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Port of Bundaberg Maintenance Dredging Environmental Monitoring

Brief description

The monitoring and management during dredging activities at the Port of Bundaberg is essential to ensure that potential environmental impacts of this activity are controlled through the identification of sensitive environmental receptors, understanding environmental risks and employing measures and safeguards to mitigate potential issues.

Document information	
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Document Accountability	
Role	**Position**
Owner	Executive General Manager SESG
Custodian	Environment Superintendent

If you require any further information, please contact the Custodian.

Contents

Terms and definitions

Term	Definition
Owner	Under the GPC governance structure, the Owner is accountable for approval and has the authorised discretion to implement or significantly change the system
Custodian	Under the GPC governance structure, the Custodian is accountable for monitoring the application of the system and advising the owner of the monitoring outcomes, and is also accountable for proposing system design or redesign and facilitation of conformance
Environmental Harm/Nuisance	Unreasonable interference or likely interference with an environmental value caused by: • Noise, dust, odour or light; • An unhealthy, offensive or unsightly condition because of contamination; or another way prescribed by Regulation.
Monitoring	• Observe and check the progress or quality of (something) over a period of time; keep under systematic review • Maintain regular surveillance over listen to and report on
Sensitive Receptor	A fixed location of significance with the potential for impact.
Water Quality	A quantitative measure of the physical, chemical and biological characteristics of water, relative to the requirements of a stated environmental value.
Exceedance	When a contaminant has been released to the receiving environment at a level beyond what is allowed or stipulated by a set limit.

Acronyms

Acronym	Spelling
DES	Department of Environment and Science
EA	Environmental Authority
EC	Electrical conductivity
ECS	Environmental Compliance Specialist
EM	Environmental monitoring
EMP	Environmental management plan
EMS	Environmental Monitoring Specialist
EMS	Environmental Management System
EVs	Environmental values
EWMA	Exponentially Weighted Moving Average
GPC	Gladstone Ports Corporation Limited
GW	Groundwater

Acronym	Spelling
LTMMP	Long Term Management and Monitoring Plan for Maintenance Dredging and Disposal
MP	Monitoring procedure
MRA	Material reclamation area
NADG	National Assessment Guidelines for Dredging
PoB	Port of Bundaberg
PSD	Particle size distribution
NATA	National Association of Testing Authorities
SAP	Sediment analysis plan
SWL	Standing water level
TSS	Total suspended solids
WQ	Water quality

1 Introduction

1.1 Purpose

The Port of Bundaberg (PoB) Monitoring Procedure (MP) has been developed to:

- Describe the Gladstone Ports Corporation Limited (GPC) systems for monitoring and managing potential environmental risks and impacts associated to maintenance dredging (MD) activities at the PoB;
- Describe the measures and safeguards to be implemented around and during MD; and
- Address compliance requirements of the Sea Dumping Permit (#1762465) and Environmental Authority (EA) EPPR00571913 (#1731208).

1.2 Scope

This MP covers all aspects of the environmental monitoring (EM) undertaken around the PoB annual MD for 2023. Typically the PoB annual MD campaign is approximately 5 to 7 days and is expected to be undertaken in April 2023. This monitoring, herein referred to as ‘’activity based monitoring’’ includes several aspects which are implemented at different locations and frequency (Section 2.3).

The present MP implements, supports and should be read in conjunction with:

- The Port of Bundaberg Environmental Management Plan (EMP) for Maintenance Dredging Activities (#971879) and;
- The Port of Bundaberg Long Term Maintenance Dredging Management Plan (LMDMP) (#1541072).

The latter describes GPC long-term, environmental management measures and monitoring for MD and dredge material sea placement at the PoB. As this is the overarching framework around the PoB MD, this MP will also introduce and describe some of its aspects and associated long-term monitoring schedule. The activity based monitoring undertaken around MD is used to prevent and manage any potential direct environmental harm. Monitoring elements part of the long term schedule are instead

commitments made by GPC in order to assess any potential long term impacts of MD activities, dredging and relocation on the receiving environment and sensitive receptors.

