Gladstone Ports Corporation

Growth, prosperity, community.

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

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List of Abbreviations and Acronyms (nomenclature)	
AASS	Actual Acid Sulphate Soils
ACA	Aquatic Conservation Assessment
ANC	Acid Neutralising Capacity
ASS	Acid Sulphate Soils
CEO	Chief Executive Officer
COO	Chief Operating Officer
CPM Act	*Coastal Protection and Management Act 1995* (Queensland)
CSD	Cutter Suction Dredge
DAF	Department of Agriculture and Fisheries (Queensland)
DAWE	Department of Agriculture, Water and the Environment (Commonwealth)
DES	Department of Environment and Science (Queensland)
DMPA	Dredged Material Placement Area
DPI	Department of Primary Industries
EA	Environmental Authority
EMP	Environmental Management Plan
EMS	Environmental Management System
EP Act	*Environment Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPP Water and Wetland Biodiversity	*Environment Protection Policy (Water and Wetland Biodiversity) 2019*
EV	Environmental Value
GBR	Great Barrier Reef
GBRWHA	Great Barrier Reef World Heritage Area
GPC	Gladstone Ports Corporation Limited
GPS	Global Positioning System
GSMP	Great Sandy Marine Park
HEV	High Ecological Value
IEMS	Integrated Environmental Management System (IEMS)
ILUA	Indigenous Land Use Agreement
IMO	International Maritime Organization
IMP	Introduced Marine Pests
LAT	Lowest Astronomical Tide
LMDMP	Long-term Maintenance Dredging Management Plan
LMDMP Guidelines	Queensland Government Guidelines for LMDMPs (TMR 2018)
LOA	Length Overall
London Protocol	*1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972*
LTTMP	Long-term Management and Monitoring Plan
MDS	Maintenance Dredging Strategy
MNES	Matters of National Environmental Significance
MRA	Material Relocation Area
MSES	Matters of State Environmental Significance
MSQ	Maritime Safety Queensland
NAGD	National Assessment Guidelines for Dredging
NGO	Non-Government Organisation
NIMPIS	National Introduced Marine Pest Information System
NTU	Nephelometric Turbidity Units
OCP	Organochloride Pesticides
OUV	Outstanding Universal Value
PAH	Polycyclic Aromatic Hydrocarbon
PASS	Potential Acid Sulfate Soils
PBPL	Port of Brisbane Pty Ltd

List of Abbreviations and Acronyms (nomenclature)	
PCBs	Polychlorinated Biphenyls
PQL	Practical Quantitation Limit
PSD	Particle Size Distribution
QA	Quality Assurance
QC	Quality Control
QLD	Queensland
QPA	Queensland Ports Association
Reef 2050 Plan	Reef 2050 Long-Term Sustainability Plan
SAP	Sediment Analysis Plan
Sea Dumping Act	*Environment Protection (Sea Dumping) Act 1981*
SMD	Slightly Moderately Disturbed
SPL	Strategic Port Land
SSM Project	Sustainable Sediment Management Project
TACC	Technical Advisory Consultative Committee
TBT	Tributyltin
TECs	Threatened Ecological Communities
the London Protocol	*1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972*
the Sea Dumping Act	Commonwealth *Environment Protection (Sea Dumping) Act 1981*
the Standard	ISO14001
TMR	Department of Transport and Main Roads (Queensland)
TOC	Total Organic Carbon
ToR	Terms of Reference
TPH	Total Petroleum Hydrocarbon
TSHD	Trailing Suction Hopper Dredge
TSS	Total Suspended Solids
UCL	Upper Control Limit
WQA	Water Quality Action
WQIP	Water Quality Improvement Plan
WQO	Water Quality Objective

1. Introduction

Gladstone Ports Corporation Limited (GPC) was formed in 1914 and since inception has been an integral part of the Gladstone community, as well as the epicentre of economic growth for Queensland.

GPC is a Company 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 manages and operates three (3) Port precincts - the Port of Gladstone, Port of Rockhampton and Port of Bundaberg. In consultation with the community, industry and government, GPC undertakes a strategic approach to planning, and setting the vision and direction for all three (3) Ports for the short and long term. The Port of Bundaberg became a part of the management structure of GPC on 1 November 2009, with a concurrent transfer of assets and liabilities from the Port of Brisbane Corporation Limited (now the Port of Brisbane Pty Ltd (PBPL)).

As the Port authority for the Port of Bundaberg, GPC's roles include:

- 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 community;
- Managing tenants;
- Coordinating and assisting in emergency response;
- Protecting the environment by minimising impact of development; and
- Being committed to, and having regard for the interests of the community.

GPC is also responsible for providing and maintaining navigable port depths and pilotage (GPC 2020a). 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 designated channel depths to ensure the continued safe and efficient passage of vessels utilising the Port (TMR 2016).

Most ports cannot sustainably function without maintenance dredging. Maintaining navigation depths is critical for the ongoing operation of our ports and 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).

1.1 Objectives and Purpose

Although the Port of Bundaberg is a not a Great Barrier Reef World Heritage Area (GBRWHA) Port, GPC have transitioned its current 10 year Long Term Management and Monitoring Plan (LTMMP) to this Long Term Maintenance Dredging Management Plan (LMDMP) in general accordance with the Maintenance Dredging Strategy (MDS) framework (TMR 2016).

The MDS provides a standardised 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 Outstanding Universal Values (OUVs) of the Great Barrier Reef (GBR) and the continued operating efficiency of ports within the GBRWHA. This LMDMP for the Port of Bundaberg has been developed to reflect with the MDS framework (Section 1.5, Figure 1).

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

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 Bundaberg. This includes both the loading and placement elements of maintenance dredging activities.

The main navigational shipping infrastructure at the Port of Bundaberg typically requires maintenance dredging annually. Maintenance dredging of the main navigational infrastructure at the Port of Bundaberg is usually undertaken annually by the *Trailing Suction Hopper Dredge (TSHD) Brisbane*. Recently it has been undertaken within a week and with an average campaign ranging between 50,000 – 88,000 m^3. The estimated average future maintenance dredging volume per campaign for the Port of Bundaberg remains within this range.

This LMDMP is in general accordance with the QLD Government's Guidelines for LMDMPs (LMDMP Guidelines) (TMR 2018) and the Commonwealth Government's Checklist for Completing Long Term Monitoring and Management Plans for Dredging (Commonwealth of Australia 2012). A LMDMP has a long-term 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

In general accordance with the MDS Framework (TMR 2016), GPC's maintenance dredging activities will be reviewed to ensure that they remain consistent with leading practice management. This framework has been adopted for the non-GBRWHA Port of Bundaberg to provide alignment with GPC's other GBRWHA port operations and provide the continued operating safety and efficiency at these GPC ports.

To facilitate the continual improvement of maintenance dredging practices that maintain and promote ecosystem health and resilience, GPC will review this LMDMP at least every five (5) years, and where necessary make revisions to the LMDMP to ensure it reflects the most up to date understanding of risk and the management of any potential impacts from maintenance dredging. Reviews should consider the question of whether the outcomes (of managing maintenance dredging activities) are consistent with the objectives detailed in the LMDMP.

Table 1 provides a summary of the review and improvement mechanisms that will be implemented under this LMDMP. The five (5) yearly reviews will include engagement with interested stakeholders (Section 1.7.3) including Technical Advisory Consultative Committee (TACC) (See Section 1.7.2 for engagement with the TACC). 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	To ensure the LMDMP reflects the most up to date understanding of risk, sedimentation processes, options available for sediment management including re-use 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 LMDMP.	Every five (5) years or as required	Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports (TMR 2016) (*Note: the Port of Bundaberg is not a GBRWHA Port but part of QLD Port Dredging Campaigns).* Environmental Code of Practice for Dredging and Dredged Material Management (Ports Australia 2016) Guidelines for Long-term Maintenance Dredging Management Plans (TMR 2018) National Assessment Guidelines for Dredging (Commonwealth of Australia 2009) GPC's Environmental Management System (EMS) (Section 8)
TSHD Brisbane Schedule and Port Specific Environmental Risk Assessment	To ensure the *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 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.	Every one (1) year	Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports (TMR 2016) (*Note: the Port of Bundaberg is not a GBRWHA Port but part of QLD Port Dredging Campaigns).* QPA Procedure Reporting and Scheduling Maintenance Dredging (QPA 2020). GPC's EMS (Section 8)
GPC's Environmental Management Plan (EMP)	To ensure continual improvement by updating the EMP based on the learnings of any previous campaign and ensuring that the EMP reflects the most up to date understanding of risks specific to each campaign. Reviews should consider the performance of the previous maintenance dredging campaign and; the volume and extent of required maintenance dredging; an	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) (*Note: the Port of Bundaberg is not a GBRWHA Port but part of QLD Port Dredging Campaigns).*

Document	Review context	Interval	Key drivers
	environmental risk assessment; and leading practice management and monitoring techniques.		Guidelines for Long-term Maintenance Dredging Management Plans (TMR 2018) GPC's EMS (Section 8)
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 Environmental Monitoring Procedure will outline an adaptive management framework which ensures that risks continue to be actively managed during each campaign.	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) (*Note: the Port of Bundaberg is not a GBRWHA Port but part of QLD Port Dredging Campaigns).* Guidelines for Long-term Maintenance Dredging Management Plans (TMR 2018) GPC's EMS (Section 8).

1.4 Implementation and Release

This LMDMP will be approved by GPC's Manager Planning Environment and Sustainability as this department is key to the implementation of this plan. 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 staff and contractors will be introduced to and made familiar with the provisions of this LMDMP. This document refers to and should be read in conjunction with the most relevant version of the EMP and Environmental Monitoring Procedure for the maintenance dredging activity being undertaken (Sections 8 and 9).

Following the commencement of any maintenance dredging campaign, significant amendments to this LMDMP that may change the environmental risk profile of the activity (Section 6) will be communicated to and re-approved by the relevant GPC staff and regulatory departments (if applicable) 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 staff 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 GPC website 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 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 2015).

The QLD Government launched the MDS for the GBRWHA on 30 November 2016. This addressed requirements of the 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 as per Figure 1.

Principle 1 of the MDS recommended 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 the preparation of a LMDMP consistent with the requirements of the QLD Government (TMR 2016).

Although the Port of Bundaberg is not a GBRWHA Port, GPC have chosen to transition its current 10 year LTMMP to this LMDMP in general accordance with the MDS framework.

A 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.

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

QPA, of which GPC is a member, will continue to support improvement by identifying and sharing best and good practice approaches to dredging management amongst all QLD ports.

Figure 1: MDS Framework (Source: TMR 2016)

1.6 Approvals and Statutory Obligations

The activity of dredging, the removal of material from the seabed, and the relocation and 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 for managing impacts of their maintenance dredging activities in compliance with the process required by each of the regulators involved (Sections 6 and 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 approved activity, location, and volume of the material to be dredged, location of the reuse or relocation site(s), methodologies, measures to mitigate impacts, environmental windows, and 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 campaign are included in GPC's EMPs for specific maintenance dredging activities which are made available on GPC's website for the relevant period of the activity. The most common statutory processes that would be applied for maintenance dredging activities at the Port of Bundaberg 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 placement or incineration of wastes at sea. Under the London Protocol, member nations may allow the placement 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 placement 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 Agriculture, Water and the Environment's (DAWE's) requirement for a LMDMP 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 all ports and regulators, and form the basis of the approvals process, particularly under the Sea Dumping Act. These guidelines 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 at 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 opportunities exist to reuse, recycle, or treat material, 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 safe, effective and efficient port facilities and services under the ***Transport Infrastructure Act 1994*** and the ***Transport Operations (Marine Safety) Act 1994***.
- The ***Sustainable Ports Development Act 2015*** prohibits capital dredging in the GBRWHA outside of the priority ports. The Port of Bundaberg, being outside GBRWHA, is not affected by the Reef 2050 plan or the SPD Act (State of Queensland 2015), and hence can undertake capital dredging, when approved.
- 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*** 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.
- As the sea placement site falls within both State and Commonwealth waters, GPC hold an Operational Works permit for disposal of dredge material in tidal waters, under the CPM Act regulated by the QLD Department of Environment and Science (DES) which includes a concurrence for Habitat Disturbance (Marine Plants) permit regulated under the ***Fisheries Act 1994*** by the QLD Department of Agriculture and Fisheries (DAF).
- 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. This LMDMP and associated management documents may be utilised to satisfy DES' requirement for an Integrated Environmental Management System (IEMS) and Monitoring Plan conditioned by the Port of Bundaberg Maintenance Dredging Environmental Authority (EA) issued under the EP Act.

1.7 Governance

1.7.1 Roles and Responsibilities

GPC staff 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 responsibilities and accountabilities of GPC staff associated with the implementation of this LMDMP and maintenance dredging operations at the Port of Bundaberg.

Table 2: 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
Chief Operating Officer (COO)	Overall responsibility for the planning and management of maintenance dredging activities, the development and implementation of LMDMPs, Environmental Policy, Strategy and EMS framework.	CEO
Manager Planning Environment and Sustainability	Approvals processes including preparation and development of the LMDMP in accordance with the MDS and other best practice frameworks. Overall responsibility for the design of the EMS.	COO
Port of Bundaberg Manager	Responsible for dredge management planning and management of the dredging contracts. Implementation of this LMDMP and associated management documents.	Manager Trade Strategy and Port Operations
Day works Supervisor	GPC contact for operational issues during dredging. Assist implementation of LMDMP and associated management documents.	Port of Bundaberg Manager
Environment Superintendent	Responsible for the implementation and continual improvement of the EMS. Assist development, implementation and revision of LMDMP and associated documents. 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, verify compliance, and review of management documents (e.g. EMP).	Environment Superintendent
Environment Specialist – Monitoring	Responsible for monitoring program design and implementation through the Monitoring Procedure. Coordination of	Environment Superintendent

Position	Responsibility	Reporting to
	environmental monitoring programs and data.	
Environment Emergency Hotline	General and after hours contact for the GPC Environment team.	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 Bundaberg in accordance with the NAGD (Commonwealth of Australia 2009) and the LMDMP guidelines (TMR 2018).

