental Significance

MNES and MSES relevant to maintenance dredging are described in BMT (2021) available on GPC's website and are summarised below. Overall, it is expected that maintenance dredging does not lead to significant impacts to MNES or MSES, especially with the application of appropriate management strategies (Sections 6 - 9).

3.3.6.1 Matters of National Environmental Significance

- **Threatened Ecological Communities (TECs):** No TECs occur in marine waters within the vicinity of the Port (i.e. no exposure). No impacts to these communities will occur as a result of maintenance dredging;
- **Critically Endangered and Endangered Species:** Based on criteria outlined in BMT 2021, no significant impacts are expected to occur to the Critically Endangered or Endangered Species known to, or likely to occur, within the vicinity of the port;
- **Vulnerable Species:** Based on criteria outlined in BMT 2021, no significant impacts are expected to occur to the, vulnerable species known to, or likely to occur, within the vicinity of the port; and
- **Listed migratory species:** Based on the impact significance criteria outlined in BMT 2021, no significant impacts are expected to occur to migratory species known to, or likely to occur, within the vicinity of the port (excluding threatened migratory species described elsewhere).

3.3.6.2 Matters of State Environmental Significance

- **Wetlands and Watercourses:** Seagrass meadows are listed as wetlands of high ecological significance and offsets may be required if dredging is deemed to have significant residual impact. Significant residual impacts to seagrass meadows are not expected because:
    - major direct or indirect impacts to seagrass meadows are not expected (see Section 3.3.4.3);
    - seagrass meadows with potential to be affected by dredge plumes could be protected by mitigation measures that may include the relocation of the dredger or the establishment of an adaptive monitoring program; and
    - the potential for dredging to introduce invasive species into the wetland (seagrass meadows) is very low as there are no known high-risk marine pests in the Port of Gladstone.
- **Protected wildlife habitat:** maintenance dredging activities are not expected to lead to significant direct or indirect effects to protected wildlife habitat. In accordance with the significant residual impact criteria, the proposed dredging will not:
    - lead to a long-term decrease in the size of a local population;
    - reduce the extent of occurrence of the species or fragment and existing population;
    - result in genetically distinct populations resulting from habitat isolation;
    - result in invasive species establishing that are detrimental to endangered or vulnerable species;
    - introduce diseases that may cause the population to decline;
    - interfere with the recovery of a species; and
    - disrupt ecologically significant locations used for breeding, feeding, nesting, and migration or resting.
- **Fish Habitat Areas and Highly Protected Zone of State Marine Parks:** maintenance dredging activities will take place adjacent to the GBR Coastal Marine Park which covers similar areas to the GBR Marine Park (GBRMP). Based on significant residual impact criteria for protected areas (State of Queensland 2014a), the proposed dredging will not (BMT 2021):
    - result in exclusion or reduction in the public use or enjoyment of the part or all of the nearby protected areas;

- reduce the natural or cultural values of all or part of the GBR Coastal Marine Park.

State significant residual impact criteria for highly protected zones of State Marine Parks refer specifically to works to be conducted within these zones. As the proposed dredging falls outside of these area boundaries, these criteria are not relevant (BMT 2021).

- **Marine Turtle Nesting Areas:** Marine Turtle nesting occurs on the eastern shoreline of Facing Island and on the southern end of Curtis Island within Port Limits. South End Beach, Curtis Island is listed as an index nesting beach due to nesting abundance. A data set is being established for Facing Island nesting. Critical Habitat (nesting) and Biologically Important Area (inter-nesting) occur at and adjacent to sandy beaches of Port Curtis for flatback turtle. These areas are remote from dredge plumes. Port Curtis and dredge/disposal sites may be frequented by this species, but they are unlikely to be directly or indirectly affected by transient, localised dredge plumes (BMT, 2021). No turtle strikes have occurred from maintenance dredging in the Port of Gladstone over the past 10 years, therefore no significant impact is expected.
- **Marine Plants -** Marine plants are protected under the *Fisheries Act 1994*. Marine plants are part of the mosaic of fish habitats, and are an integral and usually highly visible feature of the coastline. Queensland has a very high diversity of marine plant species, including mangroves, seagrass, saltcouch, algae, samphire (succulent) vegetation and adjacent plants, such as melaleuca (paper barks) and casuarina (coastal she-oaks). Effective management and protection of all marine plants and adjacent coastal areas is important in ensuring sustainable fish habitats and fisheries production. Marine plants are vital natural resources that provide shelter, food and nursery areas to about 75% of fish species caught in Queensland. Marine plants are a fundamental part of fish habitats in Queensland, as they help sustain fish for the future of commercial, traditional and recreational fishing. Marine plants provide a range of important environmental services including shoreline stability and protection from coastal conditions (DSDIP, 2014).
- **Waterways providing for fish passage** Many Australian fish need free fish passage along waterways in order to complete seasonal and flow related migration and movements to access seasonally available food sources or breeding habitat. Stream connectivity and habitat diversity are crucial components of healthy waterways (DSDIP, 2014).

4 Consultation and Key Issues

To assist in the development and review of this LMDMP, stakeholder engagement has been undertaken with GPC's TACC and other interested stakeholders. This was undertaken in accordance with an Engagement, Communication and Project Delivery Strategy. The goal of the strategy was to effectively engage and communicate with identified stakeholders to understand what values are important and use this stakeholder input to the develop a quality LMDMP for the Port of Gladstone. The strategy aimed to ensure engagement was done meaningfully, balancing operational needs and facilitating the development of this LMDMP. The objectives of the strategy were to;

- Engage stakeholders in discussion regarding real, perceived or potential issues within the Port of Gladstone; in relation to maintenance dredging activities;
- Empower stakeholders to openly participate in engagement;
- Facilitate the two (2) way flow of information between GPC and key interested stakeholders;
- Take a collaborative approach towards achieving the goal of this strategy;
- Develop and enhance partnerships with stakeholders;
- Promote transparency in the LMDMP development process;
- Balance stakeholder and operational expectations and requirements;
- Ensure that quality LMDMPs are developed within the required timeframe; and

- Promote continual improvement of GPC's maintenance dredging activities.

All feedback received as part of this consultation, including any responses from GPC, is outlined in **Appendix C.**

5 Sediment Assessment

5.1 Improved Port Sediment Understanding and Management

GPC's consideration of measures to prevent, reduce and where practical avoid maintenance dredging and the relocation of dredge material at sea has been enhanced by the SSM Project which began in 2014, which aimed to minimise environmental impacts and ensure the sustainability of maintenance dredging activities. In addition to delivering GPC's commitments under a Deed of Agreement (Commonwealth of Australia, 2015) between GPC and the Department of Environment and Energy (DoEE, now DCCEEW) (the Deed), the SSM Project aligns with the Commonwealth Government's overarching strategy for managing the GBR, as described by the Reef 2050 Plan and creates important linkages to relevant aspects of the MDS.

The SSM Project was developed to further our understanding of the interactions between our maintenance dredging operations at the Port of Gladstone and the local and regional environment. The SSM Project better informed GPC's understanding of sediment dynamics, characteristics, and sedimentation rates to forecast dredging requirements and analysis of options to avoid or reduce maintenance dredging, and / or beneficially reuse dredged material. It formed the justification for progressing potential sediment management solutions into feasibility studies and subsequently implementation via the relevant approval processes.

In arriving at a detailed understanding of long-term maintenance dredging management requirements and associated issues at the port through the SSM Project, comprehensive stakeholder engagement with affected and interested stakeholders has been undertaken. This engagement utilised traditional and digital methods .

The outputs of the SSM Project are detailed in Section 5.3 and 5.5 and are published on GPC's website. The outcomes of the SSM Project will inform revision and improvement of this LMDMP as per Section 1.3.

5.1.1 Water Quality Action 17 – Great Barrier Reef Quantitative Sediment Budget Assessment

The Reef 2050 Plan identifies nine (9) actions relating to the theme of "reducing the impact of ports and dredging". The QPA was tasked with driving the ports sector's participation and input into marine science, environmental governance and port policy development and implementation. The QPA led WQA17 which had the following objective:

Understand the port sediment characteristics and risks at the four major ports and how they interact and contribute to broader catchment contributions within the World Heritage Area.

To compliment local scale studies being undertaken by GPC through the SSM Project and similar studies by other QLD ports, the QPA commissioned a study to inform WQA17. The overarching aim of this study was to contextualise the scale of impact from dredging to naturally occurring processes and other sediment and pollutant sources which affect the GBR. The resulting report (BMT 2018) is available for access on GPC's website along with an executive summary prepared by the QPA and outcomes of a peer review process.

Each of the ports within the GBR are different. Their location, setting and design mean that sediment movement and accumulation is specific to the individual port. The rates of sediment accumulation vary as does the frequency at which action needs to be taken to keep the channel and berths operating effectively. The primary driver of suspended sediment at the port-scale is overwhelmingly due to natural wave and tidal current resuspension of existing sediment that has been deposited in the GBR inner-shelf region over geological timescales. Both catchment and dredging related contributions are found to be relatively minor in the context of the natural resuspension quantities. Key sediment budget characteristics for the Port of Gladstone are shown in **Figure 7**.

The Port of Gladstone energetic tidal hydrodynamic conditions play an important role in the context of natural bed remobilisation processes. The dredged channels are effective sediment traps, due to their increased depth relative to the surrounding seabed. The composition of the dredged material is variable, with sediments in the mid and outer navigation channels dominated by sands and some gravels (where tidal currents are energetic) and sediments in the berth pockets and closed-ended inner channels having a higher fines content (silts and clays). The offshore MRA is located in an exposed coastal environment at the entrance to the Port of Gladstone. This MRA is mainly retentive, with sediments consisting of sands with low proportion of silts and gravel.

Overall, the sediment fluxes contributed by catchments are very small compared to the channel infilling that is driven by energetic spring tide currents (within the Port of Gladstone) and wave activity (outside the Port of Gladstone). Data suggests that fluvial inputs are approximately 10% of those coming in through the Southern Entrance to the Port of Gladstone. Connectivity between new fluvial inputs and maintenance dredging requirements is considered to be weak.

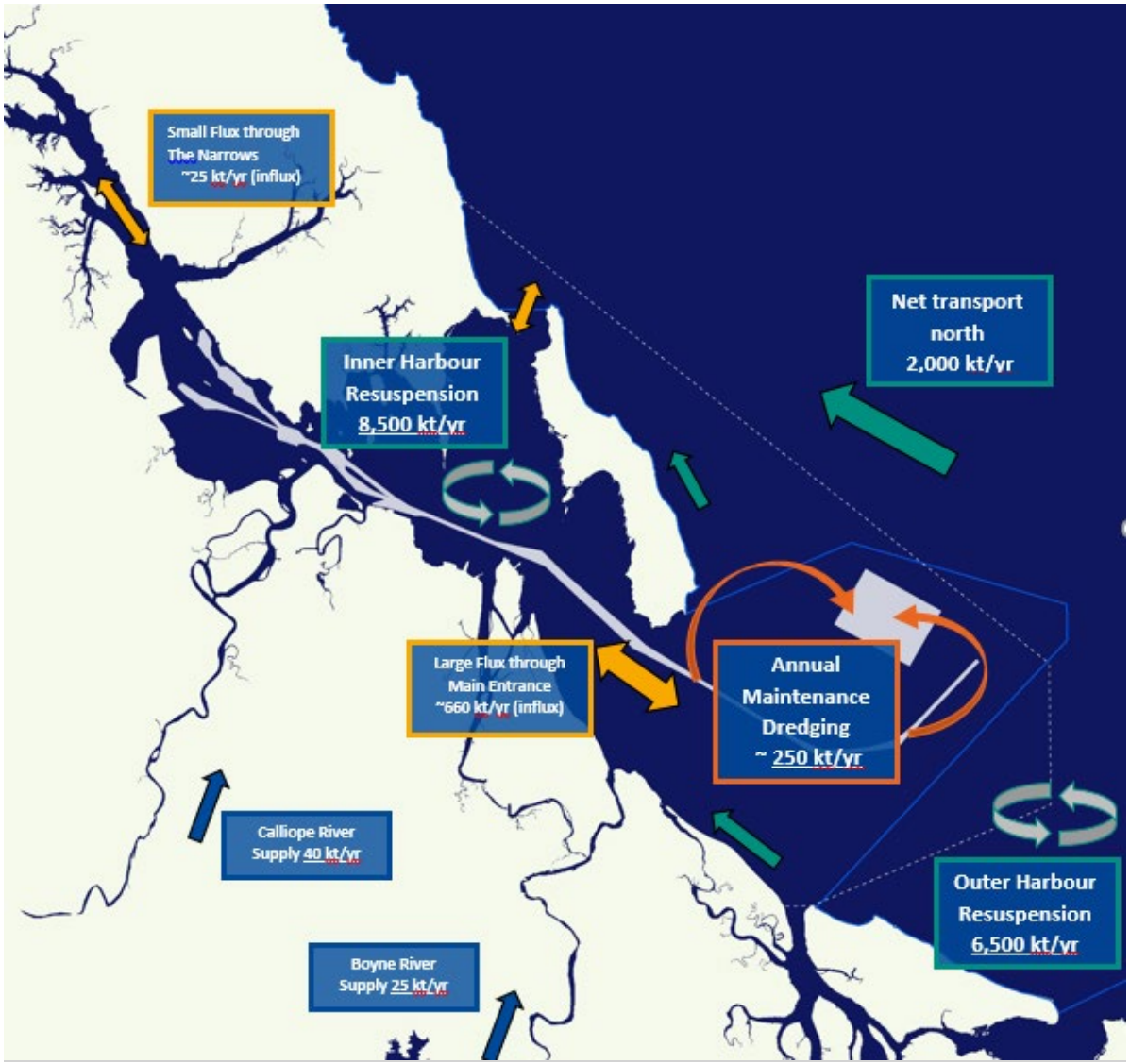

Figure 7: Sediment Input and Resuspension tonnes per year (t/yr)
(Source: GPC 2019)

5.2 Port Sediment

In the 2022 GHHP Report Card (GHHP 2023, sediment quality within the Port of Gladstone was again scored very highly and along with water quality was graded 'A' (very good) with a high confidence level. Information about physical and chemical properties of maintenance dredging sediments specifically is provided below.

5.2.1 Physical and Chemical Properties

The following physical and chemical property information summary has been taken from the Port of Gladstone SAP Design Document (BMT 2022b) and Gladstone SAP Implementation Report (BMT 2022c). These SAPs were reviewed and approved prior to implementation by the relevant Commonwealth and / or State Government regulators.

