

Inner Harbour Maintenance Dredging

Environmental Management Plan



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Customer Contact	Melissa Manns
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Author	B Coelho
Reviewed By	R De Roach, S Scott
Project Manager	S Scott

Amendment Record

The Amendment Record below records the history and issue status of this document.

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Acronyms

Acronym	
BCH	Benthic Communities and Habitats
DEMP	Dredging Environmental Management Plan
DoH	WA Department of Health
DPIRD	WA Department of Primary Industries and Regional Development
DWER	WA Department of Water and Environmental Regulation
EMP	Environmental Management Plan
EPA	WA Environmental Protection Authority
EQO	Environmental Quality Objective
ERD	Environmental Review Document
Ha	Hectare
NVCP	Native Vegetation Clearing Permit
SWASP	State-Wide Array Surveillance Program
TSS	Total Suspended Solids
WA	Western Australia
ZoHI	Zone of High Impact
ZoI	Zone of Influence
ZoMI	Zone of Moderate Impact

Executive Summary

Project name	Inner Harbour Maintenance Dredging
Proponent name	Fremantle Ports
Purpose of the Plan	This DEMP outlines the approach to monitoring and/or management of potential environmental impacts associated with the implementation of the Project on EPA's environmental factors. The potential environmental impacts requiring monitoring and/or management were identified in the Project's Environmental Review Document (BMT 2022a). Following the implementation of this DEMP it is expected that the EPA's objectives for environmental factors will be met.
Environmental factors	<p>The following key environmental factors that may be affected by potential environmental impacts associated with the Project have been assigned outcome-based conditions:</p> <ul style="list-style-type: none"> marine environmental quality benthic communities and habitats social surroundings. <p>In addition, the following 'other factors' have outcome-based provisions (monitoring and management actions and targets) assigned to provide further mitigation against impacts:</p> <ul style="list-style-type: none"> marine fauna
Project commencement timing	The scheduled timing for Project commencement is in April 2024 over 10 days to remove 60,000 m ³ initially and additional 5,000 m ³ per year until 2029. Each subsequent annual program is likely to be of short duration (one to two days)
Dredge Method	A Trailing Suction Hopper Dredge (TSHD) will be used to complete the maintenance dredging. The dredge will collect the material via trailing suction drag heads, travel to the Gage Roads Disposal ground and place the material from the base of the hopper.
Plan required prior to Project commencement	<p>Yes. The DEMP includes monitoring that is required prior to Project commencement.</p> <p>DEMP and associated compliance report will be made publicly available on the Fremantle Ports website.</p>

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1 Context, Scope and Rationale

BMT was commissioned by Fremantle Ports to assist in environmental approvals and provide technical support to enable their Inner Harbour maintenance dredging program (hereafter; Project) to proceed in accordance with State (Western Australian Environmental Protection Authority – WA EPA) and Federal (Commonwealth Department of Climate Change, Energy, the Environment and Water - DCCEEW) regulatory requirements.

Fremantle Ports is proposing to undertake maintenance dredging to remove sediments that have accumulated in the Inner Harbour from the Swan River estuary since capital dredging was undertaken in 2010. Maintenance dredging will return the Inner Harbour and Entrance Channel to design depth to ensure safe access to the harbour, safe berths and berth capacity is maintained. All berths within the Inner Harbour will be maintained.

Fremantle Ports plan to carry out an initial maintenance dredging campaign in April 2024 to remove 60,000 m³ of sediments. Over the subsequent four years, a further volume of 5,000 m³ is planned to be removed per year. The designated disposal site, within the anchorage area west of Gage Roads, is the same site used and approved for disposal during the 2009-2011 Inner Harbour capital dredging campaign. Approximately 3.1 million cubic metres of limestone and sand was dredged to allow deeper (14-metre) draft ships and provide material for land reclamation at Rous Head.

Fremantle Ports is the managing authority for the Port of Fremantle in Western Australia (WA). The Port Inner Harbour provides navigational access between the Swan River and the Indian Ocean that is vital for container trade into the state as well as livestock exports and motor vehicle imports. The Inner Harbour at Fremantle handles almost all the container trade of WA. The Inner Harbour is an important link between the Swan River estuary and nearby coastal waters, particularly for recreation boating activities.