The NAGD provide guidance on the purpose, scope and membership of the TACC and in accordance with these guidelines, 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 placement activities
- 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 (TMR 2016). The LMDMP Guidelines (TMR 2018) recognise a TACC as an appropriate mechanism for Ports to engage with stakeholders as part of the development and oversight of LMDMPs.

TACC membership is drawn from relevant Commonwealth, State and Local Government, non-Government organisations (NGOs) and community groups (Commonwealth of Australia 2009, TMR 2018). To ensure successful outcomes are achieved, it is important that TACC members have appropriate representation with sufficient skills and expertise.

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 the 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 and provided to TACC members and meeting attendees.

The TACC have been instrumental in the establishment and ongoing improvement of GPC's Long-term Monitoring Program for the Port of Bundaberg (Section 9, Table 10).

1.7.3 Independent Review

At the five (5) yearly review interval, in addition to the TACC, GPC staff, 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 key interested 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 EMS framework (Section 8) provides for auditing of this LMDMP for performance monitoring performances 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), GPC also provides:

- The final approved versions of the relevant EMP and Environmental Monitoring Procedure (Sections 8 and 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; and

- Other key reporting outcomes of GPC's Long-term Monitoring Program (Section 9, Table 10).

GPC facilitates meetings with the TACC where the outcomes of monitoring programs are reviewed and discussed. TACC meeting minutes are published on GPC's website. GPC also has a data request process established for the external dissemination of environmental monitoring data and reports not already published on GPC's website.

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 the Queensland Department of Transport and Main Roads (TMR) in accordance with Principal 8 of the MDS (TMR 2016). A summary of key information and accessibility is provided in Section 11.

2. Port Locality, Setting and Shipping

2.1 Location and Environment Setting

The Port of Bundaberg is located at the mouth of the Burnett River, approximately 185 km south of Gladstone and 365 km north of Brisbane (Figure 2). The Port is situated 19 km downstream from the City of Bundaberg, 4.8 km from the mouth of the Burnett River at Latitude of 24°46.62'S, Longitude 152°23.29'E. The Port of Bundaberg is identified as one of QLD's 15 strategic ports and provides a vital link for the industry in the Bundaberg region.

Areas surrounding the Port include environmental values (EVs) of national and state importance, and are recognised and protected through Commonwealth and State legislation. Key environmental assets of the Port include intertidal habitats, benthic macroinvertebrates, fish, shellfish, shorebirds, and marine megafauna, especially marine turtles. The Port is situated across from Barubbra Island Conservation Park, adjacent to Mon Repos Conversation Park with the Port limits excluded from, but surrounded on three (3) sides, by the Great Sandy Marine Park (GSMP).

The Bundaberg region has a sub-tropical climate with hot, moist summers and mild, dry winters. Rainfall in the Bundaberg region is highly seasonal, with most rain (44.7%) occurring during the summer months (December to February). Climatic data for the Port of Bundaberg is limited over time with consistent data in recent years only available from the Bundaberg Aero Station located approximately 16 km from the Port (Climate statistics for Australian locations (bom.gov.au)).

Throughout its history, the Port of Bundaberg has been influenced by flood events. Major floods in 1893, 1942, 1954, 1971, and 1974 caused considerable damage and disruption to the Port. The flood in 1971 caused widespread damage to port facilities and reduced the channel depth in the outer sea reach from 6.1 m to 2.6 m by flood deposition. This resulted in the closure of the Port for two (2) months. Since 1970 there have been ten cyclones within 100 km of the Bundaberg region. Several of these cyclones passing along the QLD coastline or related rainfall, in the last decade have resulted in the temporary closure of the Port of Bundaberg, the most significant being in 2010 / 2011 and 2013, which brought significant sedimentation requiring emergency dredging.

2.2 History

The Port of Bundaberg is referred to in Government documents dating back to 1878. At that time, and up to the development of a new port for Bundaberg in 1958, the main Port was located at the City of Bundaberg approximately 18 km upstream from the mouth of the Burnett River. Records from around the turn of the century indicate that dredging was routinely required to maintain a minimum channel depth in the river of 2.2m. Dredging was normally undertaken with the Bundaberg Harbour

Board's dredge "Ceratodus". Dredging of the shipping channel continued into the 1900s, with the dredged depth of 2.2 m being maintained up to the Town Reach into the late 1950s, allowing E class vessels to use the Port.

In the 1950's, the Queensland Sugar Board began the implementation of bulk sugar handling throughout the Queensland industry. Bulk handling required the use of larger and deeper draft vessels for the transportation of bulk sugar. Considering the substantial cost and likely difficulty of dredging and maintaining a channel up to the existing Port at Bundaberg, a decision was made in 1955 to develop a new deep water port some 4km from the mouth of the Burnett River on the southern bank. This is the site of the current Port. The new shipping channel to the Port was 45 m wide and 5.5 m deep. The Port of Bundaberg and we know it today was opened in 1958, although construction of the northern training wall was then required to eliminate a sand bar, which frequently developed at the mouth of the river.

We acknowledge that we are on the original lands of the First Nations people Bailai, Gurang, Gooreng, and Taribelang Bunda, whose land we all share, live, work and play on. We acknowledge and pay our respects to all Elders of past, who have made the many sacrifices, contributions and paved the way for us all to be here today. We acknowledge our future and emerging Leaders who will continue the fight for a better and united Australia for our generations of today, tomorrow and in the future.

2.3 Current and Future Use

Port of Bundaberg Strategic Port Land (SPL) covers 465 ha and is spread across three (3) key localities Burnett Heads, Fairymead and Town Reach. The Port limits extend 7.25 nautical miles east from the Port of Bundaberg, 5.5 nautical miles north from the Port of Bundaberg, and 25.9 km from the mouth of the Burnett River (to the Branyan Range) (GPC 2010, 2020b). They include the dredged access channel and offshore dredged material placement area (Figure 2). There are two (2) main wharves at the Port of Bundaberg, the Sir Thomas Hiley Wharf, which is used for the shipment of bulk conveyable products and the John T. Fisher Wharf, the bulk liquids loading point.

The sugar terminal buildings have a storage capacity of 300,000 tonnes of bulk raw sugar in two (2) sheds, one (1) of which is 425 m long and is the longest single sugar storage built in QLD. The belt conveyor system has a loading capacity of 1,400 tonnes per hour.

The bulk molasses terminal has three (3) storage tanks with a total capacity of 36,641 tonnes. A loading rate of 285 tonnes per hour is attained through a 375 mm pipeline connected to five (5) electrically operated pumps.

The development of the Pacific Marine Base Bundaberg land-backed wharf commencing in 2022 will allow vessels up to 100m in length to berth alongside upon completion of stage one (1). A further stage two (2) is under consideration which would allow vessels up to 180m in length to berth alongside. The land-backed wharf will be suitable for loading and unloading general cargo, as well as over-size and over-mass cargoes. .

In the 2020-21 financial year, the Port of Bundaberg handled 354,559 tonnes of cargo and hosted 16 vessels (GPC 2021a, Trade Statistics | Gladstone Ports Corporation (gpcl.com.au)).

It is expected that the throughput for the Port of Bundaberg will continue to grow with the ongoing development of the silica sand, gypsum and wood pellet markets. GPC continues to explore other opportunities for future trade and expects to see an increase in dry bulk and break bulk throughput with key asset development.

2.4 Navigational Infrastructure

The Port of Bundaberg shipping channel is 103 m wide, 10 km long and has a minimum navigable depth of 9.5 m (below Lowest Astronomical Tide (LAT)). This leads into a swing basin 1,165 m in length and 320 m in width. Limits of the Port of Bundaberg are shown in Figure 2.

The Sir Thomas Hiley Wharf berth is 191 m long with 11 m available depth at berth. This includes an approach wharf, 63 m in length. The John T Fisher Wharf berth is 240 m long with 9.7 m available depth at berth. This includes a swing basin width of 320 m wide and the capability of accepting vessels up to 190 and 185 m length overall (LOA) respectively and a beam of 32 m. The minimum under keel clearance is 1.0 m in the channel and 1.2 m for vessels over 180 m. Depths and locations of channels, berths and swing basins are provided in Table 3.

Table 3: Details of the Port of Bundaberg Berths

Berth	Design Depth (m LAT)	Berth length (m)	Wharf height above LAT (m)	Max LOA x Max beam (m)
Sir Thomas Hiley	-11.0	191	7.0	200 x 32
John T Fisher	-9.7	240	7.0	185 x 32

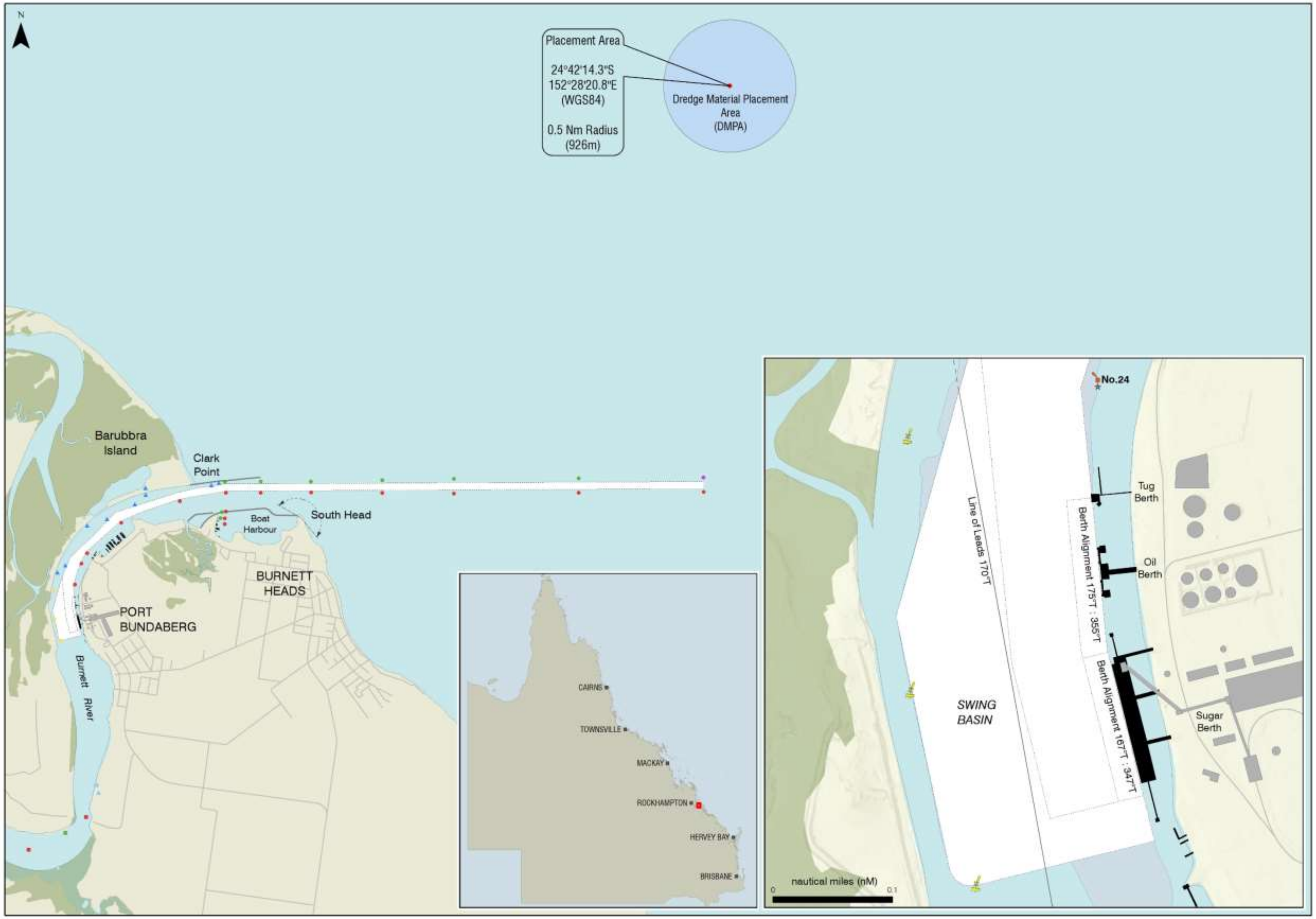


Figure 2: Location of the Port of Bundaberg and Associated Port and Navigational Infrastructure

3. Port Environmental Values

3.1 Burnett River Estuary

The Burnett River estuary has the largest catchment area of all the estuaries within the Burnett-Mary region, discharging into the Coral Sea at Burnett Heads. The Burnett River estuary is river-dominated, with a tide-dominated delta. The upper estuary is predominately mud substrate due to a strong riverine influence and the lower estuary is dominated by sand due to oceanic influence (Mackenzie and Duke 2011). Although the estuary is highly modified, ~ 540 ha of tidal wetlands remain (Duke et al. 2019). The area includes areas considered to be of notable EV. This includes Barubbra Island at the mouth of the river, which maintains healthy tidal wetlands (Duke et al. 2019).

Key sensitive environmental receptors and ecological assets for the Port of Bundaberg are described in Table 4. Other relevant values within and surrounding the Port are outlined in Table 5.