1.3 Objectives

This MP aims to monitor the effects of dredging activities and inform adaptive management, while demonstrating compliance with the EA, SDP, EMP and LMDMP commitments at the PoB. Adaptive management actions based on activity based monitoring results are in place to ensure no environmental harm occurs to the receiving environment and sensitive receptors from MD related plumes. The present document addresses:

- Environmental values and risks;
- Incorporation of a risk based framework in the monitoring programs;
- Monitoring of the effects of dredging activities and inform adaptive management. This can be subdivided into three (3) aspects:
    1. Ambient monitoring;
    2. Impact detection; and
    3. Real time adaptive management.
- Implementation of relevant components of the Long Term Monitoring Schedule;

This MP will be reviewed annually and/or prior to each MD campaign, including emergency MD. Moreover, the performance of this document will be measured through post dredging audit (EMP Section 3.11). Permit non compliances or other environmental incidents during MD operations will be used as a measurement of this procedure effectiveness and will also trigger review of its contents.

2 Port of Bundaberg Monitoring Procedure

2.1 Roles and responsibilities

GPC staff and contractors are responsible for the environmental performance of their activities and for complying with the general environmental duty as set out in Section 319 (1) of the *Environmental Protection Act 1994* which states:

'A person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to minimise the harm'.

Roles and responsibilities in relation to this monitoring procedure are outlined in Section 3.7 of the EMP.

2.2 Environmental monitoring framework

GPC's Risk Management Framework provides the processes to ensure the Environmental Management System (EMS) suitably identifies, analyses and evaluates, manages and monitors all aspects under the control or influence of GPC. The PoB MD risk assessment is documented in GPC's SAI360 Risk Management, Risk Register for the activity. Monitoring based risk controls are documented and communicated in this MP and are derived from the LMDMP which sets the long term monitoring programs for and around MD activities.

To establish the activity based (Section 2.3) and long term monitoring program (Section 2.4), GPC applies a risk assessment framework and considers the following aspects and impacts:

- Identification of sensitive receptors and environmental values including water quality (WQ), flora and fauna, and Matters of State and National Environmental Significance;

- Predicted impacts of MD on identified sensitive receptors and environmental values;
- State-wide MD considerations to optimise operational efficiency and minimise environmental impacts;
- Ambient and observational information for environmental evaluation purposes; and
- Activity based environmental monitoring and adaptive management to prevent and mitigate predicted impacts.

An Environmental Monitoring Schedule (#314935) has been established to ensure the key elements of GPC's monitoring around MD are being identified and implemented. Monitoring outcomes inform GPC's adaptive management of MD and the continual improvement processes described in the LMDMP.

2.3 Activity based monitoring overview

At the PoB, MD is regulated through the EA EPPR00571913. The latter is divided into two (2) sections regulating dredging with sea relocation (Section 1) and land relocation (Section 2). The third Section of the EA regulates sand screening activities. The separate sections trigger different types of monitoring which are described in this document:

- Sea placement: ambient WQ; and
- Land placement: ambient water, tailwater and groundwater (GW) quality.

All monitoring programs are designed to protect sensitive receptors around the PoB, with the closest being the conservation park at Barubbra Island (Figure 1). Moreover, the programs have been devised based upon verification sampling works undertaken by GPC in previous campaigns as well as numerous studies and modelling undertaken for the PoG MD which has generated significant knowledge around MD generated plumes, their extent and longevity.

Data generated from monitoring is analysed and adaptive management decisions and/or mitigation measures proactively taken in case of necessity. All monitoring related to the PoB MD is undertaken by suitably qualified personnel following relevant standards and guidelines such as the DES Monitoring and Sampling Manual 2018. Where applicable, samples are analysed by a National Association of Testing Authorities (NATA) accredited laboratory holding the accreditation for the analyses required. All instruments are calibrated and maintained as per the manufacturer recommendations.

2.3.1 Sea placement monitoring: ambient and impact WQ

At the PoB, an impact to WQ by means of increased turbidity is an environmental risk to the local receiving environment and sensitive receptors. Turbidity is in fact a measurement of water clarity and is influenced by suspended matter (organic and inorganic) and dissolved organic matter. Turbidity is an expression of the optical property of light to be scattered and absorbed with a greater amount of matter within the water column leading to a higher amount of light scattering and thus higher turbidity. Dredging activities have the capacity to increase turbidity levels potentially resulting in environmental harm. Therefore turbidity is an important parameter to measure during dredging operations.