Table 10: Summary of Physical and Chemical Properties of Maintenance Dredging Sediment
(Source: BMT 2022c)

Physical properties	Chemical properties including Potential Acid Sulfate Soils (PASS)
Sediment types in the Main Channel varied greatly among locations, from well-sorted muds, to muddy sands, sandy gravels and gravelly sands. This variability reflected differences in geomorphological and hydrodynamic conditions along the 50 km length of the channel	Mean concentrations of detected metals and metalloids were all below their respective NAGD screening levels and National Environmental Protection Measures (NEPM) investigation levels. The 95% upper control limit (UCL) for all metals in dredged sediments were also below NAGD screening levels. Phase III dilute acid extraction tests for arsenic and copper confirm that the bioavailable fraction of these metals is unlikely to result in adverse impacts to sediment biota. Therefore, both Phase II and III testing indicates that dredged material is considered clean and suitable for sea placement. Metals were also below NEPM investigation levels, and do not constrain on land reuse. NAGD and NEPM do not provide screening / investigation levels for nutrients. Concentrations were similar to other estuarine environments in Queensland. Total Petroleum Hydrocarbons (TPH) concentrations were well below the NAGD screening value of 550 mg/kg; benzene, toluene, ethylbenzene and xylene (BTEX) concentrations were below the Limits of Reporting (LoR); and Poly Aromatic Hydrocarbons (PAH) concentrations were well below the NAGD screening level of 10,000 µg/kg, and well below NEPM investigation levels. In lieu of NAGD and NEPM guideline values, dioxin / furans concentrations were compared a dioxin assessment in the non-industrialised Noosa River catchment. Concentrations recorded in dredged sediments were less than half the minimum value, and were also well below average levels recorded in other Australian estuaries (520 pg/g). Per- and poly-fluoroalkyl substances (PFAS) and Cyanide concentrations were below the LoR in all samples
Sediment cores across the Gladstone Marina were mostly comprised of fine material (clay and silts) and were homogeneous across dredged area.	The 95% UCL for all metals and metalloids were below NAGD screening levels. Phase III dilute acid extraction tests for arsenic and copper confirm that the bioavailable fraction of these metals is unlikely to result in adverse impacts to sediment biota. Therefore, both Phase II and III testing indicates that dredged material is considered clean and suitable for ocean disposal. Metals were also below NEPM investigation levels, and do not constrain on land reuse. NAGD and NEPM do not provide screening / investigation levels for nutrients. Concentrations were similar to other estuarine, silty sediments environments in Queensland. TPH concentrations were well below the NAGD screening value of 550 mg/kg; BTEX concentrations were below the LoR; and PAH concentrations were well below the NAGD screening level of 10,000 µg/kg. Hydrocarbon parameters were below relevant NEPM investigation levels. Therefore, the material can be considered clean and suitable for ocean disposal or re-use. In lieu of NAGD and NEPM guideline values, dioxin/furans concentrations were compared a dioxin assessment in the non-industrialised Noosa River catchment. Concentrations recorded in dredged sediments were less than half the minimum value, and were also well below average levels recorded in other Australian estuaries (520 pg/g). Concentrations of organotins (monobutyltin - MBT, dibutyltin - DBT, tributyltin - TBT) were below the LoR in most samples. DBT and TBT were detected in some samples, however none exceeded the NAGD screening level for TBT (9µg/kg) or NEPM investigation levels. PFAS concentrations were below the limit of reporting in all samples. Sediment sampling indicates potential acid sulfate soils (PASS). The Acid Neutralising Capacity (ANC) metric provides a measure of the capacity of

Physical properties	Chemical properties including Potential Acid Sulfate Soils (PASS)
	sediments to self-neutralise acids upon oxidation, and results indicate sufficient ANC to neutralise sediments. ANC values were verified by slab / chip tray incubation test. The slab / chip tray results confirmed that the ANC of all samples was sufficient to neutralise acid upon oxidation, indicating no treatment would be required if the material was placed on land.
Sediment cores across the Boyne entrance had low spatial variability and high proportions of sand.	The 95% UCL for all metals and metalloids were below NAGD screening levels and NEPM investigation levels. On this basis, sediments were considered suitable for ocean disposal or land-based reuse. NAGD and NEPM do not provide screening or investigation levels for nutrients. Nutrient concentrations were however similar to other estuarine environments in Queensland. TPH concentrations were well below the NAGD screening value of 550 mg/kg; BTEX concentrations were below the LoR; and PAH concentrations were well below the NAGD screening level of 10,000 µg/kg. Hydrocarbon parameters also had concentrations below relevant NEPM investigation levels. Therefore, the material can be considered clean and suitable for ocean disposal or re-use. In lieu of NAGD and NEPM guideline values, dioxin / furans concentrations were compared a dioxin assessment in the non-industrialised Noosa River catchment. Concentrations recorded were less than half the minimum value, and were also well below average levels recorded in other Australian estuaries (520 pg/g). PFAS concentrations were below the limit of reporting in all samples. Sediment sampling indicates PASS. The ANC metric provides a measure of the capacity of sediments to self-neutralise acids upon oxidation, and results indicate sufficient ANC to neutralise sediments. ANC values were verified by slab / chip tray incubation test. The slab / chip tray results confirmed that the ANC of all samples was sufficient to neutralise acid upon oxidation, indicating no treatment would be required if the material was placed on land.

The catchment of Port Curtis includes the City of Gladstone and a variety of coastal and hinterland townships. Industries in the catchment include pastoral, agricultural, processing and manufacturing. Potential pollutant sources in the Port of Gladstone are highlighted in **Table 11** (BMT 2022b).

Based on previous studies undertaken in the Port of Gladstone, potential contaminant types include:

- Metals and metalloids;
- Polycyclic Aromatic Hydrocarbons (PAHs); and
- Organotin compounds including tributyltin (TBT), dibutyltin (DBT), tributyltin (MBT).

In addition to historical contaminants, emerging contaminants (ECs) were sampled to inform the contaminant list. Insufficient data exists to determine the status ECs in the Port of Gladstone, and in accordance with NAGD, a pilot study will be used to inform the contaminants list. The pilot study proposed to sample 20% of the locations specified in NAGD (BMT 2022b).

Contaminant concentrations found in estuarine sediments are controlled by a range of processes. Sediments near contaminant sources, such as those shown in **Table 11**, can have concentrations of metals and organic pollutants that are elevated in comparison to natural background levels. Sediment grain size, which itself is a function of hydrodynamic processes (currents, waves) is also a primary

determinant of contaminant concentrations and potential ecotoxicity. Due to their physical and chemical characteristics, fine-grained sediments tend to adsorb contaminants, and areas containing a high proportion of sediments in this size range can have higher contaminant concentrations (particularly metals / metalloids) than areas dominated by coarser grain sediments. Fine sediments such as clay can also chelate contaminants, making them less biologically available (BMT 2022b).

A wide range of physico-chemical sediment properties and biological processes (e.g. bioturbation by burrowing organisms) also strongly influence contaminant concentrations. The natural geology occasionally has high concentrations of nickel, arsenic, and manganese, which have been found in reference sediments in several studies (BMT 2022b).

Table 11: Potential pollutant sources in the Port of Gladstone
(Source: BMT 2022b)

Potential source	Metals / metalloids	PAHs	Hydrocarbons (TPHs, BTEX)	Organotins (TBT)	Herbicides Pesticides	Nutrients	Cyanide	Bauxite, coal, clinker, alumina
Natural geology	✓	✓	✓			✓		✓
Shipping and portside operations	✓	✓	✓	✓		✓		✓
Industrial discharges and site runoff	✓	✓	✓			✓	✓	✓
Landfills	✓	✓	✓			✓		
Agriculture and horticulture					✓	✓		
Urban stormwater runoff	✓	✓	✓		✓	✓		

The individual contaminant inputs from various sources in the Port of Gladstone catchment has the potential to cause cumulative sediment quality and water quality issues in the Port of Gladstone. These issues may in turn have an impact on GPC's ability to undertake and manage maintenance dredging. To understand these potential impacts in relation to maintenance dredging activities GPC undertakes sediment and water quality monitoring programs (Section 9).

While GPC has a limited ability to prevent contamination from many of the potential sources, GPC takes appropriate steps to prevent or minimise contamination through monitoring and managing all port activities under the EMS (Section 6) and through diligent port planning. GPC's planning functions include: planning future port and port-related development; reviewing and commenting on EISs for proposed development which will utilise the port; fulfilling a legislative assessment role for developments on or adjoining Strategic Port Land (SPL) under the *Planning Act 2016*; management of activities undertaken on SPL and at port facilities (e.g. restricting high risk activities including ship hull cleaning); supporting the development and implementation of the Master Plan for the Port of Gladstone (Section 2.3.1).

5.2.2 Biological characteristics

A survey of Introduced Marine Pest (IMP) was conducted in the Port of Gladstone in 2019-20 as part of the Queensland Seaports eDNA Surveillance (Q-SEAS) marine pest pilot program (DAF 2021). This

pilot program focused on winter / spring and summer events and did not find any IMP species from the National Introduced Marine Pest Information System (NIMPIS) from settlement plates and plankton tow samples.

Q-SEAS is Queensland's first state-wide marine biosecurity surveillance program, which provides a coordinated surveillance network for the early detection and proactive management of marine pest threats at Queensland's ports. The program is risk-based, adaptable, transformative, cost-effective and in alignment with the National Strategic Plan for Marine Pest Biosecurity 2018-2023 (DAWR 2018). The multifaceted, holistic approach and high level of scientific rigour adopted by Q-SEAS resulted in identification of a wide diversity of taxa with high taxonomic resolution. This proof of principle has provided confidence in its feasibility as an early warning surveillance tool for marine pests (DAF 2021). The Q-SEAS marine pest program will continue in partnership with the Queensland Department of Agriculture and Fisheries (DAF) at the Port of Gladstone and operate as an early warning system to identify marine pest (DAF 2021). This surveillance has been incorporated by GPC into the Long-term Monitoring Schedule (Section 9, **Table 16**).

5.3 Minimisation of Sediment Accumulation and Dredging Needs

The objectives of the London Protocol and the Sea Dumping Act include minimising pollution caused by sea placement.

The London Protocol requires consideration of measures to prevent, reduce and where practical avoid the relocation of dredge material at sea. Ports therefore aim to reduce their maintenance dredging requirements as much as possible and will only undertake dredging when necessary. It is also worth noting that maintenance dredging is considered an expensive and inconvenient requirement for many ports (Haskoning Australia 2016) and ports therefore strive to undertake it as efficiently as possible.

As part of the SSM Project, GPC undertook an assessment of options to completely avoid maintenance dredging and placement at sea (P&CS 2018). There were two (2) main aims of this study, namely:

- To undertake a detailed assessment of the accumulation rates within the dredged areas of the Port of Gladstone and use this to predict the future sedimentation and declared depths in the Port of Gladstone; and
- To undertake an options assessment for completely avoiding sediment management, maintenance dredging and the placement of dredged material at sea.

Based on analysis of historical bathymetric surveys, future sedimentation above the declared depths in the Port is predicted to be 213,000 and 317,000 m^3/yr (in-situ volume) for typical and worst case years. The majority of this sedimentation is within the LNG Terminal berths and swing basins in the Jacobs Channel region. If no sediment management (i.e. no maintenance dredging or drag barring / bed levelling) is undertaken then future sedimentation above declared depths is predicted to be 1.2 M m^3 (in-situ volume) of sediment after five (5) years, 2.7 M m^3 (in-situ volume) after 10 years and 5.9 M m^3 (in-situ volume) after 20 years.

After one (1) year of sedimentation, with no sediment management, there is predicted to be reduced loading for the majority of vessels at five (5) of the berths in the Port of Gladstone (influencing the LNG, chemical manufacturing and aluminium industries) and reduced loading for Cape size vessels at one (1) berth (influencing the coal industry). After five (5) years of sedimentation, there is likely to be no access to the Port for Cape size vessels, a tidal constraint for Panamax vessels and insufficient depth for vessels at a further four (4) of the berths (nine (9) in total, also influencing the cruise industry). After 20 years of sedimentation, access through the Golding Cutting would be unpassable for most unladen vessels which would mean that the Port of Gladstone would not be able to continue operation.

To maintain declared depths within the Port a number of regions of the Port of Gladstone will require annual dredging, with typical and maximum volume estimates of 170,000 to 260,000 m^3/yr (in-situ volume), while other regions will require biennial (or less frequent) dredging, with typical and maximum volume estimates for these regions of 90,000 to 100,000 m^3 (in-situ volume) every two (2) years. Based on this, the total annual average (averaged between annual and biennial years) maintenance dredging requirement for the Port of Gladstone is between 210,000 and 265,000 m^3/yr (in-situ volume) (excluding any insurance dredging) depending on whether the sedimentation which has occurred is typical or worst case.

Options for completely avoiding sediment accumulation, maintenance dredging and the placement of dredged material at sea were then assessed. Based on the future sedimentation predictions for the Port of Gladstone, it was found that there is no realistic options available to completely avoid sedimentation or maintenance dredging with the Port remaining operational. There are possible options which could be considered for localised areas to avoid sedimentation and maintenance dredging, but none of these could be adopted for the Port of Gladstone. As such, these options would reduce the total sedimentation and therefore maintenance dredging in the Port of Gladstone, rather than completely avoiding it, and were considered as part of the subsequent reduce assessment, described below.

The only available options to completely avoid sea placement of maintenance dredged sediment would be for all of the sediment to either be used for beneficial reuse or to be placed on land. These options formed part of the beneficial reuse investigation detailed in Section 5.5.

GPC currently employs a number of strategies to minimise maintenance dredging activities. These are listed below.

- **Hydrographic survey;** repeat hydrographic surveys ensure that maintenance dredging is focused on the areas where sedimentation has occurred and that maintenance dredging is only undertaken when and where it is required. As detailed in Section 3.3.2, the entire channel area is not dredged during each campaign;
- **Bed levelling;** bed levelling is used to level out high points in a channel and therefore help to reduce the frequency of maintenance dredging;
- **Tidal windows;** vessel movements are maximised through shallower areas during higher stages of the tide to ensure sufficient under keel clearance. This approach can result in operational inefficiencies and has the potential to result in safety and environmental implications if not managed correctly;
- **Dynamic Under Keel Clearance Systems (DUKCS);** A DUKCS can help to promote safe navigation and improved overall efficiency and has the potential of allowing for reduced bed levels in channels. It can therefore potentially reduce the frequency of maintenance dredging. The system can be beneficial in environments like the Port of Gladstone which are exposed to waves, have large tidal ranges and long navigation channels. In addition, the associated near-real time and forecast data streams associated with the DUKCS can be of direct application in operational management of dredging activities (Haskoning Australia 2016). GPC implemented a DUKCS in 2018 which is being used to optimise sailing windows; and
- **Port Management;** ports will typically manage their infrastructure and operations to minimise the requirement for maintenance dredging including working with port tenants and customers where possible.

In addition to the above practices, and subsequent to the 'Avoid' assessment, GPC undertook a comprehensive objectives assessment of possible approaches to reduce maintenance dredging (either

the volume or duration) within the Port (P&CS 2019). It was identified that the majority (approximately 90%) of the ongoing sedimentation above declared depths in the Port of Gladstone occurred in the LNG Terminal region, Marina, Outer Harbour Cuttings (Golding, Boyne and Wild Cattle Cuttings) and berths. These areas were therefore the focus of the reduce assessment option, with possible alternative approaches to maintenance dredging considered for each area.

To allow for ongoing SSM, it was important to acknowledge that sediment from maintenance dredging is an essential component of natural sediment budgets and ecosystems. Therefore, a key principle was to consider dredged material as a valuable resource to be used in the natural environment, rather than a waste material for placement. In line with this, recent industry guidance has been promoting the approach of sustainable relocation where dredged sediment is released into the active sediment system, where it can be transported to areas which rely on an ongoing supply of sediment. This approach helps to maintain the sediment supply and therefore helps to support sediment-based habitats and shorelines which rely on an ongoing natural supply of sediment. In Gladstone, this natural supply is mainly from the marine environment, with catchment contributions being low. This type of sustainable practise was considered as an approach to reduce maintenance dredging when it improves the efficiency of the dredging. This practice, therefore, has the potential to reduce the duration of maintenance dredging as well as reducing the volume of sediment placed at the offshore MRA.

Reduce approaches were based on three (3) broad strategies, (i) keep sediment out, (ii) keep sediment moving and (iii) keep sediment navigable. A total of 11 possible reduce approaches were identified based on information taken from global best practise guidance. Of these, seven (7) approaches were considered potentially feasible based on the natural processes driving sedimentation in the Port and were considered as part of a detailed objectives assessment. The Seven (7) approaches were assessed, along with ongoing maintenance dredging, as part of a comprehensive objectives assessment and four (4) approaches were selected as possible options that could be further investigated to reduce maintenance dredging in the Port, namely:

- LNG Terminal Region – Sustainable Relocation: This approach assumed that half of the annual sedimentation which requires management in this region is managed through sustainable relocation to an area near the entrance of Jacobs Channel using the *TSHD Brisbane*, while the other half continues to be placed at the offshore MRA by the *TSHD Brisbane*. This approach would reduce the maintenance dredging duration by five (5) days per year and would reduce the volume of sediment placed at the offshore MRA by 75,000 m^3/yr (in-situ).
- Marina – Sustainable Relocation: This approach assumed that all of the annual sedimentation which requires management in the Marina (40,000 m^3/yr) is managed through sustainable relocation through a pipeline to the edge of Clinton Channel.
- Berths – Jet Array: The jet array approach is only expected to be feasible in berths with high rates of sedimentation such as the berths at the LNG Terminals. Due to the configuration of the berths at the LNG Terminals, there is the potential that some sedimentation could occur in the corners of the berths and so ongoing drag barring is likely to be required in conjunction with the jet array. If the approach is adopted at all berths in the LNG Terminal region then it could reduce maintenance dredging and the subsequent placement of sediment at sea by an estimated 23,600 m^3/yr (in-situ) which equates to approximately four (4) days of maintenance dredging.
- Berths – Nautical Depth Navigation / Drag Barring: This approach required quarterly drag barring and is only considered to be potentially feasible in berths where the adjacent apron is at a similar depth to the berths, such as the berths at the LNG Terminals. It is likely that sediment testing and a dual frequency bathymetric survey would be required between annual maintenance dredging campaigns to better understand the sediment properties and determine if the nautical depth navigation aspect would be applicable. If the approach is

adopted at all berths in the LNG Terminal region then it could reduce maintenance dredging by approximately 16,000 m^3/yr (in-situ). This would reduce dredging in the berths (only) to every three (3) years, on average.