Land adjacent to the dredging footprint includes Victoria Quay situated on the south side of the Inner Harbour, and North Quay and Rous Head land reclamation sites are situated on the north side of the Inner Harbour. The North Quay/Rous Head area includes approximately 60 lots owned by Fremantle Ports and leased to private (commercial and industrial) entities associated with container shipping and common stevedoring activities. Victoria Quay is used for a variety of purposes including shipping, commercial activities, and public car parking.

1.1 Purpose of this document

This Dredging Environmental Management Plan (DEMP) provides details on the monitoring and management of potential environmental impacts on the relevant environmental factors (key and other environmental factors) associated with the implementation of the Project. The key and other environmental factors are:

- Marine environmental quality (key environmental factor)
- Benthic communities and habitats (key environmental factor)
- Social surroundings (key environmental factor)
- Marine fauna (other environmental factor)

This DEMP has been prepared in accordance with EPA (2021a, b, c, d). The potential environmental impacts requiring monitoring and management in this DEMP were identified in the Project's Environmental Review Document (ERD; BMT 2022a). Following the implementation of this DEMP it is expected that the Western Australia (WA) Environmental Protection Authority (EPA) objectives for the relevant environmental factors will be met.

1.2 Proponent details

Relevant Fremantle Ports proponent details for this Proposal are provided in Table 1.1.

Table 1.1 Proponent details for the Inner Harbour Maintenance Dredging Project

Detail	Proponent
Proponent name:	Fremantle Ports
Proponent address:	1 Cliff Street, Fremantle WA 6160
Australian Business Number:	78 187 229 472
Key contact name:	Melissa Manns (Senior Environmental Advisor)
Key contact details:	Phone: 0439 698 715 Email: melissa.manns@fremantleports.com.au

1.3 Project description

1.3.1 Dredging and disposal

Recent hydrographic surveys of the seabed show approximately 60,000 m³ of material has accumulated within the Inner Harbour since the capital dredging in 2010. The Port currently uses a sweep bar to maintain water depths within the Inner Harbour and material is redistributed to deeper areas of seabed. The Port is proposing to complete small-scale maintenance dredging campaigns over the next 5 years to remove larger volumes of material accreted since 2010, 60,000 m³ in the first year and future accretion of 5,000 m³ a year for four years based on known sedimentation rates in the Inner Harbour. It is proposed material from the Inner Harbour will be disposed at the historical Gage Roads offshore disposal area located southwest of the Deep-Water Channel and utilised in the 2010 capital dredging campaign (hereafter; Disposal Area).

A summary of the Project is provided in Table 1.2, the key elements of the Project are provided in Table 1.3 and a summary of the existing environment are provided in Table 1.4.

Table 1.2. Summary of the Inner Harbour Maintenance Dredging Project

Project title	Inner Harbour Maintenance Dredging
Proponent name	Fremantle Ports
Timing and duration	Five-year period from 1 April 2024 to 31 March 2029. Ten operational days (24hrs) during 2024 (from 1 April to 31 August 2024) One to two operational days (24hrs) in subsequent years 2025-2029 (any month).
Short description	The maintenance dredging project intends to remove accumulated sediment from the Swan River deposited within the Inner Harbour and the Entrance Channel (since capital dredging in 2010) to ensure the navigational safety standards are met. An initial volume of 60,000 m ³ is expected to be dredged in April 2024, with a further volume of 5,000 m ³ dredged each year until 2029.

Table 1.3 Key elements of the Inner Harbour Maintenance Dredging Project

Element	Location	Proposed Extent
Physical elements		
Not applicable	Not applicable	There are no new physical elements associated with the Proposal
Construction elements		
Dredging	Inner Harbour (Figure 1.1)	Removal of 60,000 m ³ of sediment in order to restore the Inner Harbour to its design depth of -14.7 meters Chart Datum (CD), and a further 5,000 m ³ /year to be removed over the subsequent years.
Disposal	Gage Roads offshore disposal area (Figure 1.1)	Disposal of 80,000 m ³ of sediment within the anchorage area west of Gage Roads. It is noted that the disposal locations designated for this dredging campaign is the deep area from -18 to -22 meters deep located in the south-east area of the offshore Gage Roads disposal area.
Operational elements		
Dredging	Inner Harbour (Figure 1.1)	A Trailing Suction Hopper Dredge will be used to complete the maintenance dredging. The dredge will collect the material via trailing suction drag heads.
Disposal	Gage Roads offshore disposal area (Figure 1.1)	The Dredge vessel will travel from the Inner Harbour dredging area to the Gage Roads Disposal area and place the material from the base of the hopper.