Table 4: Key Local Attributes and Environmental Values for the Port of Bundaberg

Key sensitive receptor / asset	Information relevant to Port of Bundaberg
Reef communities	Intertidal rocky shores and inshore reefs are present along the Woongarra Coast, from Burnett Heads (just within the Port limits) to the Elliot Heads (DES 2021). The rocky shores and reefs on the Woongarra Coast are comprised of basalt outcrops. Reef communities in the area are a mix of tropical, subtropical and temperate species of hard and soft corals, with at least 46 species of hard coral known to occur in the GSMP (DES 2021). The structural characteristics (dominant taxa, richness, abundance) of reef communities near Burnett Heads are undefined. Flooding from the Burnett and Mary rivers in 2011 and 2013 negatively impacted the surrounding coral reefs, reducing coral abundance by up to 60% on the Woongarra Coast, with an increase in the coverage of the stress tolerant coral *Turbinaria* and a decrease in *Acropora* coral communities (Butler et al. 2013; Coppo et al. 2014).
Tidal wetlands	The Burnett River estuary supports ~540 ha of tidal wetlands comprised of mangroves, saltpan / saltmarsh and fringing coastal she oak and paperbark communities (Duke et al. 2019), including in the tidal areas of GPC-owned land. Tidal wetland floristic diversity in the Burnett River estuary is the lowest in the Burnett-Mary region, due to extensive modification and degradation of river water quality (Mackenzie and Duke 2011). However, tidal wetlands on GPC-owned land support a relatively high diversity of mangroves and saltmarsh species (Mackenzie and Duke 2011; FRC 2008; ESP 2020). Many of the tidal wetlands within the vicinity of the Port are mapped as essential habitat (DES 2020a), due to the presence of threatened and migratory shorebirds.
Seagrass and macroalgae	Seagrass formed large deep-water meadows of *Halophila decipiens*, *H. ovalis* and *H. spinulosa* in offshore areas of the Port of Bundaberg but was absent from shallower coastal and estuarine areas of the port. Seagrass was recorded in water depths of 12 to 22 m and had a sparse cover. Smith and Rasheed (2021a) found that biomass was similar or greater than other deep-water meadows at other ports in the GBR region, which they suggested indicated that meadows were in good condition. It was estimated that deep-water seagrass meadows covered 5,788 ± 975 ha or 35% of the port limits area, and that it was likely that the meadows extended much further outside the port limits. Macroalgae occurred throughout the port but at very low cover. Filamentous algae was common seaward of the dredge material placement area (DMPA) often as epiphytes on seagrass and erect macrophytes were more common in the coastal zone with turf algae in the estuary and shipping channel. Seagrass meadows and their associated epiphytes in the Port of Bundaberg likely provide a foraging habitat for listed threatened, migratory and marine species including the green turtle, dugong and seahorses; and also provide important habitat for species of fisheries significance. It is likely that these deep-water meadows found in the Port of Bundaberg are highly variable seasonally and between years.

Key sensitive receptor / asset	Information relevant to Port of Bundaberg
Benthic fauna	Ongoing benthic monitoring demonstrates highly variable composition of benthic infauna composition within the offshore dredged material placement area, consistent with a high variability in sediment type (AMA 2015). Benthic infauna are regarded as indicators of ecosystem health and provide a range of services including nutrient cycling, bioturbation and as a component of food webs, particularly as a food source for species of fisheries and conservation significance, including loggerhead turtles (DES 2018a). Coarser sediment types supported taxa such as crabs, whereas fine sediment was dominated by polychaete worms (AMA 2015). There was a positive significant relationship between seagrass biomass and infauna species richness, diversity, abundance and the abundance of annelids and crustaceans (Smith and Rasheed 2021b).
Fish and fisheries	The Port and surrounding areas provide a range of habitats for marine and estuarine fish (e.g. mangroves, mudflats, anthropogenic structures, bare soft sediment and potentially sparse seagrass). Commercial and recreational fishing occurs in the area, targeting small and large bodied fish (i.e. whiting, yellow-fin bream, flathead), prawns and mud crabs, which are valuable to the fisheries in the local area (DAF 2020; Lupton and Heidenreich 1999).
Marine mammals	There are relatively few published records of marine mammals in the area. Coastal dolphin species, including the Australian snubfin dolphin and the Australian humpback dolphin have been sighted or are considered likely to occur within the Burnett River estuary and coastal environments (DES 2020b). Migratory whales, including the humpback whale, are likely to traverse further offshore through the broader Port limits during their seasonal migration (winter and spring). Dugong are likely to occur during seasonal peaks of seagrass growth, but are more likely to be seen south of the Port of Bundaberg in Hervey Bay (Sobtzick et al. 2017).
Marine turtles	Several marine turtle species have been recorded in the area. The Mon Repos Conservation Park is located approximately 4 km south of Burnett Heads. It is the most significant loggerhead turtle rookery in the southern hemisphere, with small numbers of flatback and green turtles also nesting here (DES 2018a; Limpus 2007; Limpus 2008; Limpus 2009). This is recognised by the long-term Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017). During the nesting season (November to January), marine turtles will occur in the coastal waters off Burnett Heads within the Port limits, and are known to use the dredged channel as inter-nesting habitat (DES 2020c). Moore Park beach to the north of the Port is monitored by a local community group in collaboration with the Queensland Government. Barubbra Island supports a few tens of nesting Loggerhead turtles annually and poorly quantified low number density nesting population of Flatback turtles (Col Limpus, pers. comm.). It is possible that green turtles may occur within the vicinity of the Port year-round, foraging on seagrass, macroalgae, mangrove propagules and other food sources (Sobtzick et al. 2017).
Shorebirds	Barubbra Island Conservation Park, the tidal wetlands on Port-owned land associated with Wallace Creek (Port of Bundaberg wetland area) and the Port of Bundaberg Material Relocation Area (MRA) are important foraging and roosting habitat areas for resident and migratory shorebirds (Milton and Harding 2007; Worley Parsons 2012). Several threatened migratory birds are known to frequent the area including Eastern Curlew and Curlew Sandpiper (ESP 2020).
Marine water quality	The water quality of the Burnett River estuary has been affected by altered hydrological flow, bank erosion and industrialisation (BMRG 2015). Coastal waters are likely to have good water quality at times, sufficient to support coral and seagrass growth (DES 2018b; AMA 2015, DERM 2010). There are high ecological value (HEV) waters along the Woongarra Coast, immediately south of Burnett Heads (DERM 2010). Water Quality Objectives (WQOs) under the Reef 2050 Water Quality Improvement Plan (WQIP) apply to the waters within the Port limits (State of Queensland 2018).

Table 5: Other Values Within and Surrounding the Port of Bundaberg

Value	Description
Cultural and heritage values	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 Bundaberg 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 Bundaberg. Significant cultural sites are located on GPC-owned land and within the vicinity of the port (GPC 2021b).
Heritage values	Commonwealth, State and Local Heritage Places
Social values	The Port is the gateway to the southern Great Barrier Reef, with many tourism operators operating from the marina, international visitors entering Australia through the Ports customs facilities and the social and leisure environment attracting locals and tourists to the marina. The Port's coastal environment is frequently used by recreational fishers, and turtle nesting and hatching season at Mon Repos attracts tourists to the region (DES 2018b).
Commercial activities	Additional commercial opportunities including other industries and commercial fishing.
Recreational activities	Areas utilised for conservation, environmental management, tourism, open space, and sport and recreational uses. Also includes areas that provide natural scenic amenity.

3.2 Community Environmental Values

In QLD, EVs and WQOs are established under the Environment Protection Policy (Water and Wetland Biodiversity) 2009 (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 WQOs have been refined from Australian and QLD Water Quality Guidelines. No EVs or WQOs have been scheduled for the Burnett Basin and adjacent coastal waters under the EPP (Water and Wetland Biodiversity). However, the Burnett - Mary WQIP provides draft EVs (referred to as community values in the WQIP) for the Burnett River estuary and adjacent coastal waters (BMRG 2015). BMRG (2015) classifies both waters as Slightly Moderately Disturbed (SMD) ecosystems. EVs and WQOs have been scheduled under EPP (Water and Wetland Biodiversity) for offshore coastal waters south of Burnett Heads, adjacent to the offshore DMPA. Coastal waters adjacent to the DMPA are classified as High Ecological Value waters (HEV), whereas offshore waters more than five (5) kilometres from the coast are classified as SMD ecosystems. Draft and defined EVs for the Port of Bundaberg and surrounding areas are presented in Table 6.

Table 6: Environmental Values for Burnett River Estuary and Adjacent Coastal Waters

(Source: EPP Water and Wetland Biodiversity and WQIP for the Burnett Mary Region)

Port of Bundaberg	Type	Aquatic ecosystems	Seagrass	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual recreation	Industrial use	Cultural and spiritual values
Open coastal waters south of Burnett Heads (EPP (Water and Wetland Biodiversity))	HEV, SMD	✓	✓	✓	✓	✓	✓	✓		✓
Open coastal waters north of Burnett Heads including offshore DMPA (WQIP)	SMD	✓		✓	✓	✓	✓	✓		✓
Burnett River estuary including dredged area (WQIP)	SMD	✓			✓	✓	✓	✓	✓	✓

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 DMPA. Impact assessments include desktop assessments involving the review and analysis of existing information, as well as hydrodynamic and sediment transport modelling of the generation, advection and dispersion of dredging-related plumes.

GPC commissioned BMT to develop and validate a suitable hydrodynamic and sediment transport model (BMT 2021a). The principal objective of this was to develop and validate the TUFLOW FV numerical hydrodynamic and sediment transport model for the Port of Bundaberg to demonstrate its suitability for use in developing a quantitative sediment budget for the Sustainable Sediment Management Project (SSM Project) (See Section 5). This model was subsequently used to undertake an impact assessment, the general aims of which were to describe the potential impacts of maintenance dredging activities and to 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 provides detailed information about the key EVs that are relevant to maintenance dredging activities. Although extensive areas of intertidal habitat (mangroves, saltmarsh, saltpan and mud flats) occur throughout Port of Bundaberg, these are not expected to be impacted from maintenance dredging. The most significant potential receptors that are sensitive to the effects of this annual dredging are identified as nearshore reefs, seagrass meadows, turtle nesting beaches and the HEV boundary (BMT 2021b).

3.3.1 Modelling Results

In this section, the modelling results for a simulated 90,000 m^3 maintenance dredging campaign in the shipping channels and dredge material placement at sea at dredge material placement area (Figure 2) are analysed and discussed as this is the largest campaign that will be potentially undertaken under this LMDMP. This simulated maintenance dredging campaign was set up to take place over nine (9) days and was undertaken over two (2) months to allow for the effects of sediment resuspension following completion of the dredging campaign (BMT 2021b).

3.3.1.1 Turbidity and Deposition Rate

Sustained increases to the turbidity (50th percentile increases) are only significant within the river and near the entrance. Short-term increases (95th percentile increases) in the turbidity are noted between the Port and the river entrance and in the vicinity of the DMPA, indicating that plumes are short lived. The modelled impacts to the 50th and 95th percentile of the turbidity for the 90,000 m^3 maintenance dredging campaign are shown in (Figure 3). As expected, the largest increases in deposition rate occur within the shipping channels and at the DMPA. The modelled impacts to the deposition rate percentiles for the 90,000 m^3 maintenance dredging campaign are shown in (Figure 4).

Time series of the modelled depth-averaged turbidity and deposition rate were extracted from the model at the points of interest (Figure 5). Having simulated both dredging and ambient sediment, the time series show both these contributions to the total signal and in doing so provide important information on the relative magnitude of the dredging related signal.

Time series of the modelled depth-averaged turbidity at the DMPA reporting site displayed the following trends:

- During the dredging campaign (modelled period 28th May to 6th June) - a series of short- term (measured in 100s of minutes) spikes (>15 Nephelometric Turbidity Units (NTU)) occurred with placement events, which were interspersed with slightly elevated turbidity (typically <5 NTU);
- A rapid decline in the days immediately after the completion of dredged material placement (<1 NTU); and
- Subsequent resuspension events resulted in temporary increases in dredge-related turbidity (less than 5 NTU). During the resuspension event, the contribution of the dredging-related turbidity to the total turbidity was relatively small.

The modelled turbidity therefore temporarily exceeded the draft WQO of <2 NTU at the DMPA.

Time series of the modelled depth-averaged turbidity and deposition rate were extracted from the model at the points of interest shown in Figure 5. At the reporting site 1000 m west of the DMPA (Figure 5), the modelled dredging-related turbidity was very low during dredging (around 1 NTU) and was also much smaller than the modelled ambient turbidity during resuspension events that occurred after dredging was complete. Both ambient (ambient conditions from natural environmental events) and dredge-related turbidity was predicted to temporarily exceed the WQO of 2 NTU during resuspension events. No major impacts to seagrass meadows are expected given the short duration and low intensity of dredge-related turbidity.

At all other reporting sites in coastal waters and the Burnett River estuary (Barubbra Island Beach South, Burnett Heads, HEV Boundary 1, HEV Burnett Heads, Gateway Marina North, Gateway Marina South, Port of Bundaberg East and West, Bundaberg Port Marina North and South), the modelled dredging-related turbidity was a similar magnitude to the ambient turbidity during the dredging operation, and was very low at all locations (less than 1 NTU) following the completion of dredging. This shows that due to rapid dispersion of the dredging-related plumes, the duration of any potential increase in turbidity due to dredging is limited to the length of the dredging campaign (in this case, 9.5 days).