Monitoring of ambient WQ during MD with sea placement is undertaken starting at least two (2) weeks prior MD operations commencement, continuing throughout dredging operations and concluding no earlier than two (2) weeks post dredging operations completion. The monitoring is conducted at the Bundaberg River Mouth (BRM) telemetered buoy (-24.755452, 152.407077) by a multi-parameter sonde collecting the full suite of physical-chemical parameters at 15 minutes intervals (Figure 1). The sonde is connected to a telemetry system allowing raw data to be consulted in real-time. Turbidity readings as an Exponentially Weighted Moving Average (EWMA) are screened and assessed against trigger values (Section 2.3.3).

The EWMA is a smoothing technique developed by statistical experts that takes into consideration background levels so that readings increase and decrease gradually avoiding false readings and

alarms (both on and off). Therefore when values exceed triggers or go below triggers they will not be expected to invert their trends suddenly. The 6 Hour EWMA is calculated by using a 60:40 weighting system, where the current EWMA (Zi) is computed by adding 60% of the mean turbidity readings during the preceding (just recorded) 6 hours (X i) to 40% of the preceding 6 hour EWMA value (Zi-1). Mathematically, 6-hourly values of the EWMA statistic are computed using the following equation:

$$Zi = 0.6\ Xi + 0.4Zi\text{-}1$$

Where i is the mean of the data for the ith period (in this case, the current 6-hour period).

In the event that the deployed sonde fails or data generated is questionable/unreliable, WQ data from the adjacent pylon with WQ telemetry (Pylon #12) at the mouth of the Burnett River (-24.755083, 152.407367) will be utilised. As a further backup in case both telemetry systems are not operating correctly, daily monitoring for turbidity using a hand held calibrated instrument shall occur in proximity of BRM instead. In this scenario, the repair to the telemetry equipment will be undertaken as soon as practicable with minimum turnaround time. Turbidity as EWMA, only in the instance telemetry data from BRM is used, is screened against turbidity triggers developed for the PoB from long term data sets with adaptive management actions in place in case the triggers are reached (Section 2.3.3).

2.3.2 Land placement monitoring

Land relocation monitoring covers different components such as ambient (similarly to sea placement monitoring), tailwater and GW WQ. As well as impact through dredging, this monitoring is also tailored to highlight any potential issue caused by placement of dredge material on land with related tailwater discharge. However, it is acknowledged that GW dynamics especially between saline and fresh terrestrial GW such as in the case of the PoB are extremely complex and thus discerning a causal factors in some instances might be not possible.

GPC undertakes dredging with land relocation only when it is not practicable to undertake sea relocation. The latter is therefore the most utilised method of relocation of dredged sediments at the PoB. In the instance dredging with land relocation is undertaken, all materials are placed within the approved material relocation area (MRA) (Figure 2).

2.3.2.1 Ambient and Impact WQ

As per during MD with sea relocation, ambient WQ monitoring for MD with land relocation is undertaken starting at least two (2) weeks prior MD operations commencement, continuing throughout dredging operations and concluding no earlier than two (2) weeks post dredging operations completion.

As sampling locations are not fixed and not always suitable for telemetry systems such as the one described in Section 2.3.1, monitoring is undertaken daily with grab samples/ hand measurements (Table 1); observations such as tidal state are also recorded. Monitoring locations are based upon proposed dredging footprint, however they are approximately 100 m upstream and 200 m downstream of any proposed dredging work.

Turbidity data are screened against triggers developed for the PoB from long term data sets with adaptive management actions in place in case the triggers are reached (Section 2.3.3).