Table 1.4. Existing environment of the proposal area

Value / aspect	Description
Existing habitat	<p>The dredging area is an active industrial area and is located within the Inner Harbour and the Entrance Channel of the Port of Fremantle (Figure 1.1). The area has been subject to previous alteration from capital dredging works in 2010 and is the subject of frequent disturbance because of propeller wash from the vessels that use the Port and has been regularly swept to maintain the depth. Within the dredging area, the seafloor is composed of sand with presence of clay and silt.</p> <p>The disposal area is an existing ship anchorage on the western margin of Gage Roads, southwest of the Deep-Water Channel (Figure 1.1). Gage Roads disposal area was used for ocean disposal in the 2010 capital dredge campaign, when 1.1 million m³ of dredged material was placed there. The area is a natural depression that acts as a sink for soft sediments and has no prominent seabed features. No sand ripples were observed on the seabed at any location during a survey, indicating that sediment movement by wave action is likely to be minimal (BMT, 2022a). The proposed disposal area appears to be an area of sediment accretion and, hence stable although the seabed also appears to be highly disturbed by the anchoring of ships (BMT, 2022a).</p>
Sensitive Sites	<p>The western area of the entrance channel to the Inner Harbour has been mapped for benthic communities and habitats (BCH) with the remaining area likely to contain little BCH due to disturbance associated with an active port. Upstream and adjacent to the Inner Harbour, the Swan River supports ephemeral seagrass species <i>Halophila ovalis</i> makes up around 90% of the seagrass in the river and is a valuable part of the ecosystem (BMT, 2022a).</p> <p>The disposal area contains a diversity of BCH, including seagrass, macroalgae and corals (BMT 2023a & BMT 2021). Seagrass is the dominant BCH, with the local taxonomy characterised by perennial seagrass species (<i>Amphibolis antartica</i>, <i>Amphibolis griffithii</i>, <i>Posidonia angustifolia</i>, <i>Posidonia australis</i>, <i>Posidonia coriacea</i>,</p>

Value / aspect	Description
Bathymetry	<p><i>Posidonia sinuosa</i>, <i>Syringodium isoetifolium</i>, <i>Thalassodendron pachyrhizum</i> and <i>Zostera tasmanica</i>) and ephemeral (<i>Halophila ovalis</i>) seagrass species (BMT, 2022a).</p> <p>Dredging in 2024 is planned to occur from 1 April to 31 August to reduce the impacts on seagrass as their dormancy stage occurs during autumn / winter because of a reduction of sunlight (BMT, 2022a). Due to the small dredging volumes (5,000m³) dredging in subsequent years (2025-2029) is planned to be undertaken in any month (BMT, 2022a).</p> <p>The design depth for the Inner Harbour and target for the maintenance dredging footprint is 14.7 m below Low Water Mark Fremantle (LWMF). Figure 1.3 shows areas shaded yellow, orange and red above the design level which currently require maintenance dredging.</p> <p>The Gage Roads disposal area is in waters offshore from Perth ranging in depth from -15 m to -22 m (Figure 1.1). The disposal location designated for this dredging campaign is within the deep area >18m (Figure 1.1).</p>
Climate	<p>The Perth area experiences a Mediterranean climate that is typically characterized by hot and dry summers and mild and wet winters (BMT 2022a). In Fremantle, the average monthly temperatures range from a minimum of ~10°C in July to a maximum of ~28°C in February (BMT 2022a). The average annual rainfall is ~771.8 mm, with the average monthly rainfall ranging from a minimum of ~6 mm in January to a maximum of ~165 mm in June (BMT 2022a). An eastward moving subtropical high-pressure belt causes predominant south-westerly winds in the summer and easterly winds in the winter (BMT 2022a). During winter, the high-pressure belt is disrupted by mid-latitude depressions that generate high energy storms, with the strongest winds usually from the north-west (BMT 2022a). During summer, strong south-westerly sea breezes occur in the afternoons, with velocities frequently exceeding 15 m/s (BMT 2022a).</p>
Current, tides, winds/waves	<p>Hydrodynamic and sediment plume dispersion modelling was undertaken to predict the likely duration, extent and intensity of turbid plumes generated from dredging and disposal and the extent of potential sedimentation. The plume model demonstrated that the tidal currents at the study area are relatively low, and the peak currents which are likely to have significant impact on dispersion of the dredge plume are offshore of the surf zone and are mainly wind driven events (BMT 2022b, BMT 2023b).</p>
Recent Surveys	<p>Dredging and disposal area sediments were sampled and analysed in 2021-2022 to assess the physical and chemical characteristics of the sediments (O2M 2022).</p> <p>As part of Fremantle Ports' Marine Quality Monitoring Program (MQMP), annual marine quality monitoring occurs in the Inner Harbour and Entrance Channel. A subset of sediment and water quality results from this program was used to inform the Proposal (O2M 2022).</p> <p>The benthic communities and habitats (BCH) of the Gage Roads disposal area (and the western extent of the entrance channel) were mapped in 2021(BMT, 2021). Mapping was undertaken using satellite imagery from 2019/20 and historic mapping from 2012.</p> <p>A BCH survey of the Gage Roads disposal site was undertaken in December 2022 to ground truth an area of 'unknown' habitat (BMT, 2023).</p>
Marine Protected areas	<p>The proposed dredging area is located within the port limits of Fremantle Ports' Inner Harbour. The Swan Canning Riverpark occurs upstream of the Inner Harbour (BMT, 2022a).</p> <p>The proposed disposal site is located within the port limits of Fremantle Ports' Gage Roads anchorage. There are no known zonings which have a bearing on its use as a disposal area (BMT, 2022a).</p>
Recreational use	<p>The Inner Harbour is an important link between the Swan River estuary and the nearby</p>