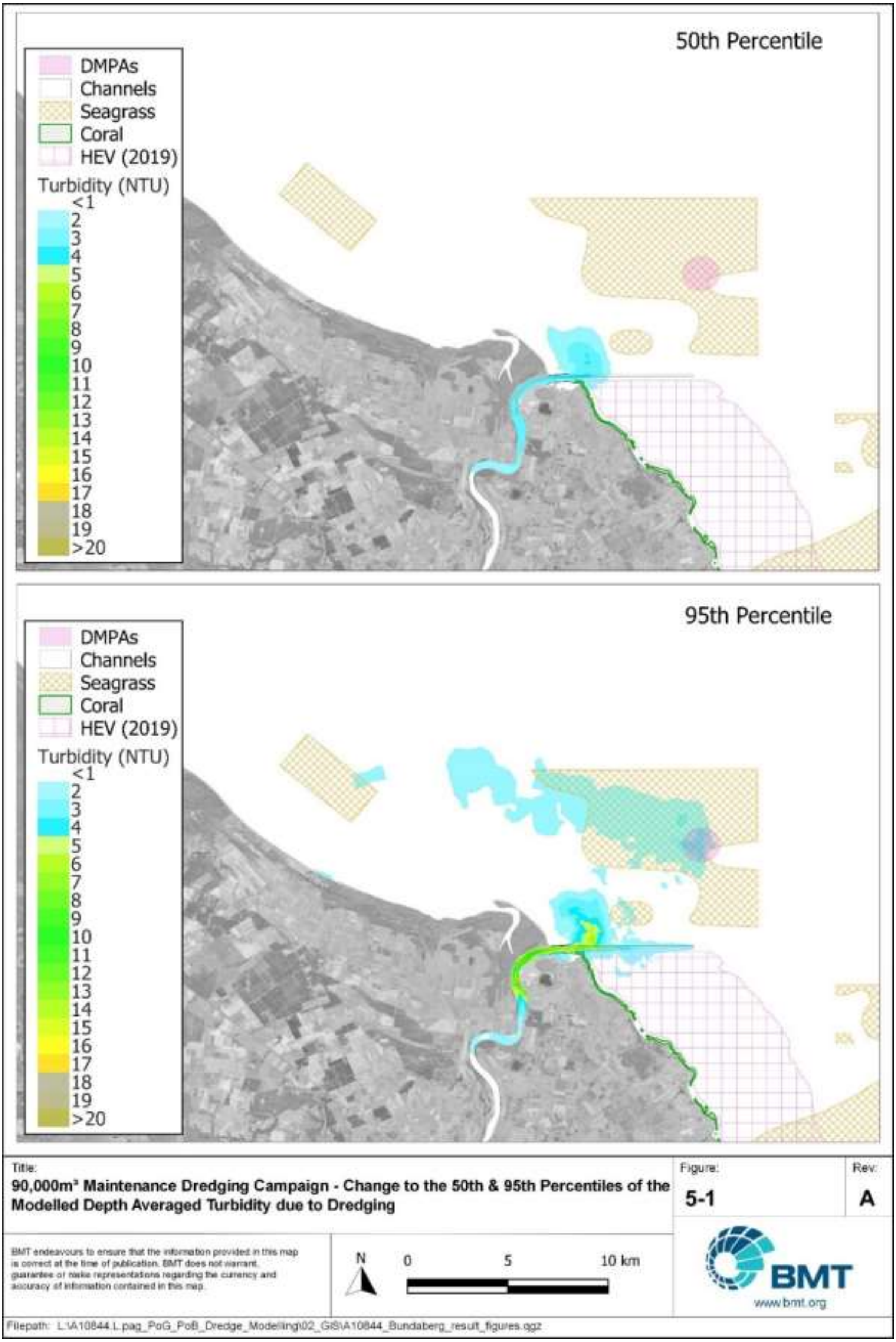


Figure 3: 90,000 m³ Maintenance Dredging Campaign - Change to the 50th and 95th Percentiles of the Modelled Depth Averaged Turbidity due to Dredging (Source: BMT 2021b)

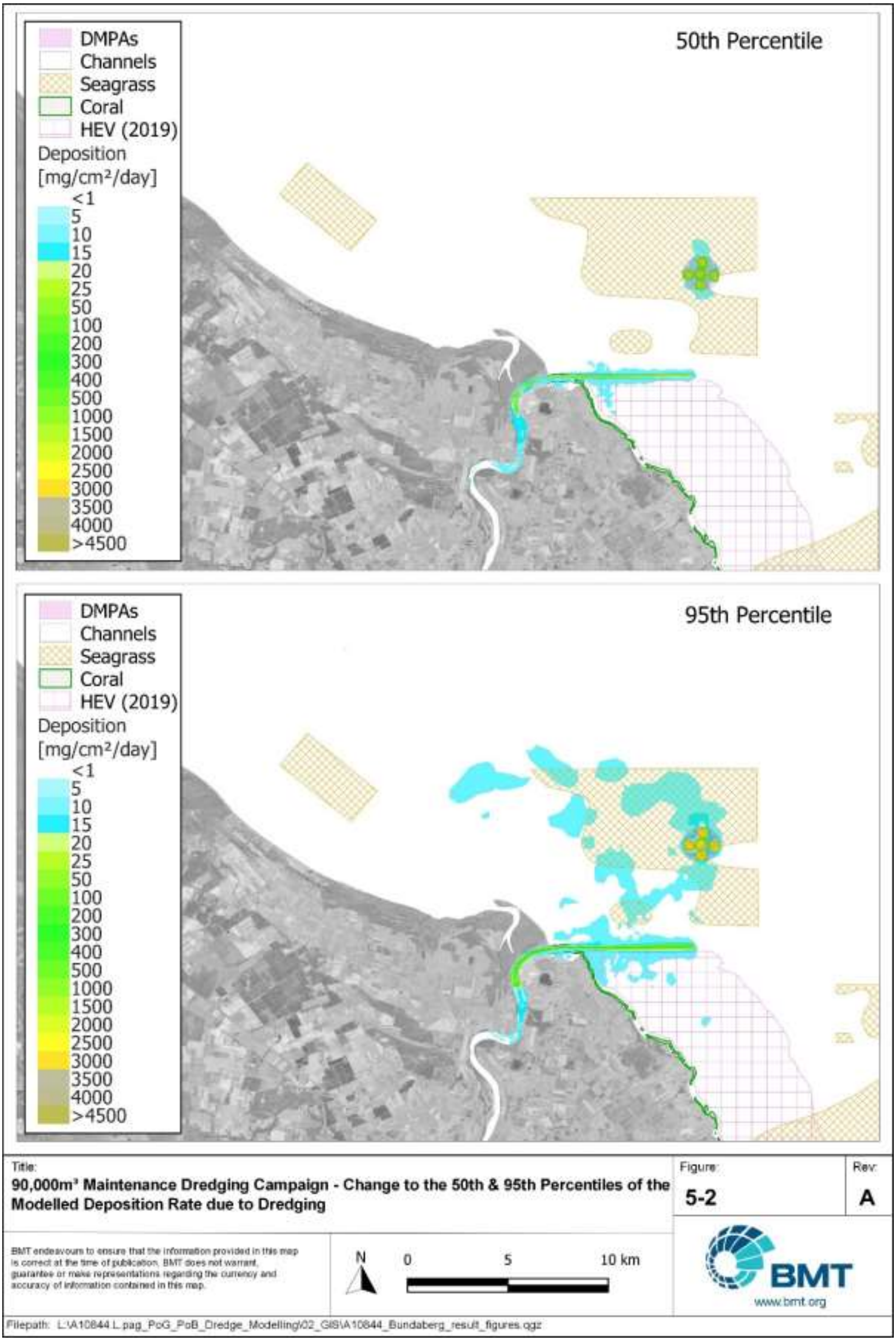
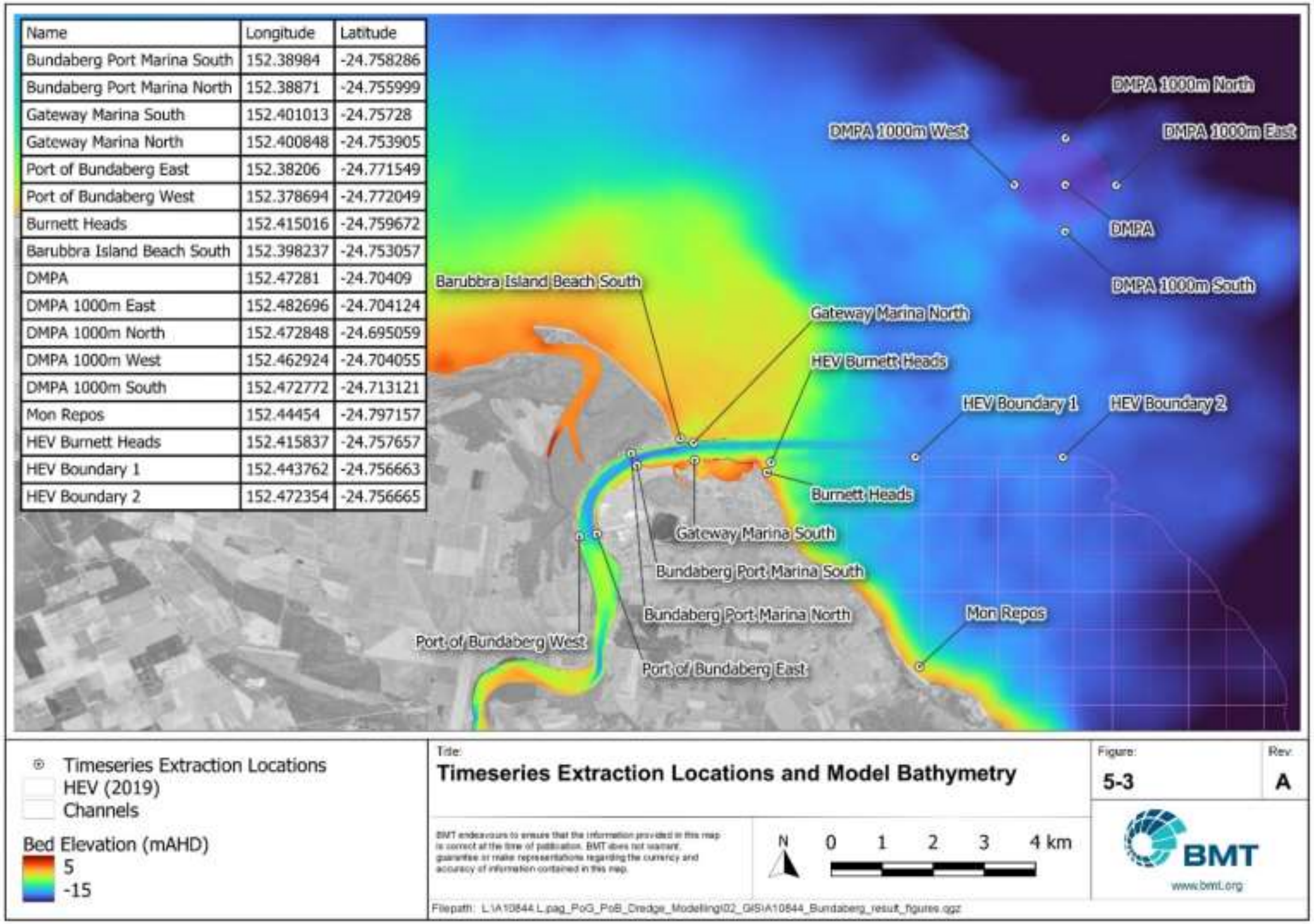


Figure 4: 90,000 m³ Maintenance Dredging Campaign - Change in the 50th and 95th Percentile of the Modelled Deposition Rate due to Dredging (Source: BMT 2021b)



Name	Longitude	Latitude
Bundaberg Port Marina South	152.38984	-24.758286
Bundaberg Port Marina North	152.38871	-24.755999
Gateway Marina South	152.401013	-24.75728
Gateway Marina North	152.400848	-24.753905
Port of Bundaberg East	152.38206	-24.771549
Port of Bundaberg West	152.378694	-24.772049
Burnett Heads	152.415016	-24.759672
Barubbra Island Beach South	152.398237	-24.753057
DMPA	152.47281	-24.70409
DMPA 1000m East	152.482696	-24.704124
DMPA 1000m North	152.472848	-24.695059
DMPA 1000m West	152.462924	-24.704055
DMPA 1000m South	152.472772	-24.713121
Mon Repos	152.44454	-24.797157
HEV Burnett Heads	152.415837	-24.757657
HEV Boundary 1	152.443762	-24.756663
HEV Boundary 2	152.472354	-24.756665

Figure 5: **Time series Extraction Locations and Model Bathymetry** (Source: BMT 2021b)

Time series of the modelled deposition rate at the DMPA showed that the modelled dredging related deposition rate was very high during the dredging activity (to be expected), but was negligible in the period following the completion of dredging. At the site 1000 m west of the DMPA, the modelled dredging-related deposition rate was very low during dredging (up to 5 $mg/cm^2/day$) and was also much smaller than the modelled ambient deposition rate during resuspension events that occurred after dredging was complete.

At all other locations the modelled dredging-related deposition rate was relatively low during the dredging operation (less than 10 $mg/cm^2/day$), and was negligible at all locations following the completion of dredging. This shows that due to rapid dispersion of the dredging-related plumes, the deposition rate due to dredging only significantly increased during the dredging campaign itself (in this case, 9.5 days). It is therefore unlikely that there would be any long term impacts to corals or other sensitive receptors due to the relatively low magnitude and short duration of the increase in deposition rate due to dredging.

Within the Burnett estuary, the modelled median dredge-related turbidity value exceeded 2.3 NTU (background turbidity one (1) standard deviation - see above for rationale) within the immediate vicinity of the dredge footprint. The WQO of 6 NTU was also exceeded in the immediate vicinity of the dredge footprint. Rock walls are expected to contain filter-feeding species that may be sensitive to prolonged periods of high turbidity. Time series of modelled turbidity at rock wall locations shows that dredging resulted in short-term, low intensity turbidity spikes (typically <15 NTU) well within the range of ambient turbidity. This is unlikely to result in major changes to rock wall communities.

Coastal waters support several sensitive ecological receptors. Below summaries the impacts from dredge plumes to these.

- **Nearshore reefs** – the dredge plume is predicted to propagate through the Burnett River mouth to nearshore reefs immediately south of Burnett Heads. Median turbidity at the most affected reef site is predicted to be 2 NTU, and the 95th percentile is predicted to be 2- 3 NTU (Figure 3). Both metrics temporarily exceed the WQO of 1 NTU (for HEV coastal). The time-series shows that dredge plumes are short-term (measured in 100s of minutes), low intensity (maximum dredging turbidity 7 NTU, peaks typically <2-3 NTU) features. On this basis, it is unlikely that dredge plumes would result in detectable changes to reef communities.

- **Seagrass meadows** – the offshore DMPA and immediate surrounds support extensive seagrass meadows. Modelled dredge-related turbidity was >15 NTU within offshore DMPA seagrass meadow reporting location, and the median and 95th percentile values were <1 NTU and 3 NTU respectively. The time series shows that dredge plumes were short-term (plumes measured in 10s of minutes to hours), infrequent, low intensity (maximum dredging turbidity ~15 NTU) features. It is possible that a combination of dredging and a sustained period of high turbidity resulting from wind driven events could result in adverse short-term impacts to seagrass meadows within the DMPA. Future maintenance campaigns will be of similar magnitude to those that have occurred previously, therefore any impacts to seagrass meadows (and dependent fauna communities) are expected to be within the historical range.

- **Turtle nesting beaches** – dredge plumes are predicted not to extend to turtle nesting beaches.