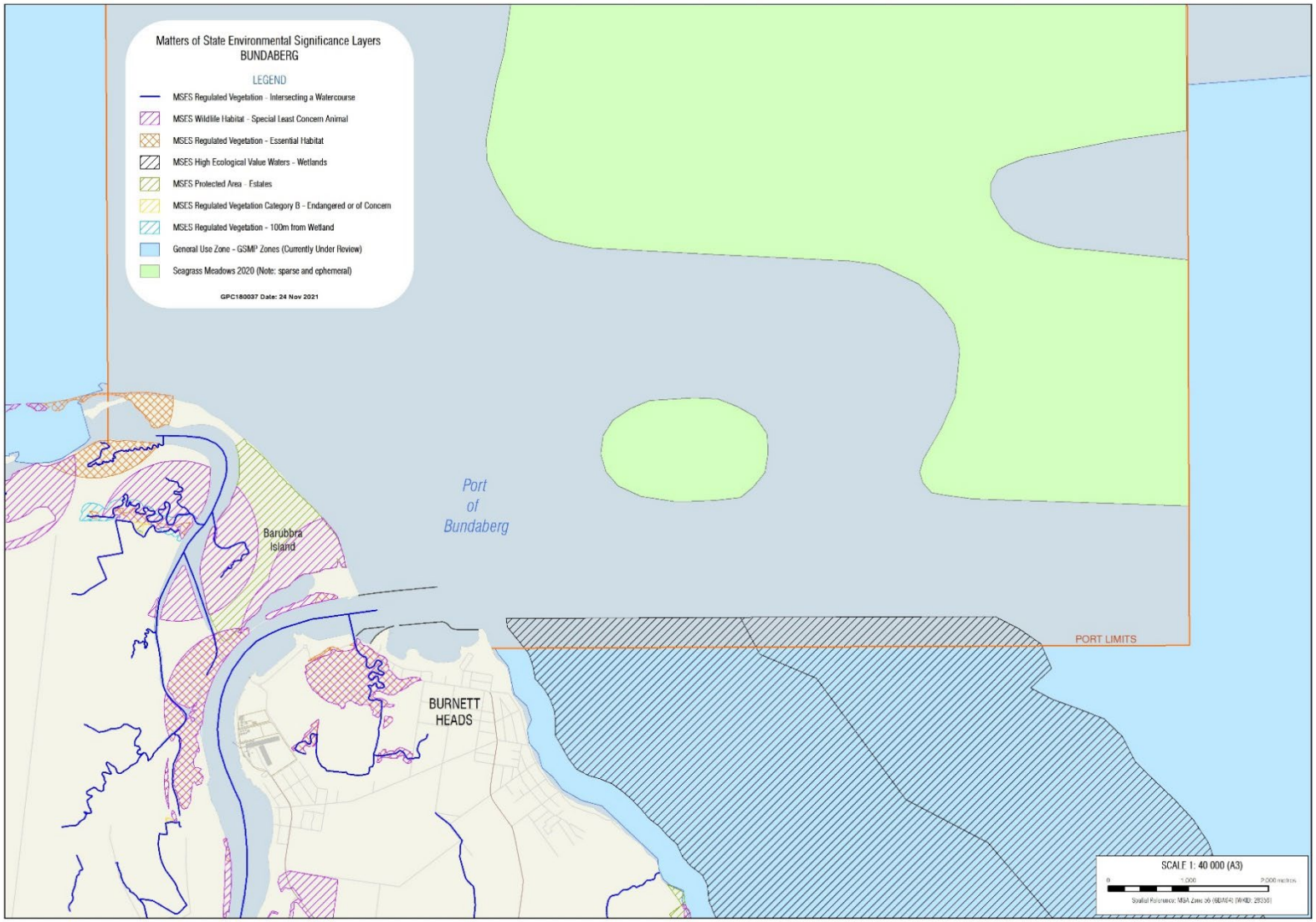

Figure 1: *Matters of State Environmental Significance around the PoB.*

Table 1: *Ambient WQ monitoring regime to be implemented during dredge with land relocation at the PoB. Note: No limits are specified within the EA.*

Approximate monitoring locations	Parameters	Limits	Units	Frequency
100 m upstream	Turbidity	Triggers (Section 2.3.3)	NTU	Daily
200 m downstream	pH	-	-	
	Visibility (Secchi disc)	-	m	

2.3.2.2 Tailwater WQ

As mentioned in Section 2.3.2, when dredging with land relocation is undertaken all dredge material is pumped ashore to the MRA. The material, which is pumped with different amounts of water depending on the type of sediment being dredged, can enter the MRA via different points. As a consequence, a different flow path and discharge point is utilised to allow the longest flow path and thus settlement time possible ensuring sediments in suspension settle out before water is released into Wallace Creek via the approved discharge points. Here monitoring must be undertaken to assess WQ and prevent discharge of non-compliant water and thus the potential risk of causing any harm to receiving environment (Table 2).