There were no realistic approaches identified to reduce maintenance dredging in the Outer Harbour Cuttings (Golding, Boyne and Wild Cattle Cuttings), and these four (4) were progressed with the beneficial reuse options discussed in Section 5.5 to a comprehensive stakeholder evaluation process.

The Sediment Relocation (LNG region and Marina) approaches were the better scoring options when evaluated by GPC and its stakeholders and were further assessed in feasibility studies, which found them feasible. These options have progressed through the regulatory approvals processes on a trial basis. If validation proves them successful, ongoing regulatory approvals will be sought and these options will become part of GPC's long-term ongoing strategy (Section 1.3).

If further opportunities to reduce maintenance dredging requirements emerge in the future, these will be considered as part of GPC's continual improvement process for maintenance dredging (Section 1.3) and documented in subsequent versions of this plan.

5.4 Maintenance Dredging and Placement Requirements

Maintenance dredging has occurred approximately annually since 1993 in the Port of Gladstone main channels. Actual campaign volumes over the last 10-year period are presented in **Table 12**. Since 2014, GPC has been maintaining channels dredged as part of capital works to facilitate the introduction of the LNG industry in Port of Gladstone and the Wiggins Island Coal Export Terminal (WICET). At this time, GPC also completed capital dredging of a new tug base facility necessary to house larger tugs to manage the LNG Vessels.

Table 12: Main Channel Maintenance Dredging Campaign Volumes over the Past 10 Years
(Source: GPC 2023)

Campaign	Volume (m^3)
November 2014	307,505
June 2015	52,000
January 2016	248,000
October 2016	206,968
August 2017	209,456
November 2018	211,102
November 2019	231,855
September 2020	255,986
October 2021	239,228
November 2022	211,726

Loss of depth within the channels due to siltation has a significant impact on the draft of vessels that are able to transit and navigate efficiently and safely within the Port. Depth reductions of up to 1 m are recorded from year to year. **Table 13** below summarises GPC's estimates of the volume of maintenance dredging required from the Port of Gladstone main channels over a five (5) year period between 2023 and 2028 The actual dredging requirement is determined prior to each annual campaign by hydrographic survey. GPC commit that no single maintenance dredging campaign undertaken in the main navigational channels during will exceed 340,000 m^3 which is the largest campaign that has been simulated for impact assessment purposes in the current ten year period. This volume includes contingency for emergency or unforeseen events such as extreme weather during the permit period or additional siltation in some channels. It is expected that these volumes could be extrapolated for a 10 year period, subject to the outcomes of the SSM Project (Section 5.1).

The five (5) year volume does not account for any additional maintenance dredging requirements due to the completion of capital works during this period. In accordance with Principle 5 of the MDS (TMR 2016), an increase in channel or berth dredging areas and depths will only occur as a result of approved capital dredging following assessment of implications of future maintenance dredging needs and placement options through approval processes.

Table 13: Estimated Maintenance Volume over a 5 Year Period from Port of Gladstone's Main Channels
(Source: GPC 2023)

Year	Estimated Volume of Maintenance Dredging (m^3)
2023	260,000
2024	260,000
2025	340,000
2026	260,000
2027	340,000
Total	**1,460,000**

The Jacobs Channel and Curtis Island LNG precinct (collectively known as Jacobs Channel) consists of three (3) 600 m diameter swing basins linked by a 200 m wide channel. These three (3) swing basins were constructed in a relatively quiescent area of the harbour. Annual pre maintenance dredging surveys regularly show sediment accumulation in the Jacobs Channel. These surveys also tend to show greater siltation in the first half of the year following the wet season. It is anticipated that approximately every third year, a larger campaign will be required to address this sediment accumulation and provide sufficient reserves to accommodate future wet season events in Jacobs Channel. Alternatively, maintenance dredging may need to be conducted twice yearly, once following the wet season and once before, to ensure capacity and safe navigation in Jacobs Channel.

The main navigational channels are maintained to the design depths shown in

Table 3, have an approximate length of 50 km and cover an area of approximately 21 km^2. The entire channel area is not dredged during each campaign, with maintenance dredging expected to occur over only <1.0 km^2 where the majority of siltation occurs. This is in isolated parts of the channels, outer channel towlines, berth quay lines and swing basins.

Dredging of the main channels is undertaken by the *TSHD Brisbane* (Section 7.1.1). With the exception of trials described in Section 5.3, that may reduce the volume of sediment relocated to the MRA. Maintenance dredging material from the navigational channels described above will be relocated to the Offshore MRA during the period of this LMDMP, subject to the review and continual improvement processes detailed in Section 1.3. The Global Positioning System (GPS) (WGS84) co-ordinates of the Offshore MRA are as follows:

23° 53'.84S	151 ° 29'.02E
23° 52'.83S	151 ° 27'.10E
23 ° 51'.53S	151 ° 27'.91E
23 ° 52'.54S	151 ° 29'.84E

Figure 8 Error! Reference source not found.illustrates the location of the MRA. The closest boundaries of the site are 10.6 km from the mainland and 6.1 km from Facing Island. The depth of the MRA ranges from 8 m to 13 m, with an average of 11 m below datum. It is calculated that a capacity of at least 35 million m^3 remains over the entire MRA. In 1980, the Gladstone Harbour Board sought approval from the Queensland Department of Harbours and Marine via an Environmental Impact Assessment process for the deepening of the Gladstone Harbour Project, which involved the establishment of the off shore MRA. This MRA was established in 1981 and has been approved for use multiple times for capital and maintenance dredging requirements since.

Additional to the main channels, **Table 14** shows the estimated maintenance volume over a five (5) year period from additional infrastructure in the Port of Gladstone. It is expected that these volumes could be extrapolated for a 10-year period, subject to the outcomes of the SSM Project (Section 5.1). Maintenance dredging material from the additional infrastructure is generally used for land reclamation in an existing GPC reclamation area. Restricted draft and space in these structures restricts the use of the *TSHD Brisbane*. Dredging of these structures may be undertaken by a Cutter Suction Dredger, Backhoe or Grab Dredger. Because of the dredging methodology and proximity to shore, it is usually more practical to place the material in reclamation areas. GPC's existing reclamation areas approved for the acceptance of maintenance material are also shown in **Figure 8**Error! Reference source not found..

Table 14: Estimated Maintenance Volume over a 5 Year Period from Additional Infrastructure in the Port of Gladstone
(Source: BMT 2022c)

Area	Volume (m^3)
Gladstone Marina and lower Auckland inlet	300,000
Upper Auckland inlet	100,000
Boyne River	40,000

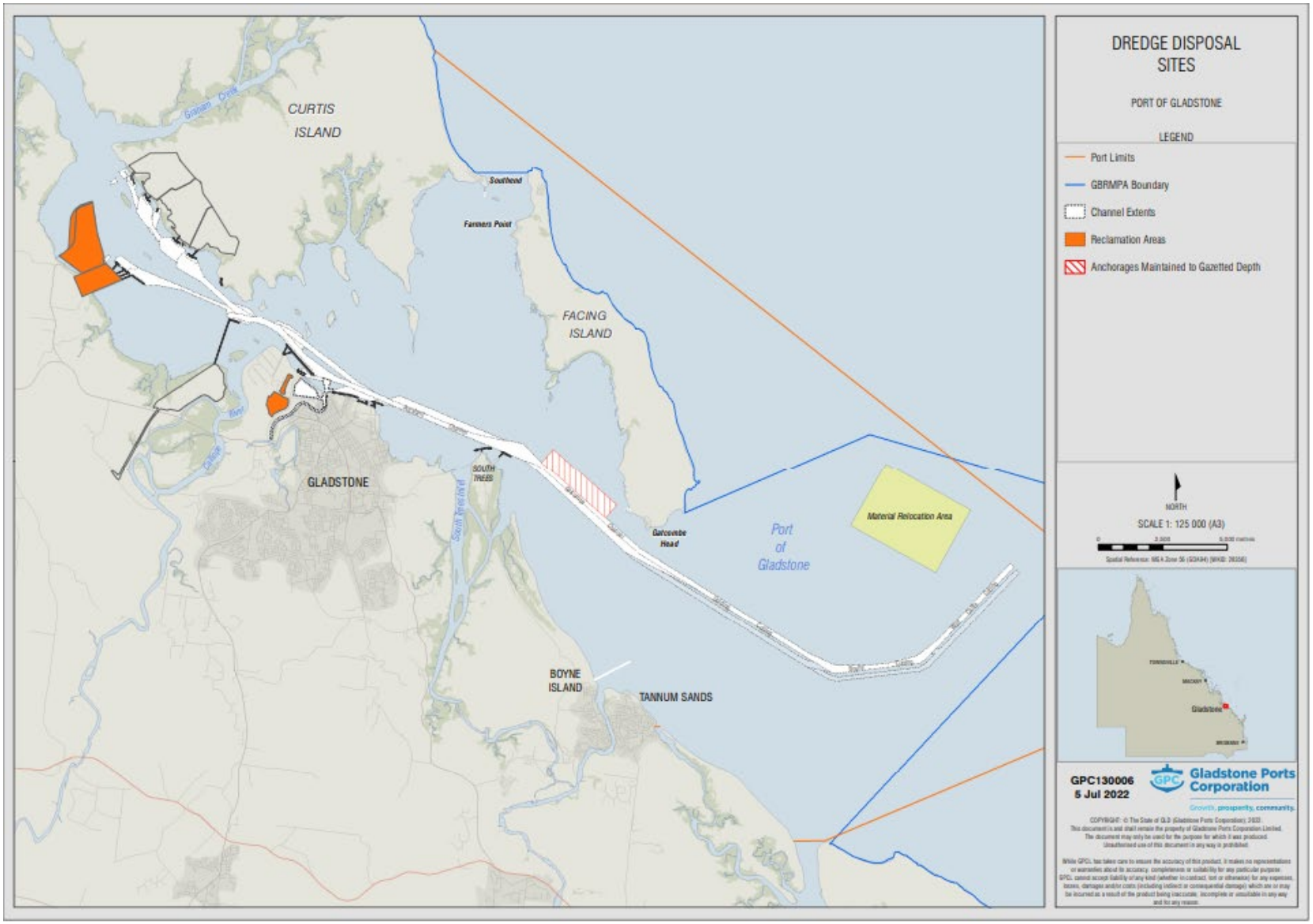

Figure 8: Offshore MRA (EBSDS) and Existing Available Reclamation Areas
(Source: GPC 2023)

5.5 Examination of Reuse, Recycle and Placement Options

The first step in the NAGD (Commonwealth of Australia 2009) framework is the evaluation of alternatives to sea placement. A number of issues influence the decision regarding material placement options including the likely environmental impacts, social impacts, as well as economic impacts on both a local and regional scale. A summary of the options considered in SSM Project's Beneficial Reuse Assessment (GHD 2019) is provided below.

A detailed assessment of each shortlisted beneficial reuse option was undertaken against the same agreed evaluation objectives used in the Reduce Assessment. This was to identify any fatal flaws and provide recommendations for the options warranting further consideration.

Key observations stemming from this phase of the investigations were:

- The Port has high rates of sedimentation and sands accumulate within dredged areas.
- Physical property results of particle size analysis reported that sediments vary based on location within the Port. Current flow and wave action are key factors affecting these findings, that is, areas of higher current flow and wave action (middle and outer channel) suspend the finer materials into the water column leaving sand and some gravel materials on the seabed. Fine-grained silt and clays were found in the locations with lower current speeds and limited wave action (upper channel and Marina) along with a higher organic carbon concentration.
- Maintenance dredge material requires removal from 10 main wharf centres and sections of over 50 km of channels. As a result, distances to relocation or beneficial reuse locations are highly variable which generally restricts the suitable dredging equipment to TSHD or barging operations.
- An initial high level review identified a list of over 30 potential options involving the beneficial recycling or reuse of maintenance dredge sediments. While the majority of these options were discounted following a preliminary feasibility review, two (2) were identified post further investigations to progress to trial stage. It is noted that technology or Gladstone region land uses may alter in the medium to long term resulting in other options potentially coming to the forefront. As GPC's LMDMP is reviewed regularly (Section 1.3), the options list may then be altered, or as part of future projects.

Nine (9) options were recommended for GPC and stakeholder evaluation / assessment, which aligned with six (6) broad categories, namely:

1. Land Reclamation – either at the existing Fisherman's Landing facility or at a new reclamation site. The availability of coarse sediments suggests that a long term reclamation area (similar to that adopted by the Port of Brisbane) would be feasible. Nevertheless, a key constraint will be the availability of suitably low lying portside land. Investigations have revealed that many of the potentially suitable areas have been designated for environmental protection or future development. In order to progress this option, a suitable reclamation area must be identified and agreed upon.

   Through GPC's EIS experience, the identification of land-based sites in Gladstone for dredged material placement has encountered a number of difficulties including:

   - The lack of land in proximity to the Port which has not already been allocated for new industry or urban development;
   - Using land that would otherwise be suitable for other purposes such as industry;
   - Unavailability of large flat land areas onshore for the creation of settling ponds and containing the dredge material;
   - Habitat impacts to terrestrial flora and fauna;
   - Adverse public perception to saline material;

- Practical difficulties in placement of saline dredge waters into terrestrial and freshwater environments without causing environmental harm;
- Reluctance by industry to accept the material onto sites where it might reduce their own process capacity;
- Restricted public access to areas and / or the introduction of a public health and safety hazard;
- The increased expense of pumping dredged material large distances from the shipping channels; and
- GPC's experience is supported by the findings of the MDS Technical Supporting Document (Haskoning Australia 2016).

2. Shoreline Protection – Coastal Erosion Mitigation was considered. The availability of coarse sands and some gravels allows direct placement of dredged materials on eroding foreshores comprised of finer, less stable sediments. Alternatively, dredged materials could be used to fill geotextile bags or tubes for use as a variety of shoreline protection structures. The high additional costs associated with such works mean that feasibility will be determined by the need for shoreline protection measures and the availability of lower cost, alternative, non-dredging related solutions.
3. Beach Nourishment – Onshore or Offshore Placement was considered. Unlike many ports of the region, maintenance dredging within the Port requires relocation of significant quantities of sand, which would be potentially suitable for beach nourishment. Beach nourishment is the preferred policy approach to dealing with coastal erosion in QLD and there are a number of local sites which would benefit from placement of dredged material.
4. Coastal Habitat Restoration / Creation – Direct and Indirect Placement Options has been considered. This option would provide significant benefits such as supporting migratory and resident birds, land fauna such as reptiles, insects and small mammals (e.g. the vulnerable water mouse), promotion of the growth of seagrass and indirect benefits such as improved long-term water quality and green and blue carbon benefits. The primary drawbacks with such options relate to the potential impact on existing habitat and additional cost of delivering the works.
5. Lining / Bunding Material has been considered. Physical properties of the maintenance dredge sediments are such that a suitable lining / bunding material could be produced. A number of industries within the Gladstone region use environmental bunds, however, it is recognised that there is relatively little demand for such material locally. The primary challenges associated with this option relate to the high cost of establishing an onshore area for dewatering and the extensive works required to produce a suitable product.
6. Land Rehabilitation / Land Improvement / Fill has been considered. The variety of material types requiring dredging means that a viable land rehabilitation improvement material could be produced. Similarly to bund material, the challenges associated with this option relate to the low demand and high resource use and costs associated with producing such a material. Once dewatered, a complex process of mixing, treatment, extraction, processing by screening, stockpiling, and then potential blending and batching with imported material, would be required which may render this option uncompetitive when compared to other potential sources of material.