- **HEV boundary** – low intensity, short-term dredge plumes are predicted at the HEV boundary. On this basis, and taking into account the short duration of the dredge campaign, impacts to ecological receptors within HEV waters are not expected.

3.3.2 Ecological Implications

Table 7 summarises marine communities in the dredging and DMPA footprint and immediate surrounds (project area), and key impact pathways.

Table 7: Marine communities in the Dredge and Placement Footprint and Immediate Surrounds (Project Area) and Potential Impact Pathways (Source: BMT 2021b)

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

3.3.3 Direct Effects

3.3.3.1 Infauna Communities in the Dredge and Placement Footprint

Dredge spoil deposition can affect benthic infauna composition 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). A dredge will extract benthic infauna from the dredge areas. The fate of infauna extracted by the dredger is unknown, although it is possible that some surviving infauna may colonise the DMPA. Benthic infauna 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. Infauna communities in affected areas therefore remain in a state of flux, resulting in localised changes to community structure (BMT 2021b).

Monitoring studies indicate benthic communities at the offshore DMPA were different from areas nearby (AMA 2015; Smith and Rasheed 2021b; Worley Parsons 2011). While benthic assemblages were more diverse in 2020, the overall abundance and distribution were similar and they varied inconsistently over each monitoring survey. WBM (2003) detected changes in benthic communities immediately after placement, but recovery within 12 months while Smith and Rasheed (2021b) determined that there was no evidence that dredge material placement in the Port of Bundaberg DMPA was having a measurable effect on benthic habitats surrounding the spoil ground.

No seagrass meadows, reef-building coral assemblages, macroalgae beds or mangroves occur in the dredge footprint (BMT 2021b).

3.3.3.2 Marine Megafauna Interactions

Marine animals that swim near the port area, such as whales, dolphins, dugongs and turtles, could interact with the dredger. A dredger is slow-moving, which would provide marine megafauna 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 TSHDs. Cutter-suction and back-hoe dredgers pose a low risk to turtles as they do not have trailing suction dragheads (Dickerson et al. 2004).

GHD (2005), citing personal communication from Dr Limpus, suggest that the numbers of turtles captured during dredging across all QLD ports is decreasing, with an average of 1.7 loggerhead turtles per year being captured across all ports. In the context of Port of Bundaberg, since 2010 there have been 11 dredging campaigns, with an average of 0.4 turtles captured per campaign (GPC unpublished data, 2021). GPC (personal communication, August 2021) advised that no turtle strikes occurred in the Inner Reaches of the Port of Bundaberg Channel, Swing Basin or Berths, and that tracking data shows that turtles tend to congregate in the Sea Reach section of the channel. Four (4) turtle interactions potentially associated with maintenance dredging have occurred in the past 10 years.

GPC have sought to continuously improve our operations to reduce potential turtle interaction associated with maintenance dredging. As of 2021, these commitments include operational enhancements, interactions protocols, administrative notifications and interaction reviews in line with GPC internal investigations and the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017).

Direct effects of loading and placement (dredger interaction) will be mitigated using existing practices such as deflection devices employed by the *TSHD Brisbane*. Commitments are included as control measures in GPC's and PBPL's EMPs in alignment with GPC's permit conditions and adaptive monitoring and management framework. In addition, to ensure controls are known and implemented, PBPL provides GPC with crew acknowledgement of EMPs prior to the commencement of dredging.

Given the relatively low numbers of turtles captured by dredgers, 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 within the vicinity of the Port.

3.3.3.4 Underwater Noise

The dredger will represent an intermittent noise source that has the potential to temporarily interfere with marine megafauna communications during the dredge campaign. Further work would be required to assess impacts. Notwithstanding this, any impacts are expected to be within the range of historical dredging campaigns.

3.3.4 Indirect Effects Due to Sediments and Water Quality Changes

3.3.4.1 Nutrients and Algae

There is insufficient data to quantify potential dredge-related changes to nutrients for the Port of Bundaberg. However, given the well flushed nature of dredge and placement sites, and the highly dispersive nature of dredge plumes, and also the plume studies in the Port of Gladstone with the same dredge, it is expected that any impacts will be short-term and low intensity, and are unlikely to cause algae blooms.

3.3.4.2 Sediment Impacts to Soft Sediment Benthos

Soft sediment benthos occurs within the dredge plume extents, 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

No 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 are predicted to occur. This is primarily based on extensive assessments undertaken in the Port of Gladstone with the same dredge and similar material that is also applicable and representative for the Port of Bundaberg.

Future campaigns are likely to result in similar effects on the DMPA 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).

3.3.4.3 Sediment Impacts to Seagrass and Reefs

Dredge plumes extend to mapped seagrass meadows at the offshore DMPA and surrounds. Plumes are short-lived and low intensity, but there is the potential for localised seagrass impacts within the DMPA if dredging occurs during or following an extended period of poor water quality conditions. Any impacts are expected to be within the historical range. Plumes outside the DMPA are low intensity and frequency/duration, and are therefore not expected to result in major impacts to meadows.

Low intensity/duration dredge plumes extend to nearshore reefs at the mouth of Burnett River. Impacts to these communities due to dredging-related turbidity are not expected. Analysis of the time series of deposition rate 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.

3.3.4.4 Sediment Impacts to Fish and Shellfish

Fish have a lateral line system that is 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 Total Suspended Solids (TSS) concentrations of 4000 mg/L could block gills, eventuating in fish mortality. There are very few documented cases of fish kills resulting solely from turbid plumes, and TSS levels are not predicted to approach these levels. Fish will also tend to evade unfavourable water quality conditions. Given the low intensity and short duration of dredge plumes, impacts to fish are not expected.

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 life-cycle. 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.

3.3.4.5 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 (GBRMPA 2011). These conditions make fauna more susceptible to starvation and boat strike.

Maintenance dredging plumes are not expected to significantly impact on seagrass meadows outside the DMPA or corals (Section 3.3.4.3), nor are major changes to benthic macroinvertebrate communities expected. It is possible that highly localised impacts to seagrass meadows in the DMPA could occur, however any impacts are expected to be short-term. It is therefore 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 vicinity of the Port 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 green and hawksbill turtle, which 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 short-lived highly turbid dredge plumes.

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

MNES and MSES relevant to maintenance dredging are described in BMT 2021b 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 to 9).

3.3.5.1 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 2021b, 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 2021b, 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 2021b, 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)

3.3.5.2 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:
    - plumes are short-lived and low intensity (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 Bundaberg.
- **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.
- **Highly Protected Zone of State Marine Park:** maintenance dredging activities will take place adjacent to the GSMP. Based on significant residual impact criteria for protected areas, the proposed dredging will not:
    - result in exclusion or reduction in the public use or enjoyment of the part or all of the nearby protected areas; and
    - reduce the natural or cultural values of all or part of the 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 2021b).

For relevant MSES, see Figure 6.

Figure 6 Matters of State Environmental Significance (QSpatial, Smith and Rasheed 2021a,b)

4. Consultation and Key Issues

To assist the development 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 (#1431526). 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 Bundaberg. 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 Bundaberg 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 A.

5. Sediment Assessment

5.1 Improved Port Sediment Understanding and Management

The SSM Project was identified by GPC as a prerequisite, to allow adaptive long-term environmental management of maintenance dredging, understanding maintenance dredging sediments and how best to manage them, supporting sustainable development and identifying sediment movement within the Port of Bundaberg and how this interacts with the environment, the port, surrounding areas and communities.

GPC had discerned the need to further improve their understanding of the interactions between maintenance dredging operations (including sea placement of dredged material) and the local and regional environment, in order to identify best environmental and operational outcomes and ensure the ongoing sustainability of these operations. All Port of Bundaberg infrastructure and activities occur within Port Limits and the Port is located outside of the GBRWHA, as inscribed in 1981, but adjacent to the GSMP.

Maintenance dredging is conducted to provide and operate safe, effective and efficient port facilities and services. The Port of Bundaberg typically requires annual maintenance dredging of its channel, berths and swing basin. As part of the maintenance dredging activity, bed levelling is commonly undertaken at the same time to assist with levelling areas after maintenance dredging and moving sediment into areas to help optimise the dredging activity.

The MDS was developed for the ports that are situated within the GBRWHA (TMR 2016). It provides a framework for the sustainable, leading practice management of maintenance dredging. Although the Port of Bundaberg is not located within the GBRWHA, GPC decided to adopt the MDS to ensure the same high standard is adopted at all of three (3) of their Ports. It is a requirement of the MDS that each Port within the GBRWHA develop and implement a LMDMP. The LMDMP Guidelines note that the LMDMPs should include, as well as other aspects, the following:

- An understanding of port-specific sedimentation conditions and processes;
- Management approaches (including dredge avoidance and reduction);
- An assessment of beneficial reuse options; and
- Long-term dredging requirements based on sedimentation rates, port safety and port efficiency needs.

The SSM Project at the Port of Bundaberg was therefore aimed at fulfilling the requirements of the LMDMP. The Project has provided a better understanding of the sediment transport and resuspension processes and how these relate to maintenance dredging requirements and activities and the subsequent placement of dredged sediment. In turn, this has assisted in delivering scientifically robust information suitable for internal and external stakeholders and resultant studies such as this are helping to guide the management of relevant GPC activities including permit applications.

5.2 Port Sediment

The Port of Bundaberg is located on the Burnett River, which is a meso-tidal estuarine system with a semi-diurnal tidal signal. The Burnett River provides the primary source of new sediment to the area, with highly variable sediment loads depending on the river conditions. There is a very large mass of existing sediment present in the region, likely to have built-up over geological timeframes predominantly due to this river supply (PCS 2020c).

The natural resuspension of existing sediment by tidal currents in the River region and tidal currents and waves in the Offshore region are the dominant processes for sediment transport in the region, as the annual mass of sediment resuspended by waves and currents is more than an order of magnitude greater than the input of new sediment to the system. Transported fine-grained sediment is likely to be regularly reworked (i.e. deposited during neap tidal conditions and resuspended during spring tidal conditions) until it is deposited in a location with consistently calm conditions (e.g. dredged berths and some areas of the channel). There is a natural net northerly transport (i.e. in a northward direction) of fine-grained sediment along the coastline to the north of the Port due to the dominant south-easterly winds and easterly wave conditions relative to the coastline orientation. During calm conditions, a small proportion of this fine-grained sediment is transported into the Burnett River and is deposited in the Port. To the south of the Port the net transport direction is more variable.

There is an annual net gain of sediment in the dredged areas of the Port of Bundaberg, with the main sources of sediment being sediment discharged from the Burnett River, local reworking of sediment from immediately upstream, downstream and adjacent to the dredged areas and sediment transported into the river from offshore (PCS 2020f).

5.2.1 Physical and Chemical Properties

Sediment properties described here are derived from sediment sample results obtained in the Port of Bundaberg SAPs undertaken between 2004 and 2019 (SKM 2004; Worley Parsons 2009a; Nearshore Marine Science 2014; FPE 2020).

The SAPs collected samples at seven (7) locations upstream of the Port, six (6) locations within the Inner and Mid reaches of the Port and three (3) locations in the Sea Reach (with some variations in locations between the years). The sediment samples from the 1 m cores (or refusal) retrieved at the sampling locations during each of the surveys were analysed for engineering/physical properties (mainly Particle Size Distribution (PSD) but also moisture content and bulk density in some cases) and sediment quality to identify the presence (or absence) of contaminants in the sediment (PCS 2020b).

5.2.1.1 Particle Size Distribution

The sediment sample data collected as part of the 2004 to 2019 SAPs capture the range of different sediment properties during both typical conditions and following flood events.

Typical year: Sediment samples in the Inner and Middle Reaches of the Port are dominated by clays and silts, while more sandy sediment can be found in the Sea Reach. Results from bathymetric analyses undertaken for the Port of Bundaberg SSM Project in 2020 shows that sedimentation above design depths during typical years predominantly occurred within the Inner Port area (PCS 2020c). Based on this, it can be assumed that predominantly fine-grained silt and clay is deposited during typical years.

Following a large flood event, the sediment samples show an increase in sediment grain size within the Inner Port area, with samples in the Inner Reach being predominantly sand and gravels, while in the Middle and Sea Reaches there was an increase in silt and clay content.

Results from the 2019 sediment sampling (which shows sediments deposited during typical conditions as well as the ongoing reworking and transport of sediment from previous flood events), suggest that the surface sediment composition is returning to a similar state to how it was in 2004 and 2009 (i.e. there was an increase in silt and clay content in surface sediments in the Inner Reach and a reduction in silt and clay in the Middle and Sea Reaches compared to 2014 (Figure 7).

The 2019 sampling showed that in all Port sampling locations, except for the outer section of the Sea Reach, there was a surface layer of clay or silty clay (ranging in thickness from 0.15 to 1.0 m) with sand or gravelly sand beneath. This suggests that the increase in fine-grained silt and clay in the Inner Reach of the Port has been due to finer-grained sediments being deposited on top of the predominantly sandy sediment which has been deposited during previous flood events. In contrast, in the Middle and Sea Reaches the fine-grained sediment has been winnowed from the surface sediment deposited during the previous flood events due to ongoing tidal current and wave action (PCS 2020b).