Table 2: *Discharge and monitoring points at the PoB MRA to be implemented during dredge with land relocation tailwater discharge.*

Monitoring and discharge points	Parameters	Release limit	Units	Monitoring frequency
M2 when discharge point W1 is utilised	Total suspended solids (TSS)	100	mg/L	Weekly
M3 when discharge point W2 is utilised	Turbidity	No visible plume	NTU	Twice a week
	pH	6.5-9.0	-	

2.3.2.3 Groundwater WQ

In case of dredging with land relocation, GW monitoring results are used to identify any fluctuations in standing water level (SWL) and WQ that may occur due to the relocation to land of dredge material. The aim of this monitoring is to prevent any potential impact to GW and the estuarine wetlands, mainly dominated by mangroves, in the vicinity of the MRA.

For this purpose, five (5) GW bores are monitored for SWL, electrical conductivity (EC) and pH at two (2) month intervals irrespective of dredging occurrence (Table 3). After collection results are reviewed internally by GPC environmental monitoring specialist (EMS), processed and appropriately recorded within GPC systems. Results from monitoring undertaken when no dredging with land relocation is taking place are used as baseline.

Results from monitoring conducted during and one (1) month after dredging with land relocation operations are instead screened against baseline results to assess potential impact on the GW and local environment. If the results deviate more than 10% from the baseline data range, the Department of Environment and Science (DES) is notified as soon as practicable including advice on the potential cause of the change and corrective measures to be implemented to avoid impact to sensitive receptors. Moreover, all results from GW monitoring are collated into an annual report and submitted to DES.

Table 3: *Groundwater monitoring around the PoB MRA.*

Bore	Parameters monitored	Monitoring interval
P3	SWL (m) EC (µs/cm) pH	Bi-monthly
P19		
P20		
P21		
B3		

2.3.3 Ambient WQ turbidity triggers

Water quality objectives (WQOs) are numeric measures to protect environmental values (EVs) such as aquatic ecosystems. No specific WQOs for the Burnett River have been developed, however the Queensland Water Quality Guidelines 2009 suggest a turbidity value of 8 NTU for mid-estuarine environments in the Central Coast Queensland Region, from the Burnett River Basin to the Black River.

This figure is not specific for the Burnett River and thus not representative of its environmental conditions. Moreover WQOs are usually developed using base flow condition data and therefore may not reflect the natural variability of highly changeable environments such as estuaries where the PoB is located. Therefore for the purpose of this MP, specific turbidity triggers based long term continuous data collected from BRM were established.

As described in Section 2.3.1 and 2.3.2.1, turbidity values obtained from ambient WQ monitoring are screened against the below mentioned triggers which are percentiles of data ranges:

- 80th percentile (%tile): 13 NTU, internal alert when values exceed trigger > 36 hrs; and
- 95th %tile: 25 NTU, adaptive management actions when values exceed trigger > 24 hrs.

Note that only in the instance turbidity data are obtained through a multiparameter sonde and telemetry station, turbidity will be screened against triggers as EWMA.

2.3.4.1 Ambient WQ adaptive management

The triggers detailed in Section 2.3.3 will be utilised to manage WQ, in particular turbidity, during MD operations. An adaptive management turbidity trigger flowchart has been developed for this purpose (Figure 4) detailing steps that will be undertaken in case of turbidity levels exceeding the abovementioned triggers. The flowchart and actions are designed to and will prevent or reduce and manage any turbidity impacts to PoB sensitive receptors.