The beach nourishment and habitat restoration / creation approaches were the better scoring options when evaluated by GPC and its stakeholders and were progressed into feasibility studies, which deemed them to be feasible options. Although feasible, these options require the involvement of others, or synergies with other projects, as the costs to implement compared to the improvements provided do not warrant changing from current method and location at this stage.

If additional information and options become available, these will be considered as part of GPC's continual improvement process for maintenance dredging (Section 1.3).

5.6 Selected Future Dredging and Placement Strategy

As discussed in Sections 5.3 to 5.5, GPC avoids maintenance dredging at the Port of Gladstone as far as practical and beneficially reuses some maintenance dredging material for land reclamation.

Sea placement remains GPC's preferred method for the remainder of the material which is sourced from the main navigational channels for the following key reasons:

- Sediments transported into the channels are retained within the marine system;
- Important intertidal areas are not replaced by reclamation;
- Placing dredge material into reclamation areas is significantly more costly;
- Placing dredge material into reclamation areas is logistically more complex;
- Clays and other fine material in maintenance dredging material can take time to dry out, delaying the future use of the land;
- The *TSHD Brisbane* has limited pumping ability (approx. 1500 m);
- The strategic utilisation of viable reclamation areas for capital dredging is particularly important since the introduction of the SPD Act;
- There are environmental risks specific to each placement method which would need to be considered and managed during maintenance dredging campaigns;
- Significant effort has been made to understand and manage the potential impacts of GPC's maintenance dredging and sea placement activities;
- The material dredged from the main channels is not contaminated and suitable for sea placement.
- The SSM Project has better informed GPC's understanding of sediment dynamics, characteristics, and sedimentation rates to forecast dredging requirements and analysed options to avoid or reduce maintenance dredging, and / or beneficially reuse dredged material.

GPC's sea placement requirements and future dredging and placement strategy will be revised at the completion of the trials of the preferred options highlighted via the SSM Project (Section 5.1) and thereafter as part of the continual review and improvement framework promoted by the MDS and implemented through this LMDMP (Section 1.3).

6 Risk Assessment Framework

GPC's EMS is the overarching framework for the identification and management of environmental risks and the promotion of continuous improvement in port operations and management (**Figure 9**). GPC's EMS first obtained certification under ISO14001 in 2006 and continues to meet the Standards requirements. The scope of the EMS is: *The development, operation and maintenance of the ports, port lands and associated infrastructure controlled by GPC.*

The EMS covers all GPC operational activities at all of its sites including maintenance dredging activities. This LMDMP and its associated management documents form part of GPC's EMS.

GPC maintains its ISO14001 certification through a commitment to the continual improvement of environmental performance of its operations. GPC regularly conducts internal audits of it operations and undergoes regular external audits to maintain this certification.

The EMS is the framework used to drive continual improvements across GPC. Continuous improvement is achieved through the ongoing identification and implementation of improvement opportunities. To achieve this, GPC has implemented the following which are reflected in the contents of this plan and its associated management documents:

- A system that promotes behavioural based environmental management by increasing awareness and encouraging proactive reporting;
- A robust internal and external compliance program based around inspections and audits; and
- Environmental improvement programs based on significant environmental aspects.

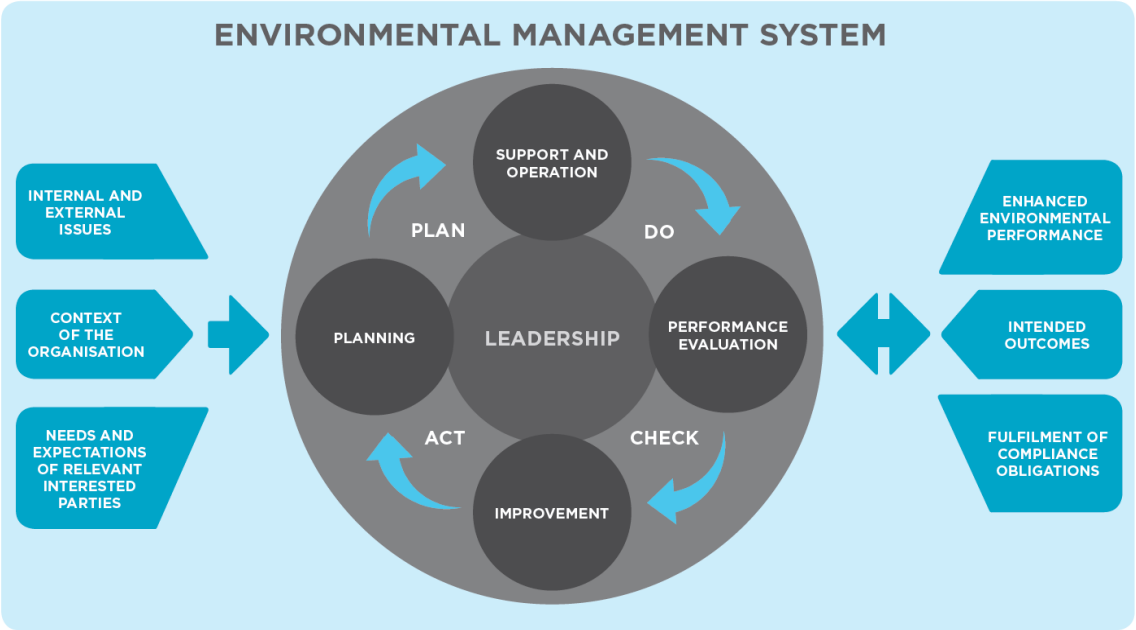

Figure 9: GPC's EMS Framework

(Source: GPC 2020

GPC's Risk Management Framework (**Table 15**) provides the processes to ensure the EMS suitably identifies, analyses and evaluates, manages and monitors all aspects under the control or influence of GPC. The risk management process is an integral component of GPC's organisational and operational decision making and ensures all elements of potential impacts are assessed i.e. environmental, compliance, interested parties (stakeholders), project delivery etc.

Table 15: GPC's Risk Management Process

Risk management process	Description
• Identify risks (what could stop you from achieving your objectives?)	• Understand the context of any potential risks. • Review sources and impacts of risks. • Describe risks in clear and concise language.
• Analyse and evaluate risks (determine the potential impacts of each risk and their likelihood of occurrence)	• Use the best available information to develop an understanding of the risk. • Identify controls in place to reduce the consequence or likelihood of the risk. • Consider the effectiveness of controls. • Evaluate the risk by nominating realistic consequence impacts. • Make likelihood assessments for each nominated consequence impact. • Map the consequence and likelihood ratings to the GPC Risk Matrix.
• Manage risks (authorisation and escalation, treatment and recording)	• Risks with a residual risk score of Medium and above must be escalated for review and authorisation prior to works commencing.

Risk management process	Description
	• Risk treatments to consider the hierarchy of controls, timing and resourcing. • Record risks in the approved risk assessment templates.
• Monitor and review risks	• Monitor the implementation and effectiveness of controls. • Risks assessed as high or extreme require status reports to GPC's Executive Leadership Team and the Board.

While each regulator has particular requirements for their assessment processes, risk assessment for maintenance dredging typically involves consideration of the following:

- Description of the proposed activity, including location, volumes of material to be removed, processes employed, duration and timing;
- Types of environmental risks and emissions, including water, land, air, waste and noise-related risks and emissions;
- The potential impacts of the dredging activity on environmental, social, cultural and heritage values;
- Description of the EVs both on and offsite that may be impacted by the dredging activity;
- Mitigation factors to prevent or minimise impacts on sensitive receptors, or the EVs, including options for monitoring, managing and mitigating the potential impacts of the proposed conduct; and
- An evaluation of all alternatives to sea placement (including all land-based placement and reuse alternatives.

Risk assessments are conducted for all new or changed activities and specifically for maintenance dredging prior to each dredging campaign ensuring risk controls are current, appropriate, communicated, implemented and monitored.

7 Identification and Treatment of Key Risks

The risk assessment process (Section 6) informs the development or review environmental and regulatory risks each maintenance dredging activity. This in turn informs the development or review of the relevant EMP and Environmental Monitoring Procedure (Section 8 and Section 9) prior to each maintenance dredging campaign. This process may also inform the review of this LMDMP (Section 1.3).

The key aspects commonly identified for maintenance dredging activities in the Port of Gladstone include:

- Dredging and dredge material placement directly disturbing marine habitats;
- Dredge and dredge material placement plumes and sedimentation impacting water quality and marine habitats;
- Hydrocarbon, chemical and waste leaks and spills impacting water quality and marine habitats;
- Air, noise or light emissions impacting air quality, megafauna and sensitive places ;
- Marine megafauna strike;
- Severe weather events impacting normal operations;
- Marine pest introduction impacting marine habitat and normal operations ;
- Non-conformance with statutory obligations impacting normal operations and GPC reputation; and
- Negative stakeholder perception impacting normal operations and GPC reputation.

7.1 Queensland Maintenance Dredging Schedule

The maintenance dredging schedule for the majority of QLD port dredging is determined by the Port of Brisbane Pty Ltd (PBPL) who own and operate the *TSHD Brisbane*. The *TSHD Brisbane* is utilised by all QLD ports for the majority of maintenance dredging activities and by GPC for all main navigational channel maintenance dredging.

The process for development of the state-wide schedule was reviewed under the MDS. The schedule is developed annually in accordance with a QPA procedure (QPA 2021) which requires each port to define its maintenance dredging requirements and complete a port specific environmental risk assessment for maintenance dredging. PBPL develops the state-wide maintenance dredging schedule by taking into account:

- Volume of material to be dredged at each port (hence dredging duration);
- Urgency of maintenance dredging required by individual ports (i.e. the degree of siltation, safety issues and schedule of deeper draft ships that may visit the port);
- Any permit specific issues (e.g. permit availability and conditions);
- Need to optimise dredge operation (e.g. avoid backtracking between ports);
- Opportunities to minimise the dredging duration at each port. Dredge operation is expensive and operational efficiency is a key management objective; and
- Important ecological and environmental timings.

This process is generally completed by late April once wet season effects (e.g. cyclones, floods) to both EVs and siltation levels can be confirmed. The schedule, once complete is provided to TMR and published on their website in accordance with the requirements of the MDS.

For the Port of Gladstone main channels, an abstract of the aspects and impacts register is prepared and provided to the PBPL to inform the development of the state wide maintenance dredging schedule. The most recent version of this abstract is provided on GPC's website. The following key factors relevant to the

Port of Gladstone are considered through this process:

- Seagrass and seagrass recruitment timings;
- Corals and coral spawning timings;
- Marine megafauna and breeding, internesting and migratory seasons;
- Extreme weather seasonality;
- Dredging requirements and;
- Regulatory approvals and conditions.

7.1.1 TSHD Brisbane

TSHDs have typically undertaken the majority of the maintenance dredging at QLD ports as they are the most suitable type of dredger. They have high production rates, can operate in offshore areas and heavily trafficked areas, have a hopper allowing offshore placement, and are well suited to dredging soft unconsolidated sediment typically associated with maintenance material (Haskoning Australia 2016).

The *TSHD Brisbane* was specifically designed for the maintenance dredging of QLD ports and has been the equipment of choice of the QLD ports to undertake the maintenance dredging programs since it was commissioned in 2000 (Haskoning Australia 2016). Whilst it is noted that future maintenance dredging could be undertaken by other TSHDs with similar equipment features, the maintenance of GPC's main navigational channels has been undertaken by the *TSHD Brisbane* since 2000 and as such GPC's impact assessment and management measures for main channel maintenance dredging are primarily focused on this vessel.

The *TSHD Brisbane* was designed with mechanisms to mitigate the environmental impacts caused by the dredging operations. These mechanisms are equivalent to the features installed in the latest TSHD models used around the world. Since the commissioning of the *TSHD Brisbane* it has been updated regularly to incorporate the latest environmental advances in dredging technology, ensuring *the TSHD Brisbane* operates at the same level as the most recent built TSHDs (Haskoning Australia 2016). The environmental impact mitigation features are described below:

- **Central weir discharge system (green valve or anti turbidity function):** this system works by controlling discharge from the dredger to limit the turbidity of overflow waters entering the receiving environment. The *TSHD Brisbane* has five (5) equally spaced conical valves in the floor of the hopper which when opened release the material. The middle valve (DV3) is surrounded by a set of six (6) cylindrical rings stacked on top of each other to form a weir of adjustable height. When dredging light material such as silts, only the top ring is lifted to create the largest possible hopper capacity and settling time for the material. When the hopper reaches point of overflow, DV3 is partially opened to allow excess water to escape. The aperture of DV3 is regulated to maintain a water column within the circular weir stack and thereby minimise the entrapment of air in the overflow water. This reduces the amount of air bubbles which can act to carry material to the water surface and generate excessive plumes.
- **Below keel discharge point:** the discharge of sediment from the hopper occurs at keel level in order to prevent unnecessary turbidity and dispersal of fine sediments.
- **Turtle deflection devices:** a flexible chain deflector is attached to the dragheads to prevent the entrainment of marine turtles during dredging operations. The device design has been evolving for the last 20 years and its efficiency confirmed by several research projects.
- **Low wash hull design:** by minimising the size of wash waves created by the vessel movement, the low wash hull design reduces agitation on the water surface, minimising the interference with the sediments suspended in the water column during discharge. This design can also reduce fuel consumption and damage to riverbank environments.
- **Electronic positioning system:** the *TSHD Brisbane* is equipped with a DGPS which is used during the operations. The positioning data is used during the discharge operations to identify the beginning and end of the material placement locations and provide evidence to the regulators to ensure compliance with the material placement boundaries. The DGPS data also assists the contractor and clients to identify the areas of origin of the sediment for each cycle.
- **EMP:** PBPL maintain a Dredge Management Plan which addresses standard operational procedures to minimise environmental impact. Separate EMPs are also developed by PBPL for each specific port / project where it undertakes dredge works. Each EMP addresses matters specific to the project including possible risks and their associated mitigation and management actions, roles and responsibilities, local regulations, sensitivities and specific permit conditions. It is submitted for review and approval by each port prior to commencement of the work.

In accordance with Principal 10 of the MDS, any other TSHDs undertaking maintenance dredging works in the future at the ports within the GBRWHA should result in environmental performance that is equal to or better than current equipment or methods used for navigational channel maintenance.

8 Environmental Management

Consistent with the MDS framework, GPC utilises three (3) tiers of documentation for the management and monitoring of maintenance dredging activities at the Port of Gladstone as detailed below and shown in **Figure 10**. These documents provide a comprehensive approach for planning and managing maintenance dredging over both the long term and for short term specific dredging

campaigns. This structure provides consistency in achieving a comprehensive and strategic approach with respect to maintenance dredging and associated environmental management, which will provide benefits to port authorities and regulators over the longer-term. Additional key inputs to this process are the results of stakeholder engagement which are summarised in Section 1.7.2, Section 1.7.3 and Section 4.