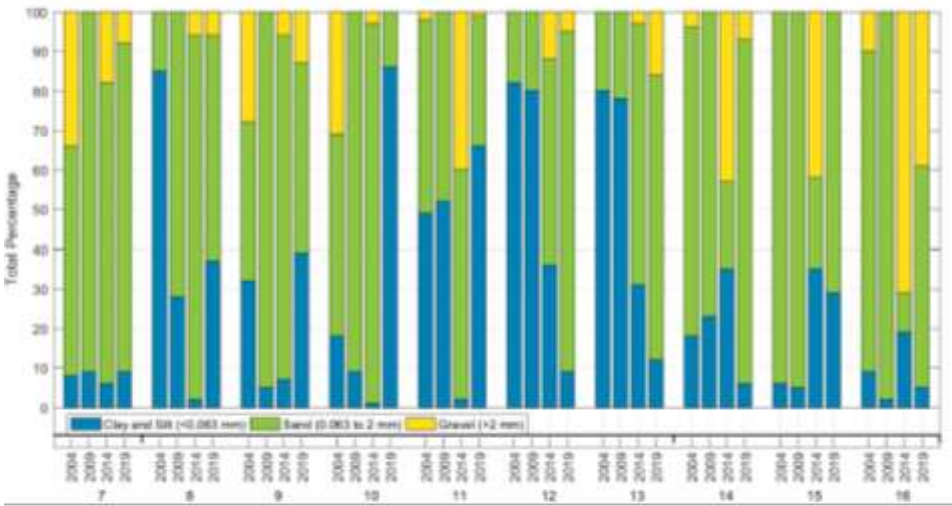


Figure 7 PSD summaries (percentage of total sample in gravel, sand, and silt and clay size classes) from 2004 to 2019 sediment sampling (Source: PCS 2020b)

5.2.1.2 Contaminants

The current imports and exports at the Port of Bundaberg are unlikely to contribute to the contamination of sediments. The only significant potential source of pollution is Tributyltin (TBT) from antifoulant used on the larger ships that have docked at the Port[1]. Other contamination that could be found in Port sediments would likely have originated from upstream sources. Emerging contaminants are also considered.

Sediment concentrations of organic substances, including polychlorinated biphenyls (PCBs), organotins (including TBT), organochloride pesticides (OCPs) and total petroleum hydrocarbons (TPHs) are below Practical Quantitation Limits (PQLs). Total polynuclear aromatic hydrocarbon (PAH) concentrations are close to the PQL (Worley Parsons 2012). These results formed part of the rationale for not testing for pesticides in subsequent SAPs.

Trace metals have been the primary contaminant group recorded. However, the 95% Upper Confidence Level (UCL) is below screening guidelines for all metals (Future-plus Environmental 2020).

An assessment of Acid Sulphate Soils (ASS) was undertaken as part of the 2019 SAP (Future-plus Environmental 2020) to determine the presence or absence of sulphates within the dredge sediment. The results from the analysis indicated that the sediment dredged from all areas of the Port are not Actual ASS (AASS) but are Potential ASS (PASS), containing significant concentrations of Acid Neutralising Capacity (ANC) (i.e. shell grit and corals).

Measured concentrations of Total Organic Carbon (TOC) were all below <1.5 %, well below what would be considered a significant TOC concentration (i.e. > 10%, ANZG 2018).

Overall, maintenance dredging sediments sampled via SAPs in the Port of Bundaberg have consistently been found to be suitable for unconfined placement, including placement at sea (PCS 2020b).

5.2.2 Biological Characteristics

No dedicated Introduced Marine Pest (IMP) surveys have been undertaken at the Port of Bundaberg. However, in the process of undertaking infauna monitoring, there have been no observations of declared marine pests listed by the National Introduced Marine Pest Information System (NIMPIS) (NIMPIS 2009, Worley Parsons 2007, 2009b, 2011; Smith and Rasheed 2021a, b).

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. The key guiding principles of the MDS also prescribe areas of improvement such as the avoidance or minimisation of maintenance dredging, beneficial re-use and comparative analysis. 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 and therefore should either be avoided or undertaken as efficiently as possible.

As part of the SSM Project, GPC undertook an options assessment for completely avoiding sedimentation, maintenance dredging and the placement of sediment at sea (PCS 2020a). As part of

[1] The use of TBT as an antifoulant was banned in 2008. Any TBT contamination would therefore be historic and, given the significant reworking and sedimentation during floods, potential for TBT contamination at the Port of Bundaberg is low.

the assessment it was also necessary to predict future sedimentation within the Port of Bundaberg and the resultant changes in declared depths.

Based on the analysis of historic bathymetric data relative to the design depths in the Port of Bundaberg it was predicted that the total volume of future sedimentation potentially requiring management ranges between 110,000 m^3 (in-situ volume) for a typical year and up to 1,460,000 m^3 for a worst case flood event[2]. The majority of this sedimentation was predicted to occur in the Inner region during typical years, while during a worst case flood event sedimentation is expected to occur throughout the Port, with the majority being in the Swing Basin and Middle Reach of the channel.

Based on historical sedimentation rates and correlations developed between sedimentation and changes in depth, predictions for future sedimentation and associated changes in depth were calculated over a 20-year period. Based on an analysis of historical metocean conditions and the fact that the frequency and severity of these events are predicted to increase in the future due to climate change (DEHP 2016), it was assumed that in the 20-year period there would be four (4) flood events, with two (2) of these being worst case floods. The assessment found that after one (1) year of sedimentation with no sediment management, there would be a tidal constraint for fully laden vessels manoeuvring in the Swing Basin and sailing throughout the Inner and Middle Reaches of the channel. After two (2) years there is predicted to be a tidal constraint or reduced loading at the South Berth, while after five (5) years there would be insufficient depth in the South Berth for ongoing operations and no access to the Swing Basin for most vessels, effectively preventing ongoing port operations.

The assessment found that to maintain design depths within the Port of Bundaberg annual maintenance dredging would be required. Within the order of 110,000 m^3/year would be required during typical years, if all areas of the port were returned to design depths and around 50,000 m^3/year required if targeted maintenance dredging occurs (e.g. South Berth and Inner channels but not Swing Basin or Middle and Outer reaches). To maintain design depths during a large flood event, it is predicted that between 773,000 m^3 to just under 1.5 M m^3 of maintenance dredging would be required.

The assessment found that while there are possible options which could be considered for localised areas to avoid sedimentation and maintenance dredging, there are no realistic options available to completely avoid maintenance dredging and the placement of dredged material at sea and for the Port of Bundaberg to remain operational.

GPC currently employs a number of strategies to minimise maintenance dredging activities at the Port of Bundaberg. These are listed below. Any further opportunities to avoid or reduce maintenance dredging requirements 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:

- **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. These surveys should comply with the Standards for Hydrographic Surveys in Queensland Waters (MSQ 2009) and the frequency of these surveys is dependent on location within the Port;
- **Bed levelling:** bed levelling or drag barring is used to level out high points in a channel and, therefore, help to reduce the frequency of maintenance dredging;

[2] It is important to note that the value for the typical year represents an annual change, while the value for the flood event just represents the sedimentation from that event, although the magnitude of the changes for such an event will make any previous changes irrelevant.

- **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 however has the potential to result in safety and environmental implications if not managed correctly; and
- **Port Management:** ports will typically manage their infrastructure and operations to minimise the requirement for future 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 (PCS 2020e). To allow for ongoing sustainable sediment management, 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. 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. 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 DMPA.

Reduce approaches that have been considered are based on three (3) broad strategies, (i) to keep sediment out, (ii) keep sediment moving and (iii) keep sediment navigable. A total of 13 possible reduce approaches were identified based on information from global best practise guidance. Of these, four (4) approaches (sediment trap, insurance trench and drag barring and two (2) sustainable relocation approaches) were considered to be potentially feasible based on the configuration and natural processes in the Port of Bundaberg. The four (4) approaches were assessed along with ongoing maintenance dredging and placement at the existing offshore DMPA as part of an Objectives Assessment. This considered objectives for 12 separate aspects which ensured a comprehensive assessment. Based on the Objectives Assessment, the following recommendations were made for the Port of Bundaberg:

- The only approach which is not considered feasible to reduce future maintenance dredging is an insurance trench in the South Berth combined with drag barring. This approach does not reduce future maintenance dredging but it has the potential to improve port operations and safety and so could still be considered at the Port of Bundaberg as an alternative sediment management approach, but it is not an approach which can reduce maintenance dredging;
- A large scale sediment trap directly upstream of the Port has the potential to reduce sedimentation in the Inner Port area of the Port of Bundaberg It is therefore recommended to be adopted, but only as long as the sediment removed to create and maintain the large scale sediment trap is primarily removed for the purposes of being beneficially reused so there is no cost associated with removing the sediment (i.e. the potential for the approach to reduce sedimentation in the Inner Port area is a secondary benefit). This is because there is significant uncertainty related to how much the approach would reduce sedimentation in the Port, but as long as this is only considered as a secondary benefit of the approach and there are not high capital and ongoing maintenance costs associated with the approach then it would still be considered beneficial regardless of whether it reduced sedimentation during flood events

by 10% or 50%. For this assessment it was assumed that the sediment trap would reduce sedimentation by 30% in the Inner Port area. Based on this the total volume of sediment requiring maintenance dredging in the Port would be reduced by just under 550,000 m^3 over 10 years, which represents a reduction in dredging duration of 45 days assuming that the sediment would otherwise have been placed at the existing offshore DMPA; and

- Both the sustainable relocation of sandy sediment within the channel of the Burnett River and at an offshore site to the north of the river have been shown to have the potential to reduce the duration of maintenance dredging as well as the amount of sediment placed at the existing offshore DMPA following flood events. Both approaches also have the potential of providing environmental benefits by ensuring that the sediment remains within the active sediment system. If all of the sediment deposited in the Port of Bundaberg during flood events is placed at either the in-channel or offshore sustainable relocation sites instead of the existing offshore DMPA there is the potential for the duration of maintenance dredging to be reduced by almost 100 days from 415 days to 321 days over 10 years.

5.4 Maintenance Dredging and Placement Requirements

Maintenance dredging has occurred approximately annually in recent times. Historical maintenance dredging campaign years and volumes since 2009 are presented in Table 8.

Table 8: Maintenance Dredging Campaign Volumes Since 2009

Year	Estimated in situ volume (m^3)[1]		Main sediment type
	Maintenance	Emergency	
2009	40,000	13,000	Silt
2010	-	24,767	Silt
2011	-	705,000[2]	Sand
2012	89,126	-	Sand
2013	-	1,012,000[3]	Sand
2014	65,000	-	Sand
2015	64,080	-	Sand
2016	56,644	-	Sand
2017	75,264	-	Sand / Gravel
2018	51,272	28,196	Sand / Silt
2019	66,200	-	-
2020	66,221	-	-
2021	88,522	-	-
Total	**662,329**	**1,782,963**	-

[1] these volumes represent the estimated in-situ cubic metres delivered by the dredger to the DMPA (or onshore for one (1) of the 2011 campaigns). These in-situ cubic metres are derived from hopper dry tonnes reported in the dredge logs by applying a variable conversion factor depending on the sediment properties. This has ranged from 0.55 (sandy sediment) to 1.1 (silty sediment) with an average conversion factor of 0.7 (e.g. 0.7 conversion factor means that 1 tonne (dry weight) = 0.7 m^3 (in-situ)).

[2] this was undertaken during three (3) separate campaigns, February by the TSHD Brisbane (65,000 m^3 placed in Burnett River), June to July by the TSHD Brisbane (280,000 m^3 placed at offshore DMPA) and May to November by the CSD Everglade (360,000 m^3 placed onshore).

[3] this was undertaken during three (3) separate campaigns, April to May by the TSHD Brisbane (337,000 m^3 placed in Burnett River), August to September by the TSHD Brisbane (300,000 m^3 placed at offshore DMPA) and October to December by the CSD Nu-Endeavour (375,000 m^3 placed along toe of Northern rock training wall).

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. The navigational depths of the Port of Bundaberg are particularly affected by flood events. During typical years, the majority of this sedimentation is within the Inner region of the Port, while during a worst-case flood event sedimentation occurs throughout the Port, with the most being in the Swing Basin and Middle Reach of the channel. If no sediment management (i.e. maintenance dredging or bed levelling) is undertaken then future sedimentation above design depths is predicted to be in the order of 2.6 M m^3 (in-situ volume) of sediment after five (5) years, 3.1 M m^3 after 10 years and 6.2 M m^3 after 20 years.

Maintenance dredging of the main channels has been historically undertaken by the *TSHD Brisbane*. Traditionally all maintenance dredging material from the navigational channels at the Port of Bundaberg has been relocated to the approved offshore DMPA at the Port of Bundaberg, although following flood years the coarser sand material have been placed on land at the approved MRA.

The DMPA as pictured in Figure 2 is a circle of 0.5 nautical miles (926 m) radius centred on Latitude 24°42'14.3" South and Longitude 152 °28'20.8" East (WGS 84 datum).

This site was chosen based on the following:

- the characteristics of the dredged material and the material at the DMPA;
- proximity to sensitive environmental receptors;
- minimising impacts to marine habitats and fauna, including seagrasses and benthic infauna;
- the depth and capacity for ongoing use of the DMPA;
- minimising the risk of placed material being remobilised to nearby sensitive areas;
- logistic and economic considerations, including optimisation of dredge cycle times; and
- safety considerations in the operation of dredging equipment at the DMPA.

Prior to placement the vessel must confirm by GPS that it is within the DMPA. Each load of dredge material must be placed in a different location in the defined DMPA, so that the dredge material is distributed evenly within the defined DMPA.

Dredging with sea placement is not permitted between October to February inclusive (the nesting period for the Loggerhead Turtle – *Caretta caretta*).

5.5 Examination of Reuse, Recycle and Placement Options

The first step in the NAGD framework is the evaluation of alternatives to sea placement (Commonwealth of Australia 2009). 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 the Port of Bundaberg SSM Project's Beneficial Reuse Assessment is provided below (PCS 2020b).

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.

Sedimentation rates in the Port of Bundaberg vary significantly depending on the conditions, with relatively small volumes of fines deposited during typical conditions and with much larger volumes of clean sand deposited during flood events. These variations facilitate a broad range of potential reuse options, some of which provide anthropogenic benefits, while others provide environmental benefits (or a combination of the two (2)).

During typical conditions the majority of the sediment is deposited in the Inner Reach of the Port, over a relatively small area and as such it is feasible that dredging operations could be undertaken by a TSHD or Cutter Suction Dredge (CSD), with broadly similar unit dredge costs expected.

A total of 16 potential beneficial reuse options were identified and assessed as part of a high level assessment which determined and removed options that are unlikely to be feasible at the Port of Bundaberg either based on suitability of sediment, opportunity, environmental impacts or economic costs. Following the high level assessment of all 16 options, six (6) beneficial reuse options were shortlisted for further assessment. The shortlisted options were for shoreline protection, onshore beach nourishment, offshore beach nourishment (considered in combination with spit restoration/creation), construction, lining and bunding material and agriculture (considered in combination with treatment/ use of contaminated material).