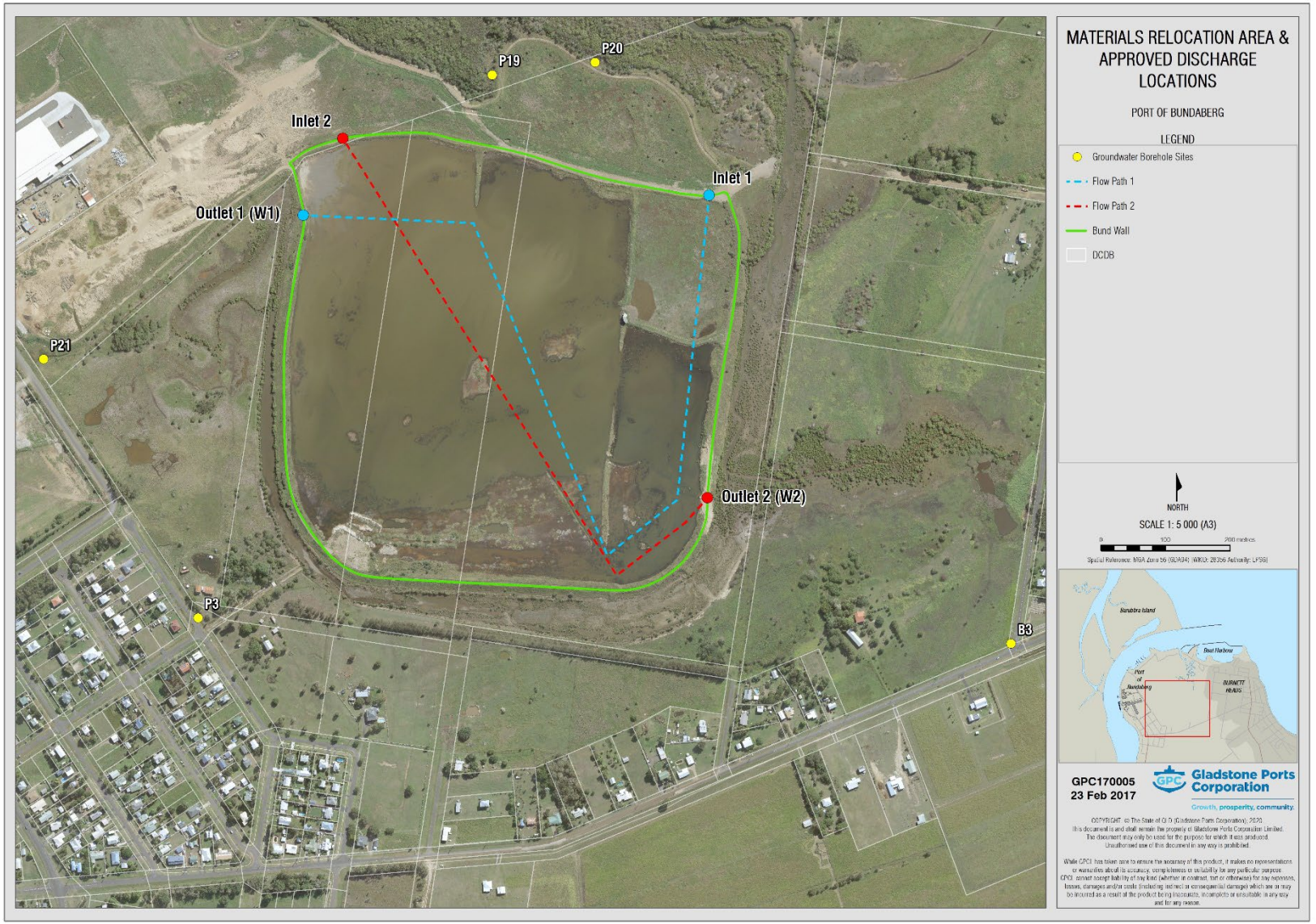

Figure 2: *The PoB MRA with marked approved discharge locations as well as flow paths and monitoring GW bores.*

While turbidity values (in the instance grab sampling is undertaken) or turbidity EWMA (in in the instance real-time monitoring is undertaken) remain below the internal trigger (Alert Level 1) no investigation into the cause of turbidity changes (if any) is conducted.

The Alert Level 1 is in fact reached when turbidity EWMA values are above 80th %tile for a 36 hour (or two (2) consecutive days in case of grab sampling is being undertaken) period triggering Response 1. Here GPC EMS increases scrutiny on data and supports an internal investigation to determine the causes of the elevation.

If the GPC EMS deems the elevation in turbidity (as EWMA) to be predominantly due to dredging activities, GPC stakeholders such GPC environmental compliance specialist (ECS), PoB Manager, Maintenance Supervisor and the dredging contractor are consulted. This consultation deliberates what management measures are to be implemented to rectify dredging related impacts on turbidity (Adaptive Management 1).

If, instead, the abovementioned investigation shows that likely causes of elevation of turbidity or turbidity EWMA are driven by environmental conditions no actions are taken, WQ monitoring continues and the status goes back to general monitoring.