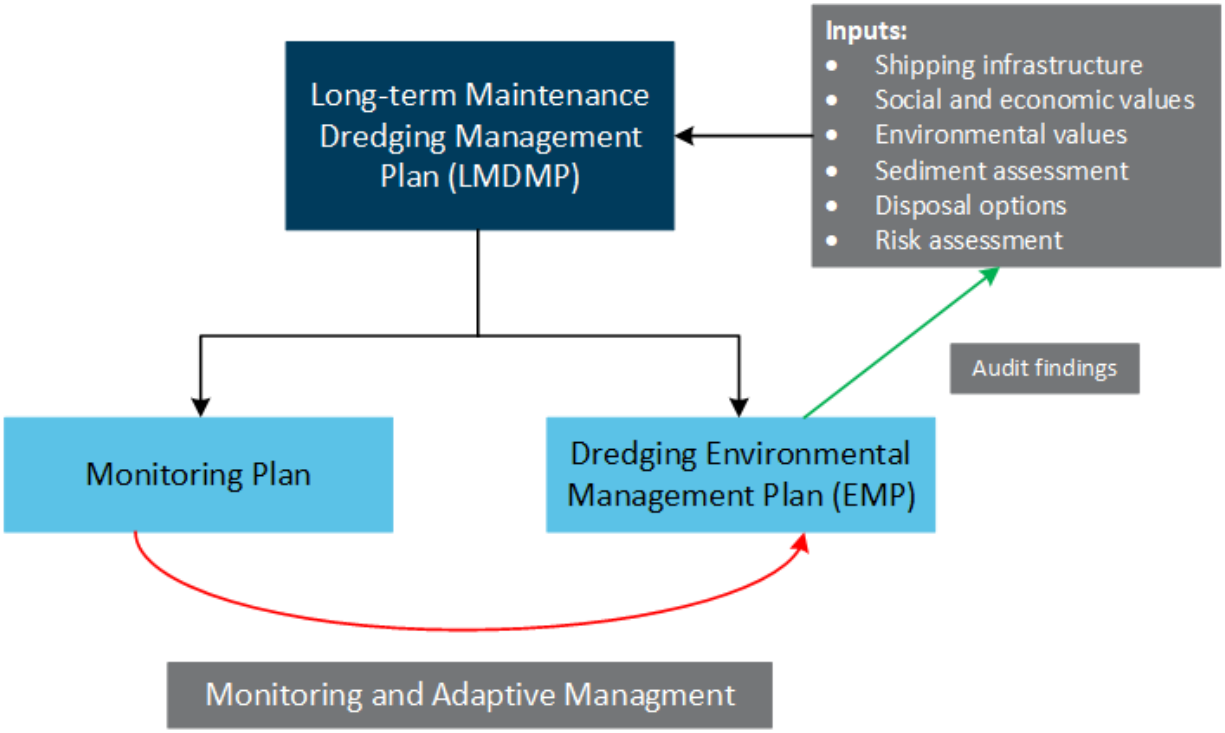

Figure 10: Elements of Dredging Management and Monitoring
(Source: TMR 2018a)

The Port of Gladstone's maintenance dredging EMPs are developed in alignment with GPC's EMS and Risk Assessment Framework (Section 6 and Section 7) to ensure an appropriate standard of risk assessment, quality assurance and document control. EMPs detail the specifics of managing each dredging campaign and includes the following:

- Roles and responsibilities;
- Location and description of the activity;
- Scheduling and timing of the dredging operations;
- Statutory obligations and approvals;
- Measures to meet permit conditions;
- Pre-dredging actions such as notifications, linkages to monitoring plans, dredge selection;
- Standard management measures relating to:
    - waste management;
    - ballast water management;
    - bunkering of fuel;
    - vessel wash-down;
    - marine pest monitoring and management; and
    - other key risks identified by the risk assessment process (Section 6 and 7);
- Adaptive management measures relating to:
    - water quality; and
    - marine fauna;
- Operation and incident reporting;
- Post-dredging actions such as surveys, monitoring, auditing and reporting; and
- Emergency provisions and contacts.

In particular, the EMP outlines strategies and actions to minimise impacts and to avoid contamination and pollution and provide linkages to the environmental monitoring program (Section 9). This should include applicable Master Plan commitments (TMR 2018b):

- Specific and auditable measures to avoid or reduce impacts (for both the dredge and dredge material placement sites);
- Triggers and adaptive responses where necessary;
- Contingencies for natural events such as cyclones and floods;
- Compliance monitoring and reporting;
- Corrective actions for impacts identified by monitoring;
- Responsibilities and timing for management and monitoring activities.

The implementation and effectiveness of risk controls are monitored through EMS processes such as periodical risk reviews, audits, inspections, incident and complaint investigations and reporting (Section 10) to ensure learnings are applied appropriately and continual improvement is facilitated.

9 Monitoring Framework

An Environmental Monitoring Procedure is developed to monitor the effects of dredging activities and inform adaptive management. A key input into this procedure is the stakeholder engagement outlined in Section 1.7.2. The procedure implements relevant monitoring programs for each maintenance dredging campaign and includes:

- A port specific program addressing values and risks;
- Appropriate Quality Assurance and Quality Control (QA / QC);
- Data management and reporting requirements;
- Responsibilities and timing for management and monitoring activities (**Table 2** and **Table 16**); and
- The identification of monitoring as follows:
    1. ambient monitoring programs; ongoing and related to key environmental parameters, used to inform impact assessment;
    2. impact detection; before and after dredging analysis to confirm and refine impact management; and
    3. real time monitoring; during dredging to inform adaptive management response actions.

GPC focusses monitoring of the marine environment where:

- Sensitive or particularly high EV habitats may be adversely affected through the maintenance dredging activities; or
- There are gaps in knowledge or some uncertainty regarding the extent of potential impact and confirmation of assumptions or previous monitoring is considered warranted.

GPC's long-term monitoring schedule (**Table 16**) includes sediment sampling, plume monitoring, water quality sampling, seagrass, reef and benthic invertebrate monitoring as well as hydrographic surveys. The long-term monitoring schedule is a revision and continuation of a program which has been in place since 2014. It has been developed though consultation with the TACC (Appendix A) and regulatory authorities and takes into account the modelling and impact hypotheses made by BMT (2021) (Section 3.3) as well as the outcomes of the previous monitoring.

The program displayed in this section relates to the annual maintenance of the main channels. It provides an overarching framework for any infrequent maintenance dredging of additional infrastructure also, particularly the ambient monitoring programs. Monitoring programs for infrequent maintenance dredging of additional infrastructure are developed and documented in the relevant management documentation developed for the works.

Table 16: Long-term Monitoring Schedule

Monitoring Component	Ambient, Impact detection, Real-time	Monitoring Objective	Activity	Impact Severity Zones	Description	Monitoring Period 2023	2024	2025	2026	2027	2028
Sediment quality	Impact detection	Placement of dredged material will not result in contaminant related impacts to the marine environment	Placement	Zone of Impact	Sediment sampling and analysis in accordance with approved SAPs and comparison of levels to screening limits outlined in NAGD					X[1]	
Water quality	Real-time, Impact Detection	Sediments generated during dredging and dredge material placement do not subsequently reach sensitive areas in amounts that would be harmful to the ecological value and amenity of Port of Gladstone	Dredging and placement	Zone of Influence and Outside of Influence	Water quality monitoring adjacent to loading activities	X[2]	X[2]	X[2]	X[2]	X[2]	X[2]
	Impact detection			Zone of Impact.	Specialised sediment monitors for targeted investigations to assist in validation of hydrodynamic modelling	(3)	(3)	(3)	(3)	(3)	(3)
		Pollutant concentrations within dredge material placement plumes do not reach levels where toxic effects or algal blooms could occur	Placement	Zone of Impact, Influence	Bioavailability of contaminants	(4)	(4)	(4)	(4)	(4)	(4)
Water Quality (Plume Validation)	Impact detection	Sediments generated during dredging and dredge material placement do not subsequently reach sensitive areas in amounts that would be harmful to the ecological value and amenity of Port of Gladstone and / or Pollutant concentrations within dredge plumes at the loading and dredge material placement sites do not	Dredging and Placement	Zone of Impact, Influence and Outside of influence	Water quality measurements and samples collected from within the plume	(5)	(5)	(5)	(5)	(5)	(5)

Monitoring Component	Ambient, Impact detection, Real-time	Monitoring Objective	Activity	Impact Severity Zones	Description	Monitoring Period 2023	2024	2025	2026	2027	2028
		reach levels where toxic effects or algae blooms could occur									
Sensitive Receptors	Real-time	Maintenance dredging activities do not result in impact to sensitive receptors	Dredging	Zone of Influence	Benthic Photosynthetic Active Radiation (BPAR) monitoring for seagrass adjacent to loading activities	**X**[6]	**X**[6]	**X**[6]	**X**[6]	**X**[6]	**X**[6]
	Impact detection		Placement	Outside of Influence	Reef condition survey	**X**[7]					**X**[7]
Benthic habitats and communities	Impact detection	The placed dredge material does not result in long term changes to benthic communities outside MRA	Placement	Zone of Impact, Influence and Outside of Influence	Benthic fauna and flora (deep water seagrass) sampling and particle size analysis within and adjacent to MRA.				**X**[8]		
Hydrographic survey	Impact detection	The placed dredge material does not result in navigation hazards within and adjacent to the MRA	Placement	Zone of Impact	Hydrographic survey of MRA	**X**[9]			**X**[9]		**X**[9]
Marine pests	Impact detection	Maintenance dredging does not result in the introduction of marine pests into new environments within Port of Gladstone	Dredging and Placement	Zone of Impact, Influence and Outside of Influence	Survey of the location and status of marine pests within the port			**X**[10]			
Water quality, benthic habitats and communities	Ambient	N/A	N/A	N/A	PCIMP and GHHP data	**X**[11]	**X**[11]	**X**[11]	**X**[11]	**X**[11]	**X**[11]
					Coastal seagrass meadow mapping and meadow transects throughout Port of Gladstone.	**X**[12]	**X**[12]	**X**[12]	**X**[12]	**X**[12]	**X**[12]
					Deepwater seagrass survey throughout Port of Gladstone.		**X**[13]				

(1) Last undertaken in November 2022, undertaken every five (5) years.
(2) Monitoring in accordance with the Monitoring Procedure. Includes telemetered turbidity at two (2) inner harbour locations during dredging; one (1) compliance site; and one (1) support site for reference. Water samples analysed for metals once before, during and after dredging at defined sites.
(3) To assist in validation of any proposed alternatives (e.g. SSM Project continuous improvement options)
(4) Bioavailability study results in alignment with the NAGD were presented to the TACC in July 2019 and further studies will be conducted when required.
(5) Validation of current modelling is complete. Further plume sampling would be scheduled in the event that the dredging activity or sediment characteristics changed and / or new information for impact modelling was required.
(6) Monitoring in accordance with the Monitoring Procedure. Telemetered BPAR at Passage Island seagrass meadows within the potential Zone of Influence during dredging with trigger limit applied for compliance.
(7) Last undertaken in 2018, undertaken every five (5) years.
(8) Last undertaken in 2021. This would normally be undertaken every five (5) years. Scheduled to ensure it occurs prior to SAP to spread budget costs.
(9) Indicative timeframes only. A survey must be undertaken prior to the commencement, at least once during (approximately half way through) and after the completion of all placement activities under the five (5) year term of this LMDMP.
(10) Last survey undertaken in 2020. Propose five (5)-yearly but may increase if risk level increases.
(11) Ongoing commitment to PCIMP and GHHP programs.
(12) Broad scale surveys and mapping via annual surveys
(13) Broad scale surveys and mapping via five (5)-yearly surveys.

9.1 Real-time monitoring and adaptive management

Where relevant, information from the monitoring programs is used to inform any required changes to the maintenance dredging program (adaptive management) to ensure that management of maintenance dredging is effective.

As described in Section 3.3, based on plume modelling outputs for a main channel maintenance dredging campaign of 340,000 m^3 and in an unmitigated scenario, seagrass meadows surrounding the Passage Islands is located in the Zone of Influence. These meadows experience the greatest duration and intensity of dredge plumes in modelling scenarios. To ensure that these potential plume related impacts do not occur, GPC employs a real time water quality and adaptive management framework based on Turbidity and Photosynthetic Active Radiation (PAR). This monitoring is undertaken to:

- Measure water quality impacts at potentially impacted sensitive receptor sites; and
- Determine the need or otherwise for further more detailed investigations and implementation of mitigation measures.

9.1.1 Turbidity

Turbidity is a measurement of water clarity and is influenced by suspended matter (organic and inorganic) and dissolved organic matter. Turbidity is an expression of the optical property of light to be scattered and absorbed rather than transmitted through the water sample, with a greater amount of matter within the water column leading to a higher amount of light scattering and thus higher turbidity.

The turbidity monitoring sites and trigger limits utilised for Port of Gladstone main channel maintenance dredging activities are detailed in **Table 17**. Sites and trigger limits have been selected from pre-established monitoring locations based on the hydrodynamic modelling outputs and mapped sensitive receptors. To adaptively manage water quality during dredging activities Sensitive Receptor Water Quality Trigger Flowcharts (**Figure 11** and **Figure 12**) have been developed.

Table 17: Management Trigger Summary
(Source: GPC 2018)

Site	Status	Zone	Parameter	Wet Season Triggers 01 Oct – 31 Mar	Dry Season Triggers 01 Apr – 31 Sep	Data requirements
WB50	Compliance	Western Basin	Turbidity (NTU) / Telemetry	30 NTU (80th %ile of the six (6) hour Exponentially Weighted Moving Average (EWMA) applied to background turbidity data – internal alert trigger) 48 NTU (95th %ile of the 6 hour EWMA applied to background turbidity data – external notification trigger)	17 NTU (80th %ile of the 6 hour EWMA applied to background turbidity data – internal alert trigger) 27 NTU (95th %ile of the 6 hour EWMA applied to background turbidity data – external notification trigger)	Real time data feed to GPC. SMART deconfounded data + 6 hourly EWMA plot
MH10	Support	Inner Harbour	Turbidity (NTU) / Telemetry	n/a	n/a	Real time data feed to GPC. SMART deconfounded data + 6 hourly EWMA plot

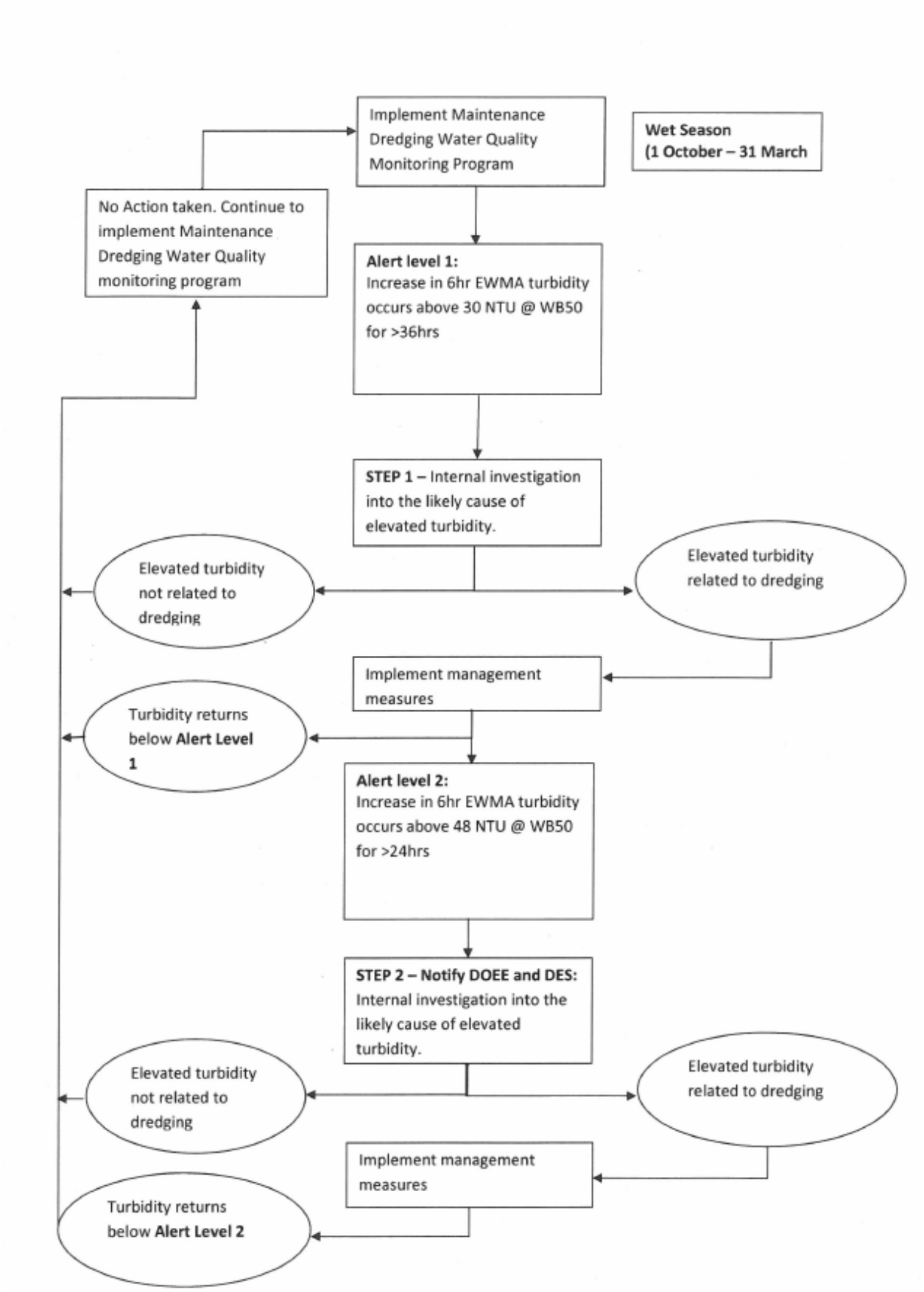

Figure 11: Sensitive Receptor Water Quality Trigger Flowchart (Wet Season)
(Source: GPC 2018)