An objectives assessment for each of the six (6) shortlisted options has been undertaken against a set of evaluation objectives developed by GPC through stakeholder engagement as part of the Port of Bundaberg SSM Project. A summary of the results for each option are provided in the following sections.

5.5.1 Shoreline Protection

The reuse of dredge sediments from the Inner Reach areas of the Port for stabilising the northern training wall to replace sediment scoured out during floods has been considered. Based on the successful implementation of this option following floods in 2013, it clearly provides a feasible reuse option. This reuse option constitutes both an anthropogenic reuse (stabilising the wall and ensuring the continued safe operation of the Port) and an environmental reuse (providing protection to the coastal habitat at Barubbra Island).

5.5.2 Onshore Beach Nourishment/Creation

The reuse of dredge sediments deposited in the dredge areas of the Port during flood years for onshore beach nourishment was assessed. This reuse option constitutes both an anthropogenic reuse (protecting beach amenity value) and an environmental reuse (protecting coastal and intertidal habitat which could include turtle nesting sites).

Beach nourishment is the preferred approach for addressing coastal erosion issues in QLD. The most suitable site within the area which could benefit from onshore nourishment is at Moore Park. In addition, the creation of a new beach within the limits of the Port of Bundaberg for recreational use could also benefit from this reuse option. The compatibility of the sediments deposited in the Port dredge areas during floods with existing beach nourishment would need to be confirmed prior to reuse in this way.

5.5.3 Offshore Beach Nourishment and Spit Restoration

The reuse of dredged sediment deposited in the dredge areas of the Port during flood years for offshore beach nourishment (and/or spit restoration) was assessed. This reuse option constitutes both an anthropogenic reuse (protecting beach amenity value) and an environmental reuse (protecting coastal and intertidal habitat).

As noted above, beach nourishment is the preferred approach for addressing coastal erosion issues in QLD. Two (2) sites were considered most suitable, namely offshore of Barubbra Island and Moore Park. Both sites provide opportunity for beach nourishment and spit restoration. Prior to reuse in this way, survey work would be required to ensure the suitability of the placement site (avoiding sensitive habitats) and modelling would be required to assess the potential for onshore transport and to ensure sensitive habitats are not at risk. In addition, a pilot study involving the placement of small volumes of dredge material with subsequent survey would be required to confirm the outcomes of the modelling work before adopting the reuse option on a larger scale.

5.5.4 Construction

The reuse of dredged sediment deposited during flood years in the dredge areas of the Port of Bundaberg for construction purposes was assessed. This option constitutes an anthropogenic reuse.

Given the large volumes of clean sand deposited in the dredge areas following floods, and the economic growth in the region, the potential for reuse in construction is considered to be significant.

5.5.5 Lining and Bunding Material

The reuse of dredged sediment deposited in the Inner Reach areas of the Port during typical years for lining / bunding material has been considered. This option constitutes an anthropogenic reuse.

The Port of Bundaberg has previously used some of the finer grained dredged sediment for the construction of internal bund walls for onshore dredge material processing on SPL. The Port of Bundaberg is looking to increase the use of sediment in this way for both onshore dredge material processing and for stormwater management on SPL. In addition, other industries within the Bundaberg region use environmental bunds, although the ongoing demand is not known.

5.5.6 Agriculture

The reuse of dredged sediment deposited in the Inner Reach areas of the Port of Bundaberg during typical year for use in agriculture has been considered. This option constitutes an anthropogenic reuse and environmental enhancement.

Arable farming is the primary land use in the Bundaberg region, with more than 5,000 ha of irrigated cropping and horticulture land located within 10 km of the Port of Bundaberg. The suitability of the Port of Bundaberg dredged sediment would need to be confirmed and the requirement to blend with other materials would need to be identified. If the dredged material is suitable for improving the soil structure for agricultural uses, due to the importance of agriculture in the region, reuse in this way could provide a long-term reuse option.

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 Bundaberg as far as practical and if maintenance dredging is required, there is currently no alternative to sea placement. GPC’s sea placement requirements and future dredging and placement strategy for the Port of Bundaberg will be revised as part of the continual review and improvement framework promoted by the MDS and implemented through this LMDMP (Section 1.3).

Sea placement is GPC’s preferred placement method for material from the main navigational channels for 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 years to dry out, delaying the future use of the land;
- The *TSHD Brisbane* has limited pumping ability, necessitating a booster pump with additional cost and fuel usage;
- There are environmental risks specific to each placement method which would need to be considered and managed during maintenance dredging campaigns; and
- Material analysed at the Port of Bundaberg has been previously considered uncontaminated for the purposes of sea placement.

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 8). GPC's EMS first obtained certification under ISO14001 (the Standard) 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 (Section 10).

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 8 GPC's EMS Framework

GPC's Risk Management Framework (Table 9) provides the processes to ensure the EMS suitably identifies, analyses, 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.

While each regulator has particular requirements for their assessment processes, risk assessments 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 ocean 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.

Table 9: GPC Risk Management Process

Risk management process	Description
1. 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.
2. 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.
3. 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 treatments to consider the hierarchy of controls, timing and resourcing. • Record risks in the approved risk assessment templates.
4. Monitor and review risks	• Monitor the implementation and effectiveness of controls. • Risks assessed as high or extreme require status reports to GPC's Executive Management Team and the Board.

7. Identification and Treatment of Key Risks

The risk assessment process (Section 6) informs the development or review of the risk assessment for each maintenance dredging activity. This in turn informs the development or review of the relevant EMP and Environmental Monitoring Procedure (Section 8 and 9). This process also informs the review of this LMDMP (Section 1.3).

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

- Dredging and placement directly disturbing marine habitats;
- Dredge and 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 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 maintenance dredging at the Port of Bundaberg.

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 Reporting and Scheduling Maintenance Dredging (QPA 2020) 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 March – 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 the TMR and published on their website in accordance with the requirements of the MDS.

For the Port of Bundaberg main channels, a risk assessment will be prepared and provided to the PBPL to inform the development of the state wide maintenance dredging schedule. The following key factors are generally considered for the Port of Bundaberg through this process:

- Marine megafauna and breeding, nesting and migratory seasons;
- Extreme weather seasonality; and
- Dredging requirements.

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 for QLD ports to undertake their 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 a the Port of Bundaberg has been undertaken by the *TSHD Brisbane* since 2000 and as such GPC's impact assessment and management measures for maintenance dredging presented in this LMDMP are primarily focused on this vessel.

The *TSHD Brisbane* was also 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 drag heads 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 global positioning system (GPS) 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 GPS 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 QLD ports 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 will utilise three (3) tiers of documentation for the management and monitoring of maintenance dredging activities at the Port of Bundaberg as detailed below and shown in Figure 9. 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 Sections 1.7.2, 1.7.3 and 4.

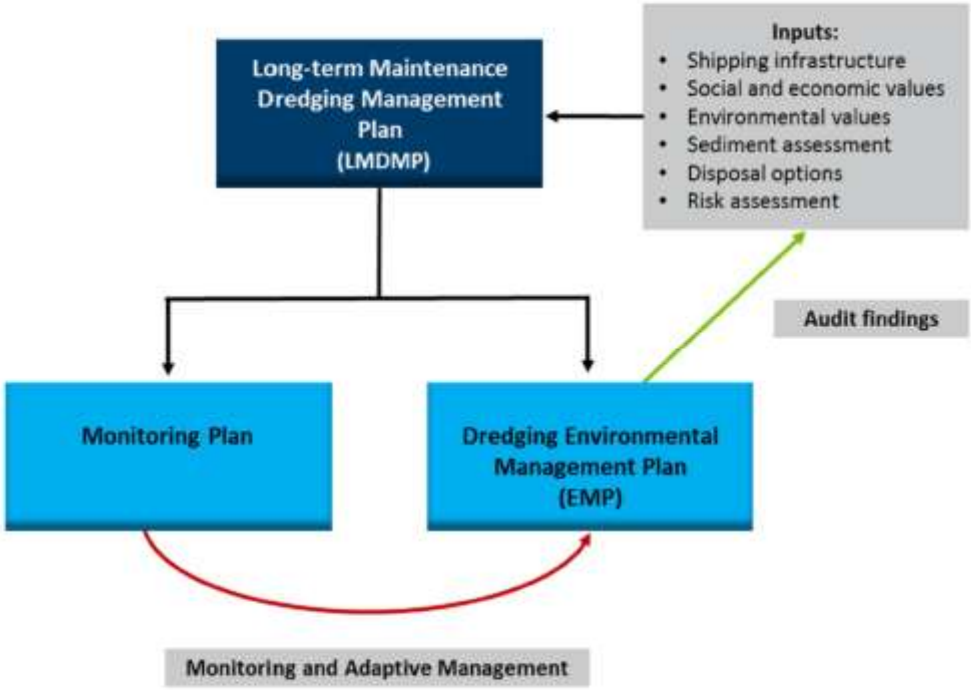


Figure 9 Elements of Dredging Management and Monitoring (Source: TMR 2018)

The Port of Bundaberg's Maintenance Dredging EMPs are developed in alignment with GPC's EMS and Risk Assessment Framework (Sections 6 and 8) to ensure an appropriate standard of risk assessment, quality assurance and document control. EMPs detail the specifics of managing each dredging campaign and include 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, and dredge selection;
- Standard management measures relating to:
    - waste management
    - ballast water management
    - bunkering of fuel

    - vessel wash-down
    - marine pest monitoring and management
    - other key risks identified by the risk assessment process (Section 6 and 7)

- Adaptive management measures relating to:
    - water quality
    - marine fauna
    - climate conditions

- 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 (TMR 2018):

- Specific and auditable measures to avoid or reduce impacts (for both the dredge and 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 (refer to Table 2 and Table 10).

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 procedures implement relevant monitoring programs for each maintenance dredging campaign and include:

- 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 10);
- The identification of monitoring contains:
    1. ambient monitoring programs: ongoing and related to key environmental parameters, used to inform impact assessment
    2. impact monitoring programs: before, during and after dredging to inform adaptive management actions. Impact monitoring and the data obtained is used to adjust monitoring and management as appropriate and required.

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.

To ensure that these potential plume related impacts do not occur, GPC employs water quality monitoring and adaptive management framework based on Turbidity. This monitoring is undertaken to:

- Measure water quality impacts
- Determine the need or otherwise for further more detailed investigations and implementation of mitigation measures.

GPC's long-term 10 year monitoring schedule (Table 10) envisaged for the Port of Bundaberg includes sediment sampling, water quality sampling, benthic fauna monitoring, impact assessments as well as hydrographic surveys. This monitoring regime was originally developed for the 2012 LTMMP and was consulted through the TACC. Further refinements to Table 10 and the monitoring regime will be developed though consultation with the TACC (Section 1.7.2) and regulatory authorities, and will take into account impact assessment (BMT 2021b) and any subsequent revision/s to this impact assessment (Section 3.3).

9.1 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.

Turbidity triggers to determine if adaptive management is required typically uses WQOs which are numeric measures to protect EVs. GPC have used historic baseline turbidity data to establish triggers for the 80th and 95th percentiles.

Table 10: Port of Bundaberg Long-term Monitoring Schedule

Monitoring component	Ambient, Impact detection, Real-time	Monitoring Objective	Activity	Monitoring / sampling area	Description	Monitoring period									
						2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Sediment quality	Impact detection	Sample sediments to determine the presence and the concentrations of contaminants of concern and thus make appropriate decisions on dredge material placement methodology.	Dredging and placement	Dredging footprint, and DMPA	Sediment sampling and analysis in accordance with approved SAPs and comparison of levels to screening limits outlined in NAGD.			(1)					(1)		
Water quality	Impact detection	Monitor water quality to assess trends and inform adaptive management.	Dredging and placement	Adjacent to the dredging footprint	Water quality monitoring adjacent to loading and / or placement activities.	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Benthic infauna, seagrass and PSD	Impact detection	Survey benthic habitats within and around the DMPA to ascertain and highlight any long term changes occurring as a result of placement activities.	Placement	DMPA and adjacent to DMPA	Benthic fauna and flora sampling and particle size analysis at sites within and adjacent to placement area.				(3)					(3)	
Hydrographic survey	Impact detection	Survey DMPA to ensure no navigational hazards have arisen following placement activities.	Placement	DMPA and adjacent to DMPA	Hydrographic survey of placement area.	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
Real-time monitoring	Ambient	N/A	Baseline	N/A	Development of a baseline dataset.	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
Port wide seagrass survey	Ambient	N/A	Baseline	N/A	Development of baseline data set				(6)					(6)	
Turtle survey	Ambient	N/A	Baseline	N/A	Increasing existing data set	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)	(7)

(1) Sediment quality undertaken every five (5) years.

(2) Prior to the commencement of dredging, water quality sites will be selected and monitoring will occur before, during and post dredging activity.

(3) Benthic in-fauna, seagrass and PSD survey every five (5) years pending commencement of maintenance dredging within the five (5) year time period.

(4) At a frequency outlined in approvals.

(5) Ambient water quality monitoring to assist in building the data set to understand natural variability and contribute to historic baseline turbidity data.

(6) Conducted in conjunction with the five (5) yearly impact detection of seagrass at the DMPA, as a port wide survey to build the dataset. The surveys will be undertaken at an appropriate time of year when seagrass is in its maximum growth phase. Surveys will also be avoided or delayed during inclement weather.

(7) An annual turtle survey of Mon Repos and the Woongarra Coast, to assist in understanding of nesting populations and any potential changes which may have occurred throughout the monitoring.

10. Performance Review

GPC's EMS (Section 8) 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 maintenance dredging activities at the Port of Bundaberg. 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;
- Non-conformity 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 support the EMS's contribution to the continual improvement framework outlined in Section 1.3 of this LMDMP which includes re-evaluation 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 would be detailed for each potential risk category in the EMP (Section 8). This would also incorporate monitoring undertaken through 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 GPC Port Strategy and Development Department or by a suitably qualified auditor nominated by GPC. Audit reports may be provided to external regulatory authorities as and when required. The Port Strategy and Development Department shall include and provide audit findings and reports to the Port of Bundaberg Operations, as the GPC department responsible for the dredging works.