Alert level 2 is reached when turbidity or turbidity EWMA values are above 95th %tile for a 24 hour (or one (1) day in case of grab sampling is being undertaken) triggering Response 2. As per Response 1 an investigation is undertaken by the EMS (or continued) and only if deemed the elevation in turbidity is predominantly due to dredging, Adaptive Management 2 is triggered where the abovementioned stakeholders will review and modify adaptive management actions on dredging operations. For any reporting detail consult the relevant section of the EMP.

2.4 Long term monitoring program overview

As mentioned in Section 1.2 and 2.2, an LMDMP is in place for the PoB describing long-term management and monitoring arrangements for MD and sea relocation. GPC have committed to various monitoring activities which are embedded in this framework (Figure 3)

2.4.1 Sediment analysis plan

As per National Assessment Guidelines for dredging (NADG) 2009, a SAP is undertaken every five (5) years to characterise sediment to be dredged during the upcoming dredging campaigns. This allows to identify contaminants of concerns present within the sediment and thus make appropriate decisions on dredge material relocation.

2.4.2 Spoil ground benthic habitats, seagrass and PSD plus Port-wide Seagrass survey

This study aims to investigate potential long term impacts of sea relocation activities on benthic habitats. Specifically, benthic fauna and seagrass monitoring is undertaken as these have been identified in the approved LMDMP as the primary receptor habitats of sea relocation activities at the PoB off-shore placement area. In addition undertake a port wide seagrass survey at the same time to gain a better understanding of deep-water seagrass meadows at PoB

2.4.3 Real Time Monitoring

Measuring turbidity during non-dredging periods to gain a baseline and assist in trigger development.

2.4.4 Turtle survey

Supporting annual turtle nesting surveys at Mon Repos (and surrounds) to gain an understanding of how turtles use PoB..

Figure 3: *PoB MD and sea relocation LMDMP (2023-2028) monitoring program from 2022 to 2031. X indicates the years when studies will take place.*

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.			x					x		
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.	x	x	x	x	x	x	x	x	x	x
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.				x					x	
Real-time monitoring	Ambient	N/A	Baseline	N/A	Development of a baseline dataset.	**x**	**x**	**x**	**x**	x	x	x	x	x	x
Port wide seagrass survey	Ambient	N/A	Baseline	N/A	Development of baseline data set				x					x	
Turtle survey	Ambient	N/A	Baseline	N/A	Increasing existing data set	x	x	x	x	x	x	x	x	x	x