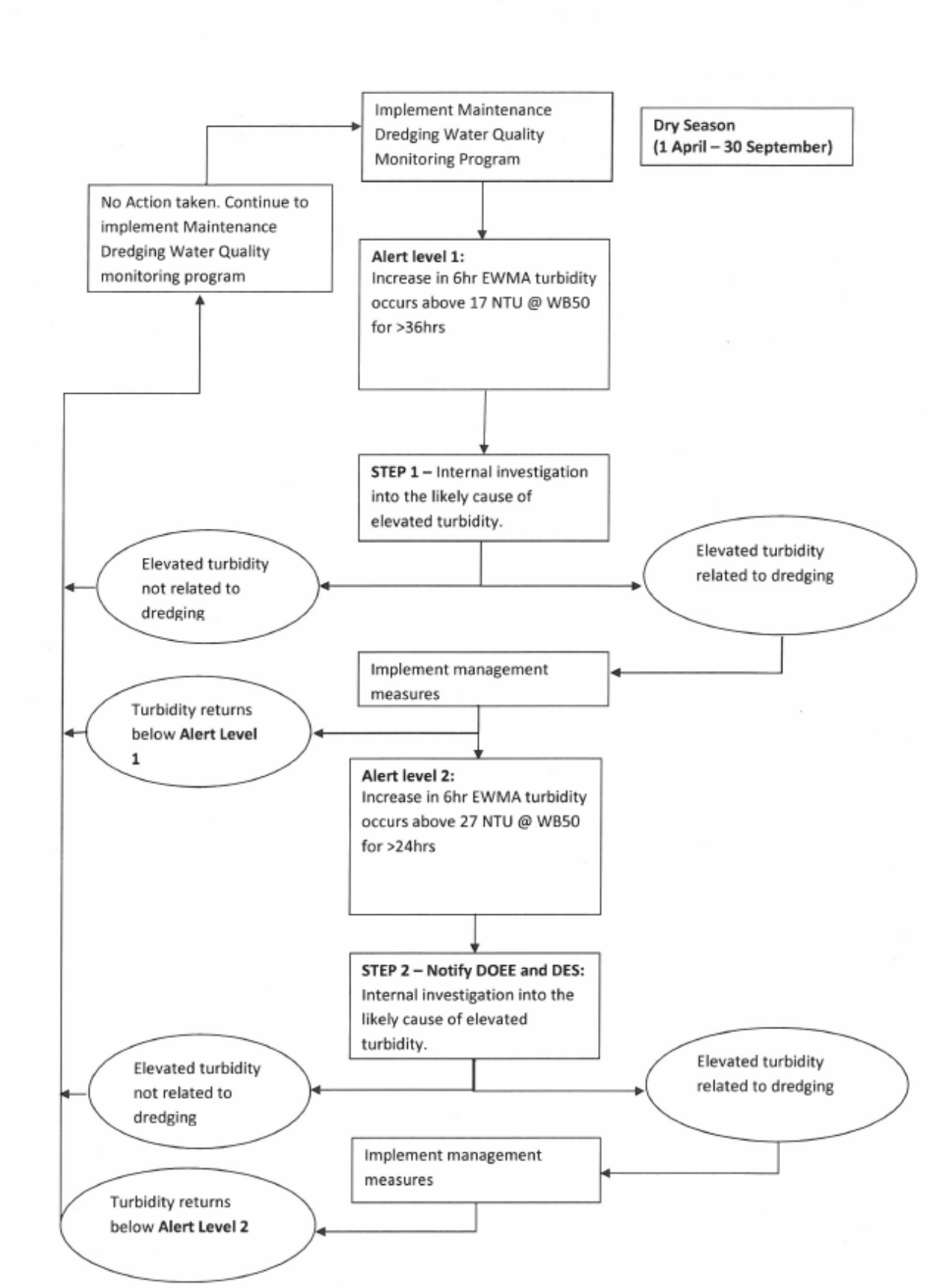

Figure 12: Sensitive Receptor Water Quality Trigger Flowchart (Dry Season)
(Source: GPC 2018)

9.1.2 Photosynthetically Active Radiation

Measurement of the light, or PAR reaching the seagrass is a key parameter of interest in order to determine whether sufficient light has reached the seagrass to meet seagrass growth requirements and maintain seagrass health.

Zostera muelleri subsp. *capricorni* (here in referred to as *Z. muelleri*) is present in the nearshore areas of Port Curtis and can survive up to a month at low light levels (5 percent surface irradiance). Shading studies within Port of Gladstone (Chartrand et al. 2012) have shown that *Z. muelleri* is most vulnerable to shading during the growth season, between July and January. Based on a combination of field experiments and observations, a light-based trigger value of 6 mol/m^2/day within a rolling two (2)-week average is required to sustain or increase *Z. muelleri* meadows in the growing season. *Z. muelleri* tolerates reductions in light occurring up to two (2) weeks in duration during the growth season.

Passage Island seagrass meadows are located in the Zone of Influence and therefore a BPAR monitor is placed at this location to monitor the light conditions during dredging. This site (WB25) is shown on **Figure 14** along with additional monitoring locations used for other elements of the monitoring program for maintenance dredging of the main channels (**Table 16**). To adaptively manage water quality during dredging activities a Sensitive Receptor Water Quality Trigger Flowchart (**Figure 13**) has been developed utilising the light based trigger value to ensure that light stress impacts due to dredging do not occur. Even though the trigger is only applicable to the growing season, GPC undertake BPAR monitoring during each maintenance dredging campaign.

Season	Rule	Condition	Activity
Growing (July –January**)	1. Go	BPAR 14 days rolling average >6 mol m^{-2} d^{-1}	None required
	2. Internal alert	BPAR 14 day rolling average <6 mol/m^{-}/d	Increased surveillance (e.g. data accuracy, equipment status, dredge operations check, environmental conditions check).
		BPAR 14 day rolling average <6 mol/m^2/day for >3 but <5 continuous days	Review data for potential causal factors (e.g. equipment status, rainfall, wind, dredging activity etc. (e.g. logger functionality, rainfall, wind, dredging activity etc.). Notify internal stakeholders.
	3. Investigate	BPAR 14 day rolling average <6 mol/m^2/day for>5 continuous days	Review and investigate causal factors and document findings.
	If significant weather event has been identified as causal factor, hold at 3 and continue monitoring light/seagrass*		
	4. Action	BPAR 14 day rolling average <6 mol/m^2/day for 7 continuous days	Trigger meeting of internal stakeholders and dredging contractor to review findings of the investigation and determine potential actions for dredge management and seagrass protection.
		BPAR 14 day rolling average <6 mol/m^2/day for 10 continuous days	Implement agreed actions for dredge management and seagrass protection.
		BPAR 14 day rolling average <6 mol/m^2/day for 14 continuous days	GPC notification external regulator(s).

* GPC to provide notification to the regulator(s) on the 14th consecutive day of BPAR 14 day rolling average <6 mol m^{-2} d^{-1}. Notification will provide clarification that the low light conditions are a result of the significant weather event.
** Growing season based on Chartrand et al. (2012).

Figure 13: Sensitive Receptor Water Quality Flowchart (BPAR): Sensitive Receptor Water Quality Flowchart (BPAR)

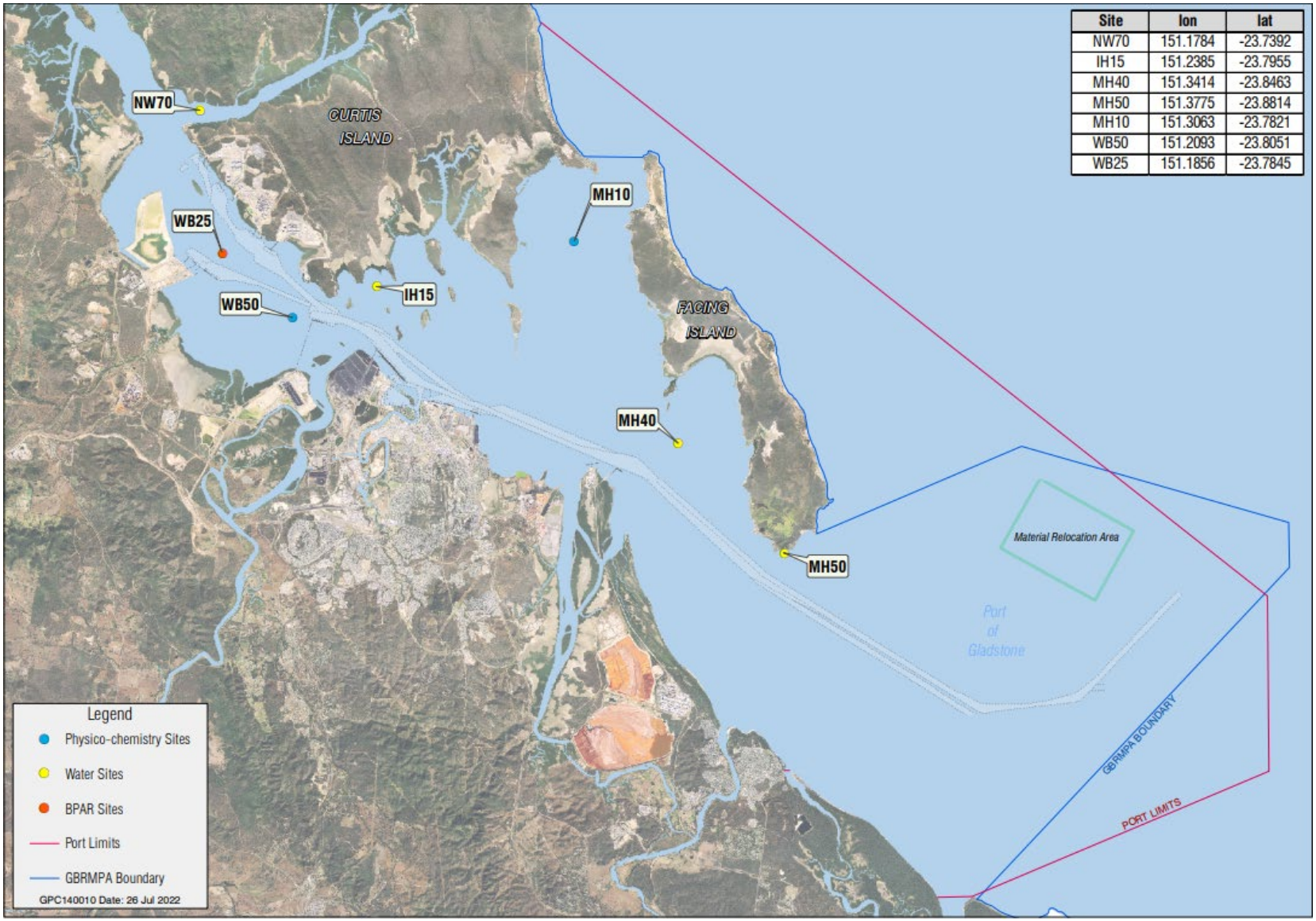

Figure 14: Main Channel Maintenance Dredging Monitoring Sites
(Source: GPC 2023)

10 Performance Review

GPC's EMS (Section 6) provides the framework for governance by setting the rules and expectations for environmental management. This framework ensures the objectives of this LMDMP and its associated management documents are being met to better inform future risk assessment and impact assessment processes for the Port of Gladstone maintenance dredging activities. This framework also ensures enhanced environmental performance and the fulfilment of compliance obligations.

GPC's environmental performance monitoring processes include; but are not limited to:

- Performance indicators;
- Audits and inspections;
- Nonconformity and corrective action;
- Environmental monitoring and data;
- Reporting – internal and external;
- Document and record control; and
- Contingency planning.

All of these processes detailed further below contribute the EMS's contribution to the continual improvement framework outlined in Section 1.3 of this LMDMP which includes revaluation of GPC's options for managing port sediments.

10.1 Performance indicators

Performance indicators allow GPC to determine the effectiveness of the dredging operations against risk based criteria and statutory approval conditions. Performance indicators employed by GPC to manage each dredging operation are detailed for each potential risk category in the EMP (Section 8). This incorporates monitoring undertaken under the Environmental Monitoring Procedure (Section 9).

10.2 Audits and Inspections

Audits and inspections will be undertaken to confirm that activities are carried out in line with the defined requirements set out in this LMDMP and associated management documents, including performance indicators (Section 10.1) as audit criteria. Audits and inspections may also include assessing GPC's compliance with relevant legislation or other compliance obligations.

Audits and inspections will be initiated and completed by the relevant GPC Department or by a suitably qualified auditor nominated by the GPC Department. Audit reports may be provided to external regulatory authorities as and when required. The PSD Department will provide audit findings and reports to the GPC Department as the department responsible for the dredging works.

10.3 Nonconformity and corrective action

Events such as incidents, complaints and monitoring exceedances result in investigations to determine root cause and corrective action. The processes for responding to non-conformances are detailed in the EMP (Section 8). Reporting to regulatory authorities is undertaken in accordance with the conditions of statutory authorities relevant to maintenance dredging as described in the EMP (Section 8).

Corrective actions ensure that GPC mitigates the reoccurrence of environmental incidents, complaints and monitoring exceedances and ensures continuous improvement of dredging operations. Corrective actions identified by GPC to manage the dredging operations are detailed for each potential risk category in the GPC EMP. This incorporates monitoring undertaken under the Environmental Monitoring Procedure (Section 9).

10.4 Monitoring data

Monitoring and data analysis conducted by GPC provides the information required to inform the risk assessment framework, adaptively manage operations and demonstrate compliance. GPC's data management process ensures QA / QC. These processes are described in the Environmental Monitoring Procedure (Section 9). Monitoring report and data availability is discussed in Section 1.7.4 and Section 11.

10.5 Internal and external reporting

To ensure GPC's Executive Leadership Team are fully informed as appropriate, of the risks associated with maintenance dredging, reporting is undertaken in accordance with the Risk Management Framework (Section 6). Reporting to regulatory authorities is undertaken in accordance with the conditions of statutory authorities relevant to maintenance dredging described in the EMP (Section 8).

GPC participates in comparative analysis and coordinated maintenance dredging reporting to TMR in accordance with Principal 8 of the MDS and communicates with the TACC and other stakeholders as detailed in Section 1.7.2 and Section 1.7.3). A summary of key information and accessibility is provided in Section 11.

10.6 Document and record control

All documents and records required by this LMDMP will be managed in accordance with GPC's Information, Document and Records Policies Standards and Procedures. Key examples include:

- Records of continual improvement processes including review of management and monitoring program outputs (Section 1.3);
- LMDMP implementation including GPC employees and contractor familiarisation, approval by GPC representatives and regulatory authorities, review of the plan, version control and publication (Section 1.4);
- Statutory approvals (Section 1.6);
- TACC membership, consultation records and outcomes (Section 1.7.2);
- Independent review records (Section 1.7.3);
- Availability of reports and data and reporting under the MDS (Section 1.7.4 and Section 11);
- Stakeholder consultation in the development and review of this LMDMP (Section 4);
- Risk assessments and the identification and treatment of risks (Section 6, Section 7);
- Assessment of maintenance dredging and dredge material placement options including efforts to minimise maintenance dredging and dredge material placement (Section 5.3 - 5.6);
- GPC input into the development of the state-wide maintenance dredging schedule including the consideration of relevant ecological timings (Section 7.1);
- The environmental performance of any alternate TSHD (Section 7.1.1);
- Monitoring and management controls including implementation of the long-term monitoring schedule, EMPs and Environmental Monitoring Procedures (Sections 8 and 9); and
- Governance records (Section 10).