10.3 Non-Conformity 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.

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, demonstrate compliance and promote continual improvement. GPC's data management process ensures QA and QC. These processes are described in the Environmental Monitoring Procedure (Section 9). Monitoring reports and data availability are discussed in Section 1.7.4 and Section 11.

10.5 Internal and External Reporting

To ensure that GPC Management and Board 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 relevant stakeholders as detailed in Sections 1.7.2, 1.7.3 and 4. 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. These include:

- Records of continual improvement processes including review of management and monitoring program outputs (Section 1.3);
- LMDMP implementation including staff and contractor familiarisation, approval by GPC representatives and regulatory authorities, review of the plan, version control and publication (Sections 1.3 and 1.4);
- Statutory approvals (Section 1.6);
- TACC membership, consultation records and outcomes (Section 1.7.2);
- Availability of reports and data and reporting under the MDS (Section 1.7.4);
- Stakeholder consultation in the development and review of this LMDMP (Section 1.7.2 and 4);
- Assessment of maintenance dredging and placement options including efforts to minimise maintenance dredging and placement (Sections 5.2 to 5.6);
- Risk assessments and the identification and treatment of risks (Section 6 and 7);
- 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 Procedure (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 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 informed the preparation of this LMDMP and will assist in the development of associated management documents. These include the outcomes of any monitoring programs commissioned by GPC at the Port of Bundaberg (Section 9) as well as by independent bodies. Table 11 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 further monitoring. This section also provides the details of the information sources cited throughout this LMDMP.

Table 11: Synthesis of Key Supporting Information

Document	Author	Description	Availability	Next scheduled revision
External Information				
Maintenance Dredging Strategy (2016)	Department of Transport and Main Roads (TMR)	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. Note: Voluntary for Bundaberg as not a GBRWHA Port.	TMR website	Not specified
Maintenance Dredging Strategy for Great Barrier Reef World Heritage Area Ports: Technical Supporting Document (2016)	Haskoning Australia Pty Ltd (2016)	The Strategy is based on the findings of a Technical Supporting Document providing a scientific and technical evidence basis for the guiding principles and actions. Note: Voluntary for Bundaberg as not a GBRWHA Port.	TMR website	Not specified
Guidelines for Long-term Maintenance Dredging	TMR	The LMDMP Guidelines support the MDS by providing State guidance on long term planning and management approaches which should be applied to	TMR website	Not specified

Document	Author	Description	Availability	Next scheduled revision
Management Plans (2018)		maintenance dredging of ports in the GBRWHA. The LMDMP Guidelines assist each GBRWHA port in preparing a LMDMP. Note: Voluntary for Bundaberg as not a GBRWHA Port.		
Schedule for State-wide Maintenance Dredging of Queensland Ports (2020)	Queensland Ports Association (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. The Procedure for Scheduling and Reporting the Annual State-wide Maintenance Dredging Program by *TSHD Brisbane* (QPA 2020) is a procedure used to provide a standard process for QLD ports.	TMR website	2021 (annual)
Maintenance Dredging of Queensland Ports Review of Activities (2020)	QPA	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 dredge material placement locations, and outcomes of monitoring. The results of the annual review are incorporated into the dredging schedule for the following year. QPA - *Reporting and Scheduling Maintenance Dredging* is a procedure used to provide a standard process for QLD ports (referenced in Section 12)	TMR website	2021 (annual)
Environmental Code of Practice for Dredging and Dredged Material Management (Ports Australia 2016)	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 environmental principles that Australian ports follow when undertaking dredging and when reusing, relocating or disposing of dredged material.	Ports Australia website	2021 (every five (5) years)

Document	Author	Description	Availability	Next scheduled revision
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 placement; assessing loading and placement sites; assessing potential impacts on the marine environment and other users; and determining management and monitoring requirements.	Department of Agriculture, Water and the Environment website	Not specified
GPC Information				
LMDMP *(document number 1541072 V17)*	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 safety and efficiency of ports within the GBRWHA. Note: Voluntary for Bundaberg as not a GBRWHA Port. This LMDMP for the Port of Bundaberg has been developed in accordance with the MDS framework and considers the Checklist for Long-term Monitoring and Management Plans for Dredging (Commonwealth of Australia (2012). It is supported by the relevant EMP and / or Environmental Monitoring Procedure. This LMDMP will replace GPC's previous LTMMP provided to regulatory agencies. This LMDMP is relevant to all potential maintenance dredging activities undertaken by GPC within the limits of the Port of Bundaberg.	GPC website This LMDMP is relevant to all planned and potential maintenance dredging activities undertaken by GPC within the Port limits of the Port of Bundaberg.	2026 (every five (5) years or as required)
EMP (2021) *(document number 971879 V21)*	GPC	The Maintenance Dredging EMP for the Port of Bundaberg is developed in alignment with GPC's EMS and Risk Assessment	GPC website	February 2022

Document	Author	Description	Availability	Next scheduled revision
		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. The EMP is specifically developed to manage GPC's maintenance dredging and sea placement activities at the Port of Bundaberg and will be provided to the relevant regulatory agencies.		
Environmental Monitoring Procedure (2021) *(document number 964306 23)*	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. An Environmental Monitoring Procedure is specifically developed to manage GPC's maintenance dredging and sea placement activities at the Port of Bundaberg. It implements the requirements of the long-term monitoring schedule and will be provided to the relevant regulatory agencies.	GPC website	February 2022
TACC ToR (2021) *(document number 1314897 V14a)*	GPC	GPC has an established TACC for Port of Bundaberg 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.	GPC website	May 2023

Document	Author	Description	Availability	Next scheduled revision
		The GPC TACC ToR includes important information about the scope, objectives, membership and administration of the TACC.		
TACC Minutes (2021) *(document number 1710726 V2b)*	GPC	Outcomes of the most recent TACC meeting providing an operations update, environmental update, LMDMP discussion and other improvements.	GPC website	Annual
Risk assessment for scheduling annual maintenance dredging at the Port of Bundaberg (2021) *(document number 1727411 V2)*	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 Port of Bundaberg 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 maintenance dredging activities are managed in accordance with the principles of the MDS. GPC's assessment and performance reporting to TMR for the Port of Bundaberg will be undertaken in accordance with the QPA procedure which ensures consistency between ports.	GPC website	Annual
Implementation Report of Sediment Sampling and Analysis Plan for the Port of Bundaberg Maintenance Dredging (2019) (*document*	GPC (specialist contractor)	Maintenance dredging sediment sampling and analysis in accordance with approved an SAP and comparison of levels to screening limits outlined in NAGD and other relevant guidelines. The aim of the investigation will be to allow for a statistically valid evaluation of the physical and chemical sediment properties of	GPC website	2025

Document	Author	Description	Availability	Next scheduled revision
number 1572650 V5)		the sediments to be dredged. The results of this assessment will assist in determining the suitability of sediment 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.		
Port of Bundaberg Description of Environmental Values (2020) (*document number 1679563 V1*)	GPC (specialist contractor)	This report describes the terrestrial and marine environmental values in the vicinity of the dredged areas, dredge material placement area, onshore MRA and land owned by GPC. Based on a desktop assessment (e.g. review of relevant mapping, database searches, local knowledge and ecological data, and review of relevant reports) and a brief site inspection.	GPC Website	Not specified
Port of Bundaberg Maintenance Dredging Impact Assessment (2021) (*document number 1728383 V2*)	GPC (specialist contractor)	Approach and findings of the environmental assessment of potential maintenance dredging impacts to marine waters.	GPC Website	Not specified
Port of Bundaberg Sediment Budget: Model Development and Validation (2021) (*document number 1740871 V1*)	GPC (specialist contractor)	The aim of this monitoring is to model and validate a typical maintenance dredging campaign of 90,000 m^3 to better understand the impact of maintenance dredging to potential sensitive receptors.	GPC website	Not specified
Port of Bundaberg Spoil Ground Seagrass and Benthic Fauna Survey 2020 (2021) (*document*	GPC (specialist contractor)	Survey conducted to investigate the potential impacts of sea-placement activities on benthic habitats; specifically, benthic in-fauna and seagrass. Primary objectives were to:	GPC Website	Not specified

Document	Author	Description	Availability	Next scheduled revision
number 1702505 V3)		- Compare the spoil ground with nearby benthic habitats to assess any impacts of spoil disposal; - Determine if impacts in the spoil ground diminish with distance from the spoil grounds		
Port of Bundaberg Seagrass and Benthic Monitoring Survey 2020 (2021) (*document number 1693299 V2*)	GPC (specialist contractor)	This survey provides an all of port baseline for comparison with any future seagrass surveys in the area.	GPC Website	Not specified
Hydrographic Survey (2021) *(document number 1702226 V1)*	Queensland Government Hydrographic Services	GPC undertakes hydrographic surveys of the DMPA to ensure that deposited material does not cause navigational hazard.	GPC website	As prescribed by approval
Sea Dumping Permit International Reporting 2020 *(document number 1674888 V1*)	GPC	This information is required for Australia's annual reporting obligation under the London Protocol and is a condition of the Sea Dumping Permit.	GPC website	2020 (annual)

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Appendix A. Consultation Feedback and Responses (TACC and Other Stakeholders)

Affiliation	Feedback	GPC response
Queensland Department of Agriculture and Fisheries	Figure 7: Port of Bundaberg Matter of State Environmental Significance Map does not include all MSES likely to be present in the Port of Bundaberg Area. MSES Marine plants and MSES waterway providing for fish passage are not shown on the mapping layer. A caveat should be included to highlight that this map is not an accurate representation of all MSES within the Port limits.	Noted. Edits made to LMDMP.
	General: It would be beneficial for GPC to use historical and updated mapping to indicate the presence of marine plants. This information should be used as a starting point for planning, with reference to the potential sediment use options. This would help guide avoidance of known areas hosting MSES marine plants and the potential impacts associated with the proposed option. Any progression of works would require updated surveys prior to development applications.	Noted. Edits made to LMDMP.
	Table 10: Port of Bundaberg Long-term monitoring schedule: note: timing of seagrass surveys should be undertaken at an appropriate time of year when seagrass is in its maximum growth phase. Any significant natural events that may impact on seagrass (e.g. cyclones) should be noted and monitoring avoided or additional surveys undertaken once communities have recovered to ensure an accurate reflection of seagrass locations and extent.	Noted. Edits made to the LMDMP.
Sea Turtle Alliance Inc.	Respectfully hope that all the stated measures in the plan are strictly enforced to ensure the rich biodiversity of the Bundaberg Port is maintained.	Noted. No change required to the LMDMP.
	The plan should also acknowledge that significant numbers of endangered loggerhead turtles also nest on Barubbra Island and on the many sandy beaches to the north and south of the Port.	Noted. Edits made to the LMDMP.

Affiliation	Feedback	GPC response
	It would therefore be very beneficial if all dredging operations were conducted outside the turtle season, which runs from 15 October to 30 April. By not dredging during this time, many of the detrimental dredging issues relating to sea turtles would be successfully overcome.	Noted. Edits made to the LMDMP. Current environmental window for marine turtle protection included.
	The draft plan also states that the offshore DMPA and immediate surrounds support extensive seagrass meadows. Your studies have shown that dredge plumes were short-term, infrequent, low intensity features. Despite this it also states that it is possible that a combination of dredging and a sustained period of high turbidity resulting from wind driven events could result in adverse short-term impacts to seagrass meadows within the DMPA. This is of great concern to us and we seek your assurances that this will be closely monitored to ensure that any impacting from dredging on the sea grass meadows is promptly addressed and rectified.	Noted. No change required to the LMDMP.
	Whilst a dredger is slow-moving, providing marine megafauna including sea turtles, time to evade the approaching vessel there has been at least four instances of turtles being dredged up and killed in the past ten years. In addition to the current nesting species, other species of sea turtle use our coastline as their feeding habitat all year round. We feel, that all dredging operations should therefore be aware of this and also have in place strategies to avoid dredging of all marine animals.	Noted. No change required to the LMDMP.
The Department of State Development, Infrastructure, Local Government and Planning (DSDILGP)	DSDILGP thanks you for providing the opportunity to comment on the Draft Port of Bundaberg Long-Term Maintenance Dredging Management Plan. DSDILGPs support of this discussion paper is dependent on the following changes being actioned:	Noted. No change required to the LMDMP.
	Page 21, Section 2.3 Current and Future Use: Paragraph four references an oil storage facility adjacent to the John T. Fisher Wharf (bulk liquids wharf). It is State Development Group's understanding these facilities were removed and site remediated in early 2021.	Noted. Edits made to the LMDMP -

Affiliation	Feedback	GPC response
	Confirmation of the status of these facilities should be confirmed with the Port of Bundaberg Manager.	
	Page 21, Section 2.3 Current and Future Use: DSDILGP recommends the following sentence in paragraph six include a reference to break bulk. "GPC continues to explore other opportunities for future trade and expects to see an increase in dry bulk and break bulk throughput with key asset development."	Noted. Edits made to the LMDMP
	Page 21, Section 2.3 Current and Future Use: DSDILGP recommends consideration be given to this section acknowledging the opportunity and suitability of the Port of Bundaberg for transshipping activities. River ports such as Port of Bundaberg (PoB) are generally subject to vessel size restrictions and the influence of sedimentation due to flooding events. The growth and development of the PoB is challenged by ship size constraints at its existing river berths, limited to vessels of up to 200 metres length overall, with a beam up to 33 metres and approximately 30,000 tonne at present. Transshipping is recognised by industry, regional stakeholders and the Gladstone Ports Corporation as an opportunity to address this challenge and support growth and investment at the PoB and Bundaberg SDA. Opportunities exist for transshipping to support new trade through the PoB in the export of minerals such as bauxite and imports of oversize over mass break bulk i.e. wind farm components. The PoB is located adjacent to the Bundaberg State Development Area, just south and outside of the Great Barrier Reef Marine Park and Great Barrier Reef World Heritage Area. The Environmental Protection (Transshipping Activities) Amendment Regulation 2020 uniquely positions PoB for transhipping activity.	Noted. No change required to the LMDMP.