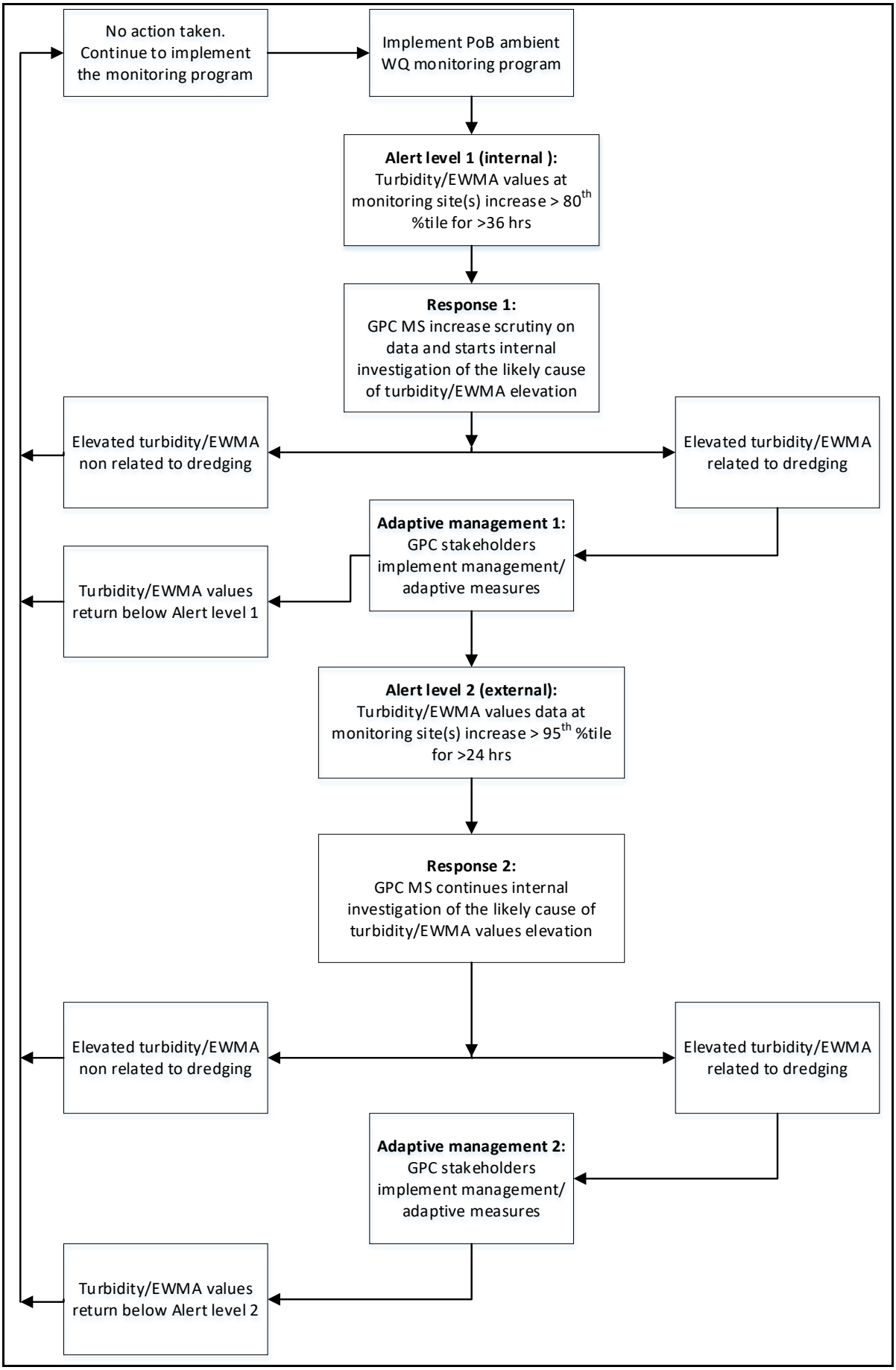

Figure 4: *PoB adaptive management flowchart for ambient WQ monitoring (turbidity).*

3 Procedure review

This procedure, its operation and implementation will be reviewed annually or as a result of findings of internal and external audits or a change in legislation in order to preserve currency, relevance and accuracy. Revisions, unless of very minor extent, are filed as new versions in GPC's document management system and communicated to all relevant internal stakeholders.

4 More information

This Procedure will be available to all GPC Representatives, Contractors and Consultants.

This document is uncontrolled when printed. The current version of this Procedure is located on Neptune.

If you require any further information, please contact the Custodian, listed under Document Accountability on the cover page.

5 Appendices

5.1 Appendix 1 – Related documents

Gladstone Ports Corporation documents

The following documents relate to this Procedure:

Type	Document number and title
Tier 1: Policy	#366016 Environment Policy
Tier 2: Standard/Strategy	#809151 Environmental Management Standard #829152 Risk Management Standard
Tier 3: Specification/ Procedure/Plan	#146256 Environmental Management System Manual #971879The Port of Bundaberg EMP for Maintenance Dredging Activities #964479The Port of Bundaberg LTMMP for Maintenance Dredging Activities

5.2 Appendix 2 – Revision history

Revision date	Revision description	Author	Endorsed by
06/03/2019	Annual review	Freddie Pastorelli, Environment Specialist	Jason Pascoe, Port of Bundaberg Manager
23/08/2019	Procedure review including alignment with conditions register and EMP. Minor Amendment to Groundwater section	Terese Tobin, Environment Specialist	

Revision date	Revision description	Author	Endorsed by
27/03/2020	Finalise for 2020 MD campaign	Freddie Pastorelli, Environment Monitoring Specialist	
16/06/2021	Document review. Streamlined document and aligned with PoG MP. Updated template	Freddie Pastorelli, Environment Monitoring Specialist	
07/02/2022	Document review and update. Administrative changes only.	Freddie Pastorelli, Environment Monitoring Specialist	
21/02/2023	Document Review. Change Pylon #12 to BRM – adjacent monitoring Buoy	Terese Tobin Environment Specialist	
10/11/2023	Document review and include LMDMP requirements	Terese Tobin Environment Specialist	Fiona Horner A/Environment Superintendent