Further document and record requirements are described in the GPC's EMPs and Environmental Monitoring Procedures.

10.7 Contingency planning

Although management measures employed by GPC and dredging contractors during maintenance dredging cover most potential aspects and impacts, contingency arrangements are required in the event of emergency or abnormal operations. Potential emergency or abnormal operations are

assessed in accordance with the GPC Risk Management Framework (Section 6). Contingency planning and emergency response during dredging operations is detailed in the EMP.

11 Supporting Information

A range of studies relevant to maintenance dredging inform the preparation of this LMDMP and its associated management documents. These include the outcomes of programs in the long-term maintenance dredging monitoring schedule (Section 9, **Table 18**). The following provides a summary of the key studies and their accessibility. This information will be updated and revised periodically taking into account recent investigations in response to changes in risk or as a result of the completion of monitoring as per the long-term maintenance dredging schedule.

Table 18: Supporting Information Synopsis

Document	Author	Description	Availability	Next scheduled revision
External Information				
Reef 2050 Long-Term Sustainability Plan (2021)	Commonwealth of Australia	In 2015, the Commonwealth and Queensland governments released the Reef 2050 Plan. The Reef 2050 Plan responds to the World Heritage Committee's recommendation that Australia develop a long-term plan for sustainable development to protect the OUV of the GBR.	Department of Climate Change, Energy, the Environment and Water (DCCEEW) website	2025 (every five (5) years)
Maintenance Dredging Strategy (2016)	TMR and Haskoning Australia	The aim of the MDS for GBRWHA Ports is to provide a framework for sustainable, leading practice management of maintenance dredging at ports in the GBRWHA.	TMR website	Not specified
Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports: Technical Supporting Document (2016)	TMR	The MDS is based on the findings of a Technical Supporting Document providing a scientific and technical evidence basis for the guiding principles and actions.	TMR website	Not specified
Guidelines for Long-term Maintenance Dredging Management Plans (2018)	TMR	The Guidelines for LMDMPs support the MDS by providing State guidance on long term planning and management approaches which should be applied to maintenance dredging of ports in the GBRWHA. The Guidelines assist each GBRWHA port in preparing a LMDMP.	TMR website	Not specified
Long Term Monitoring and Management Plan Requirements for 10 year Permits to Dump Maintenance	Commonwealth of Australia	A Long Term Monitoring and Management Plan (LTMMP) that covers the management of dredging at the port over the life of the permit needs to be submitted along with the permit application and approved DCCEEW prior to the issuing of the sea dumping permit. LTMMPs set out both the framework and specific measures for management, mitigation and monitoring of impacts	The Port overlay is the regulatory instrument that implements the Master Plan under the Sustainable	Not Specified

Document	Author	Description	Availability	Next scheduled revision
Dredge Material at Sea (2012)		and provide port authorities and other port managers with the opportunity to showcase their role as stewards for the marine environment. With reference to maintenance dredging the LTMMP needs to demonstrate how the environment at the port and surrounds will be protected over the longer term and should identify responsible parties and include mechanisms for the regular review of compliance with permit conditions, as well as a process for continuous improvement of environmental management and performance.	Ports Development Act 2015.	
Great Barrier Reef Quantitative Sediment Budget Assessment (2018)	BMT	The Reef 2050 Plan sets out strategies for protecting and managing the GBR. QPA is leading WQA17 of Reef 2050, which has the objective to: *"Understand the port sediment characteristics and risks at the four major ports and how they interact and contribute to broader catchment contributions within the World Heritage Area*."	GPC website	Not specified
Peer review of Water Quality Action 17 – Sediments and Dredging at Great Barrier Reef World Heritage Area Ports (2018)	P&CS	To inform this action, QPA commissioned the development of a quantitative sediment budget related to maintenance dredging at each of the six (6) GBR ports of Gladstone, Hay Point, Mackay, Abbot Point, Townsville and Cairns. The report underwent a technical peer review.	GPC website	Not specified
Schedule for State-wide Maintenance Dredging of Queensland Ports (2022)	QPA	The Schedule for State-wide Maintenance Dredging for Queensland Ports describes the schedule for maintenance dredging of Queensland ports by the *TSHD Brisbane*. The Schedule is prepared by the QPA before maintenance dredging activities commence. The Schedule is based on information provided by individual ports and the dredge operator.	TMR website	2023 (annual)
Maintenance Dredging of Queensland Ports Review of Activities (2022)	QPA	The QPA prepares an annual review of the outcomes of the maintenance dredging program in relation to environmental performance, including timelines, volumes, evaluation of dredge material placement options and locations, and outcomes of monitoring. The results of the annual review are incorporated into the dredging schedule for the following year.	TMR website	2023 (annual)
Environmental Code of Practice for Dredging and Dredged Material	Ports Australia	Leading practice management of environmental risks associated with dredging is well defined and recognised internationally and nationally. This Code of Practice sets out a series of	Ports Australia website	2021 (every five (5) years)

Document	Author	Description	Availability	Next scheduled revision
Management (Ports Australia 2016)		environmental principles that Australian ports follow when undertaking dredging and when reusing, relocating or placing dredged material.		
National Assessment Guidelines for Dredging (Commonwealth of Australia 2009)	Commonwealth of Australia	The NAGD set out the framework for the environmental impact assessment and permitting of the sea placement of dredged material. The framework includes: evaluating alternatives to ocean disposal; assessing loading and dredge material placement sites; assessing potential impacts on the marine environment and other users; and determining management and monitoring requirements.	Department of Climate Change, Energy, the Environment and Water (DCCEEW) website	Not specified
Information relevant to PCIMP and GHHP ambient environmental monitoring programs.	PCIMP and GHHP	The Port of Gladstone-based PCIMP program conducts ambient mid to far field monitoring of water bodies for the whole of Port of Gladstone and greater Port Curtis area. GPC is a member of PCIMP. PCIMP contributes data to the GHHP for use in an annual report card. The GHHP presents annual report cards containing the results from the testing of 107 measures within four (4) components comprising of environmental, social, economic and cultural health of Port of Gladstone and presents the evidence based findings to the community in an understandable manner. GPC is a partner of GHHP. These programs provide ambient data for Port of Gladstone and is used for impact assessment.	PCIMP website GHHP website	2022 (annual)
GPC Information				
Environmental Authority - EPPR00570813	DES	Environmentally Relevant Activity (ERA) 16 – extraction and screening in the approved maintenance dredging footprint, and includes land and in-channel placement options. Issued 2022.	GPC website (attachment to EMP)	N/A
Sea Dumping Permit - SD2018 3762 V2	DCCEEW	Approval to load for the purposes of dumping, and to dump up to 57,689cubic metres (in-situ) of dredged material, derived from maintenance dredging of the channels, swing basins and berths at the Port of Gladstone, Queensland; Issued 29/09/2023.	GPC website (attachment to EMP)	January 2024
Material Change of Use and Operational Works – 2206-29253 SDA	GPC, SARA	Volume based trials to place maintenance dredging material into new in-channel MRAs. Tide Island (for Jacobs Channel up to 70,000m^3) and Clinton Channel (for the Marina up to 150,000m^3)	To be published on GPC website prior to use	Upon completion of the approved trials

Document	Author	Description	Availability	Next scheduled revision
LMDMP (2023) *(document number 1385321 V7)*	GPC	The QLD Ports MDS provides a framework for sustainable, leading practice management of maintenance dredging at ports in the GBRWHA (TMR 2016). The objective of the framework is to ensure the ongoing protection of the GBR's OUV and the continued operating efficiency of ports within the GBRWHA. This LMDMP for the Port of Gladstone has been developed in accordance with the MDS framework. It is supported by the relevant EMP and / or monitoring procedure. It is relevant to all planned and potential maintenance dredging activities undertaken by GPC within the Port of Gladstone Port Limits. This LMDMP will replace GPC's previous LMDMP approved by regulatory agencies in 2018.	GPC website	2028 (every five (5) years or as required)
EMP (2022) *(document number 879363 V20)*	GPC	The Port of Gladstone's Maintenance Dredging EMPs are developed in alignment with GPC's EMS and Risk Assessment Framework to ensure an appropriate standard of risk assessment, quality assurance and document control. EMPs detail the specifics of managing each dredging campaign. In particular, the EMP outlines strategies and actions to minimise impacts and to avoid contamination and pollution and provide linkages to the environmental monitoring program. This EMP is specifically developed to manage GPC's main channel maintenance dredging and sea placement activities and has been approved by the DES and DCCEEW.	GPC website	2023 (annual or as required)
Environmental Monitoring Procedure (2022) *(document number 1013458 V24)*	GPC	An Environmental Monitoring Procedure is developed to monitor the effects of dredging activities and inform adaptive management. The procedure implements relevant monitoring programs for each maintenance dredging campaign. This Environmental Monitoring Procedure is specifically developed to manage GPC's main channel maintenance dredging and sea placement activities. It implements the annual requirements of the long-term monitoring schedule and has been approved by the DES and DCCEEW.	GPC website	2023 (annual or as required)

Document	Author	Description	Availability	Next scheduled revision
TACC ToR (2022) *(document number 1314897 V15)*	GPC	GPC has established a TACC for Port of Gladstone maintenance dredging operations. A TACC is an important consultative mechanism intended to ensure that interested stakeholders have a forum to understand GPC's maintenance dredging activities and to assist GPC and regulatory agencies to access local knowledge and reconcile stakeholder interests. The GPC TACC ToR includes important information about the scope, objectives, membership and administration of the TACC.	GPC website	2027 (every five (5) years)
TACC Minutes (2022) *(document number 1779293)*	GPC	Outcomes of the most recent TACC meeting providing an operations update, environmental update, LMDMP discussion and an update of the SSM Project.	GPC website	2023 (annual or as required)
Risk assessment for scheduling annual maintenance dredging at the Port of Gladstone (2022) *(document number 1316395V13)*	GPC	This risk assessment is conducted to inform the Schedule for State-wide Maintenance Dredging for Queensland Ports and provides information to; • Determine if there are any Gladstone specific risks associated with the scheduling of maintenance dredging by the *TSHD Brisbane* with a focus on environmental windows impacting on key EVs; • Identify if any changes in current control measures are required; and • Demonstrate GPC's dredging activities are managed in accordance with the principles of the MDS. GPC's assessment and performance reporting to TMR is undertaken in accordance with a QPA procedure which ensures consistency between ports (QPA 2021).	GPC website	2023(annual)
Port of Gladstone Maintenance Dredging Impact Assessment (2021) *(document number 1711156)*	BMT	Gladstone Ports Corporation (GPC) is required to undertake environmental assessments of annual maintenance dredging whenever new dredging footprint is added to the Port's shipping channels . The aim of this assessment is to evaluate the effects of maintenance dredged areas within Gladstone Port, including newly created dredged areas in the Clinton Vessel Interaction Project (CVIP) channel footprint. The specific objectives of this assessment are to:	GPC website	2026 (every five (5) years or as required)

Document	Author	Description	Availability	Next scheduled revision
		• Based on a review of existing information, describe relevant matters of national and state environmental significance, and the location of sensitive ecological receptors, within the footprint and in adjacent areas potentially affected by maintenance dredging; • Undertake numerical modelling to simulate changes to turbidity and sediment deposition resulting from maintenance dredging; • Assess the potential impacts of the proposed maintenance dredging to water quality and marine environmental values, considering the vulnerability (exposure, sensitivity, adaptive capacity) properties of species and communities; and • Assess potential impacts to matters of national and state environmental significance from maintenance dredging.		
Boyne River Mouth Maintenance Dredging Impact Assessment (2022) (*document number 1785225)*	BMT	This report describes the approach and findings of the environmental assessment of the Boyne River maintenance dredging impacts to marine waters in Port of Gladstone. The specific objectives of the report are to: • Identify relevant MNES and MSES, and the location of sensitive ecological receptors, within the footprint and in adjacent areas potentially affected by maintenance dredging; • Assess potential changes to water quality and the marine environment associated with the proposed dredging; and • Assess potential impacts to MNES and MSES as a result of maintenance dredging	GPC website	2027 (every five (5) years or as required)
Port of Gladstone Maintenance Dredging 2022 SAP design (2022) (*document number 1821626)*	BMT	Sediment SAP design document provides the approved plan for the sampling and analysis of sediments from each of the areas requiring maintenance dredging. The SAP is be implemented every five (5) years. The specific SAP objectives are to: • Provide a summary of dredging and disposal operations • Identify a list of contaminants based on a review of existing data and potential contaminant sources • Determine the number of samples required to provide an adequate characterisation of the physical and	GPC website	2028

Document	Author	Description	Availability	Next scheduled revision
		chemical sediment properties in the entire area to be dredged • Establish Data Quality Objectives relating to quality assurance and quality control (QA / QC) standards and requirements • Provide a description of statistical procedures used to determine the contaminant status of the dredged material • Describe procedures for validating the analytical data to assess whether the sample collection, handling and laboratory analysis was undertaken to a standard allowing assessment of sediment quality against the appropriate NEPM and NAGD screening levels • Outline the proposed reporting framework.		
Port of Gladstone Maintenance Dredging 2022 SAP Implementation Report (2022) *(document number 1846570)*	BMT	Maintenance dredging sediment sampling and analysis in accordance with an approved Sediment Sampling and Analysis Plan (SAP) and comparison of levels to screening limits outlined in NAGD and other relevant guidelines. The results of this assessment assist in determining the suitability of sediment for land based re-use and unconfined offshore placement. GPC's impact detection sediment sampling and analysis ensures that the dredging and material placement will not result in contaminant related impacts to the environment.	GPC website	2028 (every five (5) years)
Gladstone Harbour Maintenance Dredge Monitoring Compliance Report (2022) *(document number 1845736)*	Vision Environment	This report presents the results of the water quality and BPAR monitoring and adaptive management undertaken during the main channel maintenance dredging campaign including real time physicochemistry and BPAR, and impact detection water analysis data. This monitoring assists GPC to determine compliance with statutory obligations, manage water quality and ensure that potential impacts seagrasses do not occur. GPC's real time and impact detection water quality and BPAR monitoring program ensures that sediments generated during dredging activities will not reach sensitive areas in amounts that would be harmful to the EV or	GPC website	2023 (annual)

Document	Author	Description	Availability	Next scheduled revision
		amenity of the area and will not result in impacts to sensitive receptors.		
Information and documentation relevant to the Deed of Agreement relating to sea placement of Maintenance Dredged Material at the Port of Gladstone by GPC GPC's SSM Project	Multiple	The SSM Project better informs GPC's understanding of sediment dynamics, characteristics, sedimentation rates that can be used to forecast dredging requirements, analysis of avoid, reduce and reuse options and the justification for proposed and / or selected sediment management solutions. The project also aimed to minimise environmental impacts and ensure the sustainability of maintenance dredging activities. In addition to delivering GPC's commitments under the Deed, the SSM Project aligns with the Commonwealth Government's overarching strategy for managing the GBR, as described by the Reef 2050 Plan and creates important linkages to relevant aspects of the MDS. The SSM Project forms part of GPC's water quality impact detection monitoring program improving our understanding of sediments generated during dredging and dredge material placement and their potential to impact ecological value and amenity of the area. Sustainable Sediment Management - Gladstone Ports Corporation (gpcl.com.au)	GPC website	Not specified
Monitoring of Maintenance Dredging Plumes – Gladstone Harbour, November and December 2018 (*document number 1478946*)	BMT	This monitoring built upon previous plume validation sampling to investigate Bioavailability of contaminants in dredging and dredge material placement plumes. Sediment concentrations, extents and longevity of turbid plumes created during dredging and dredge material placement activities measured. Concurrently, water quality sampling of the plumes measured standard physical chemical parameters, dissolved metals, nutrients and chlorophyll-a. This monitoring tests the impact hypothesis that pollutant concentrations within dredge material placement plumes do not reach levels where toxic effects or algal blooms could occur.	GPC Website	As required
Monitoring of Maintenance Dredging Plumes	BMT WBM	Water quality measurements and samples collected from within the plume.	GPC website	As required

Document	Author	Description	Availability	Next scheduled revision
– Gladstone Harbour (November 2014), March 2015 (*document number 1230493*)		This plume validation water quality monitoring contributes to the validation of the numerical modelling system and impact assessment process for maintenance dredging improving the confidence in impact hypotheses made.		
Facing Island reef surveys (2018) *(document number 1430554)*	BMT	An extensive network of nearshore reefs occurs on the eastern side of Facing Island. This reef system is located more than five (5) km from the MRA. GPC monitors the condition of reef assemblages at Facing Island every five (5) years. GPC's impact detection reef monitoring ensures that maintenance dredging activities do not affected adjacent reef communities.	GPC website	2023 (every five (5) years)
Port of Gladstone East Banks Sea Disposal Site Benthic Habitat Monitoring 2021 *(document number 1794283)* *Note: Includes deepwater seagrass in the vicinity of the MRA.*	Smith et al	This study describes the physical and other relevant characteristics of the MRA, assesses spatial and temporal patterns in benthic communities and sediments and assess the spatial extent of the near-field effect of material placement. GPC's impact detection macroinvertebrate monitoring ensures that deposited dredge material does not result in long term changes to benthic communities outside the MRA. In addition, deep water seagrass in offshore areas in the vicinity of the MRA are also surveyed. This monitoring provides ambient data for GPC and mapping is used for impact assessment.	GPC website	2026 (every five (5) years)
Hydrographic Survey, 2020.*(document number 1801997)*	Queensland Government Hydrographic Services	GPC undertakes hydrographic surveys of MRA to ensure that deposited material does not cause navigational hazard.	GPC website	2023 (once prior, once during and once after every five (5) year period)
Queensland Seaports eDNA Surveillance (Q-SEAS) marine pest pilot program 2019-2020 Port of Gladstone (2020) *(document number 1698193)*	DAF	The objectives of the monitoring is to describe the presence / absence of introduced marine species and marine pest species within key areas of the Port of Gladstone frequented by vessels, and subject to shipping and dredging activities. The QSEAS program occurs annually but every five (5) years the additional elements required to meet the LMDMP	GPC website	2025 (every five (5) years)

Document	Author	Description	Availability	Next scheduled revision
		monitoring objective are included in the monitoring and reporting.		
Seagrasses in Port Curtis and Rodds Bay 2021 Annual long-term monitoring *(document number 1781166)*	Chartrand KM, Rasheed MA and Carter AB.	Coastal seagrass monitoring in Port Curtis and Rodds Bay commenced in 2002 and has been conducted annually since 2004. Each year, monitoring meadows are assessed for changes in three (3) seagrass metrics; biomass, area and species composition. These monitoring meadows represent the range of different seagrass community types in Port Curtis and Rodds Bay. Changes in the seagrass metrics are used to develop a seagrass condition index. This monitoring provides ambient data for GPC and mapping is used for impact assessment.	GPC website	2023 (annual)
Sea Dumping Permit International Reporting 2022 *(document number 1848330)*	GPC	This information is required for Commonwealth Government's annual reporting obligation under the London Protocol and is a condition of the Sea Dumping Permit.	GPC website	2024 (annual)
Priority Port of Gladstone Master Planning – Local Expression of the OUV of the GBRWHA, Aurecon Brisbane, 2017. *(document number 1340043)*	Aurecon	The purpose of the port overlay is to implement the priority Port of Gladstone master plan under the Ports Act to ensure that the strategic vision, objectives, desired outcomes, state interests and priority management measures (PMMs) are achieved. The port overlay prescribes: 1. How the PMMs in the master plan are to be achieved, including the entity or entities responsible for the measures. 2. Matters which regulate development in the master planned area by stating aspects of development that may not take place or including measures to reduce the risk of environmental harm, or serious adverse natural, cultural, economic or social impacts in the master planned area 3. Matters an assessment manager under the *Planning Act 2016* must consider in assessing a development application for development in the master planned area 4. Matters which a local government or port authority must consider when making or amending a local	GPC website	As required

Document	Author	Description	Availability	Next scheduled revision
		planning instrument or land use plan		

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13 Appendix A – TACC Summary

The Port of Gladstone TACC collaborates in the development and review of GPC's Long-term monitoring schedule for annual main channel maintenance dredging. The key recommendations from this program initial development meeting held in 2012 are summarised in **Table 19**.

Table 19: Monitoring Recommendations made by the TACC for the Development of the Long-term Maintenance Dredging Monitoring Plan (LTTMP) in 2012

TACC Recommendation	GPC Action and Status
Investigate the effects of maintenance dredging on corals in the Port of Gladstone.	Reef condition surveys were included in the Long-term Monitoring Schedule to be undertaken every five (5) years.
Investigate the likelihood of oxygen depletion at the MRA.	This was tested through water and plume measurement and monitoring. During field investigations within observed plumes there was no evidence of reduced dissolved oxygen observed (BMT WBM 2014a). No further plume studies are proposed in the current long-term monitoring schedule.
Investigate the bioaccumulation at the MRA.	The deployment of oysters at the MRA in addition to the monitoring conducted in the wider area by the PCIMP was included in the Long-term Monitoring Schedule. This methodology is under review in the current long-term monitoring schedule.
Retain species level identification in macrobenthic surveys of the MRA	This will be noted in the Scope of Works for macrobenthic surveys ongoing and was undertaken in the most recent macrobenthic study (Vision Environment 2017). Macrobenthic studies are undertaken every five (5) years in the long-term monitoring schedule.
Consider investigating copper and aluminium in dredge sediments in the mini Sediment Analysis Plan (SAP) to be undertaken in in new dredging areas in 2014 post completion of the Western Basin Dredging and Disposal Project.	This was included in the scope of the SAP for the new dredging areas in 2014 (BMT WBM 2014b). The 95% Upper Control Limit (UCL) of the mean concentrations of all analysed metals and metalloids were below their respective NAGD (2009) screening levels.
Create a monitoring schedule	GPC created the Port of Gladstone Long-term Monitoring Schedule which continues to date.
Facilitate access to reports and data for maintenance dredging campaigns	Access to key reports is provided on GPC's website and monitoring program outcomes are discussed with the TACC.

Since 2012, the outcomes of the monitoring programs undertaken in accordance with the schedule have been reviewed in TACC meetings annually. The following

Table 20 summarises recommendations that have been supported by the TACC and implemented through amendments to the Port of Gladstone's long-term monitoring schedule to ensure that monitoring is fit for purpose and managing maintenance dredging effectively.

Table 20: Monitoring Recommendations Supported by the TACC for the Continual Improvement of the LMDMP

Meeting Date	Monitoring Program	Recommendation
December 2017	Bioaccumulation of contaminants investigated at MRA	Because of the lack of success with the retrieval of oysters used for bioaccumulation studies at the MRA, GPC have committed to review available options for assessing the bioaccumulation of contaminants at MRA. The TACC recommended that GPC's alternative method should focus on primary producers, if possible. GPC's review will consider the outcomes of any investigation also undertaken by PCIMP into alternate methodologies.
December 2017	Hydrographic Survey	The frequency of hydrographic surveys of the MRA required for a five (5) year sea dumping permit period was clarified. Surveys will be undertaken once prior, once during (approximately half way through) and once upon completion of all sea disposal activities permitted within a five (5) year period.
August 2018	Bioaccumulation of contaminants investigated at MRA	Following on from discussions in December 2017, it was decided that GPC would NAGD (2009) framework for testing the hypothesis regarding bioavailability and bioaccumulation rather than continuing oyster studies. This would involve targeted plume measurement from dredging campaigns, then based on results, a decision about whether any further bioaccumulation study was needed.
August 2018	Seagrass (coastal and deep water)	Monitor coastal seagrass annually and deep water seagrass every five (5) years.
March 2022	Decommissioning wharf analysers	Reliability and safety issues, have resulted in a recommendation to decommission the three (3) wharf analysers which were deployed to provide additional ambient data in addition to PCIMP and GHHP.
March 2022	Alignment of monitoring locations for due diligence grab samples	Historically grab samples and real time monitoring have not been in alignment. The alignment of these parameters will provide synergies to be able to compare parameters and enhance evaluation of the data. It will also assist when trouble shooting, namely equipment and trigger elevation investigations.
March 2022	Increased deployment period for BPAR monitor.	Historically BPAR has been deployed 14 days prior to dredging, this gives the rolling average of 14 days on the first day of dredging. To better evaluate seagrass impacts it is recommended to have the rolling average in place for 14 days prior to dredging, which means deployment of the BPAR 28 days prior to dredging.

14 Appendix B – Hydrodynamic model validation summary

The following is a summary of the development and validation of the numerical modelling system used for the Port of Gladstone maintenance dredging which is used to inform GPC's risk assessment, environmental management and monitoring for annual main channel maintenance dredging.

The numerical modelling system is fit-for-purpose, and has been validated using a variety of measurements of water levels, currents, wave parameters and ambient turbidity. The model is sufficiently accurate to characterise the existing marine environment in the port, and it is an appropriate tool for the assessment of the likely impacts of dredging on turbidity levels within the port (BMT WBM 2017). A summary of model validation specifically for maintenance dredging is provided below:

- **2013 Maintenance Dredging Modelling and Impact Assessment:** BMT WBM were engaged by GPC to model and assess the potential impacts of a 200,000 m^3 dredging campaign. The outcome of the BMT WBM investigation was the development of several impact hypotheses (BMT WBM 2013) which assisted the initial development of GPC's monitoring program for the Port of Gladstone.
- **2014 Model Validation:** Plume sampling was undertaken during the February – March 2014 maintenance campaign to validate the modelling undertaken in the 2013 study (BMT WBT 2014c). Erroneous metals results were recorded during this study due to sampling error. Measurement of metals in the dredge plume were repeated during a second maintenance campaign in July 2014 (BMT WBM 2014d).
  The results from the validation process were presented in BMT WBM (2014e). The model had over-predicted turbidity in the Gatcombe Channel and occasionally under-predicted the extents of dredge plumes for the Jacobs channel. A set of measurements relating to the dredging of berth pockets or swing basins in the Jacobs Channel was collected during the field campaign. Based on these data, source loads were increased above those used in BMT WBM (2013).
- **2014 Maintenance Dredging Modelling and Impact Assessment:** The 2013 modelling study was revised by BMT WBM in 2014 (BMT WBM 2014e). The revised study assessed six (6) maintenance dredging campaigns with volumes ranging from 200,000 m^3 to 400,000 m^3 to reflect a range of potential volumes anticipated for maintenance dredging.
  The updated study utilised the plume data collected during the 2014 maintenance dredging campaigns as well as additional dredge logs and water quality data to improve the calibration of the model. BMT WBM produced additional model outputs to increase the robustness of the revised impact hypotheses.
- **2014 – 2015 Model Validation:** Plume sampling was undertaken again during the November 2014 – January 2015 maintenance campaign to: quantify the behaviour of the dredge plumes; assess the potential exposure of sensitive ecological receptors to dredge plumes during these conditions; and provide a data set to complement past numerical modelling works.
  The results of this study were consistent with the measurements collected in the previous 2014 studies. Overall, these results were also consistent with the 2014 modelling predictions (BMT WBM 2015).
- **2017 Maintenance Dredging Modelling and Impact Assessment:** BMT WBM's numerical modelling was revised again (BMT WBM 2017). The model configuration and boundary conditions changed considerably from the previous assessment of maintenance dredging by BMT WBM in 2014. The key changes include:
  - Modelling is now fully three (3)-dimensional, and includes salinity and temperature influences on the vertical density structure (fully baroclinic), as well as atmospheric boundary conditions
  - Regional oceanic influences were incorporated in the offshore open ocean boundary conditions

- Ambient (background) suspended sediment dynamics have been included in the modelling, to provide additional context for analysing dredging impacts, to allow calculation of light transmission impacts associated with dredging, and to improve the accuracy of modelling the resuspension of dredged sediment and
- The dredging and placement plume source rates have been estimated more accurately, making use of available particle size distribution data, dredge operation mode statistics, and additional measurements of plume intensity carried out in September 2017 as detailed above.

- **2021 Maintenance Dredging Impact Assessment:** This study updates the previous maintenance dredging assessment completed in 2017 (BMT WBM 2017) with improved modelling methodology in 2021, refined dredging plume source rates and updated bathymetric data to reflect completion of the CVIP project. The refined numerical model now consists of a much larger regional-scale model with a relatively coarse mesh that is used to drive a local nested model with a higher mesh resolution (BMT 2021). The model configuration and boundary conditions are somewhat different to model used for the previous assessment of maintenance dredging (BMT WBM 2017). The model now consists of a much larger regional-scale model with a relatively coarse mesh that is used to drive a local nested model with a higher mesh resolution (BMT 2021).

For the purposes of 2021 impact assessment, two (2) campaigns were simulated to represent a typical campaign and a large campaign scenarios of single maintenance dredging campaigns that may occur. The volume and assumed duration of each of the campaigns is shown in **Table 21**.

Table 21: Simulated Maintenance Dredging Campaigns

Simulation	Volume (m^3)	Duration
1	260,000	5.3 weeks
2	340,000	6.8 weeks

The numerical modelling software TUFLOW FV was used to simulate the three (3)-dimensional hydrodynamics of the Port and the advection and dispersion of suspended sediment (both ambient sediment and plumes generated during dredging). The model was used to simulate the dredging campaigns in full so that the potential effect on the turbidity levels and deposition rate within the Port could be estimated. TUFLOW FV carries out calculations on an unstructured mesh, which allows the mesh resolution to be enhanced in the areas of greatest interest.

The TUFLOW-FV model complies with the Guidelines on the use of hydrodynamic numerical modelling for dredging projects in the GBRMP (BMT 2021).

15 Appendix C – Consultation Feedback and Responses (TACC and Other Stakeholders)

Affiliation	Feedback	GPC response
Department of Agriculture and Fisheries	DAF has no major concerns and have noted that in Section 3.3.6.2 – Matters of State Environmental Significance (pg39) that Marine Plants and Waterways providing for fish passage were not included in the section, even though both MSES occur within the study area. This does not affect the overall outcome or purpose of the Management Plan, but for completeness they should be included. Our team in Biosecurity Queensland within DAF would be happy to be invited to be a biosecurity representative to your technical advisory committee if this is appropriate".	Marine Plants and Waterways providing for fish passage included in Section 3.3.6.2. Commitment to a review of TACC stakeholders, and appreciate identifying Biosecurity Queensland as a potential stakeholder.
Department of Environment and Science	The LMDMP states that: This LMDMP and associated management documents may be utilised to satisfy the Queensland Department of Environment and Science's (DES') requirement for a Receiving EMP (REMP) conditioned by the Port of Gladstone Maintenance Dredging Environmental Authority (EA) issued under the EP Act. The LMDMP and associated management documents may satisfy the receiving environment monitoring program (REMP) requirements specified in environmental authority (EA) EPPR00570813 subject to: a) a suitably qualified person designing and/or conducting the REMP, in accordance with condition GPMG7 of EA EPPR00570813; and b) documentation includes the minimum REMP requirements outlined in condition GPMG8 of EA EPPR00570813, which states:	No change required

Affiliation	Feedback	GPC response
	The receiving environment monitoring program must include at least the following aspects: (a) significant and sensitive receptors in the port area are identified and mapped; (b) environmental aspects and potential impacts are identified; (c) all contaminant releases are monitored; (d) the methods for collection and analysis of the samples (including specific areas to be monitored, when monitoring is to be undertaken and duration of monitoring); (e) the methods of analysing the data and responding to the results to ensure compliance with conditions; (f) long-term ecological impacts associated with dredging operations are monitored; (g) reporting intervals; and (h) review of environmental performance is undertaken after each dredging campaign. The department reminds GPC of your obligations under section 319 of the Environmental Protection Act 1994, which sets out the general environmental duty, and requires anyone who carries out an activity that causes or is likely to cause environmental harm to take all reasonable and practical measures to prevent or minimise the harm. In that regard, you are encouraged to actively identify all environmental risk factors associated with the activities at the site on an ongoing basis, and to implement strategies and processes to effectively manage them.	