Value / aspect	Description
Indigenous / cultural	<p>coastal waters, particularly for recreational boating activities (BMT 2022a). Anchoring is not permitted in the Inner Harbour and Entrance Channel. The Swan River is a popular recreational area for Perth residents and visitors (BMT, 2022a).</p> <p>The offshore Fremantle marine area is important for recreational boating and travel to and from Rottnest Island (BMT, 2022a). The proposed Gage Roads offshore disposal area is not highly utilized by recreational fishers as it is an active anchorage site (BMT, 2022a).</p> <p>The dredging area is located within the Swan River Registered Aboriginal Site ID 3536. In 2007, Section 18 approval for Aboriginal site ID 3536 (Swan River) was granted under the <i>Aboriginal Heritage Act 1972</i> to undertake capital dredging and ongoing maintenance of the Inner Harbour. Rocky Bay Registered Aboriginal Site ID 3596 occurs upstream of the Inner Harbour dredging area (BMT 2022a). Fremantle Ports undertook stakeholder consultation with identified Aboriginal representatives (Whadjuk Aboriginal Corporation (WAC) and their Cultural Advice Committee) for the project. WAC requested that Whadjuk/Noongar rangers are engaged to undertake dredge and plume monitoring. WAC’s recommendations have been incorporated into this DEMP (Table 2.2).</p>
Marine Fauna	<p>The significant marine fauna for this project includes sea mammals (including sea lions, whales and dolphins), sea turtles and sea birds (BMT, 2022a).</p> <p>The only resident marine mammal species interacting directly with the Proposal area is the Indo-Pacific bottlenose dolphin (<i>Tursiops aduncus</i>) in the Swan River. All other species are migratory and uses the area sporadically (BMT, 2022a). The Swan River dolphins are a core group of around 20 dolphins resident year-round in the estuary, while 16 others make occasional visits throughout the year (Chabanne <i>et al</i> 2012, BMT 2022a). In the estuary, dolphins tend to spend most of their time in the lower to middle reaches of the Swan River and, in the Canning River, following tidal movement upstream before turning back towards the river mouth when the tide turns. In the Ocean, the dolphins are found in habitats such as Owen Anchorage and the seagrass meadows on Parmelia and Success banks between Cockburn Sound and Fremantle (Finn & Holker 2009, BMT 2022a).</p> <p>Marine fauna known for the project area has the potential to collide or to be struck by the dredge vessel resulting in adverse impacts to the animal(s) involved in the incident. The dredge will be moving at low speeds both when dredging, moving to and from the disposal area and during disposal activities. The risk of injury resulting from collision with the dredge is considered low (BMT, 2022a).</p> <p>The areas proposed to be dredged are not known as habitat for megafauna that rest upon the bottom (such as turtles) and as such the potential for entrainment is considered very low. However, as a Trailing Suction Hopper Dredge (TSHD) operates like a large vacuum cleaner and sucks everything up into the drag the dredge has the potential to entrain marine fauna. A Turtle Exclusion Device will be fitted to the dredge vessel to reduce the risk of marine fauna entrainment to as low as reasonably practicable.</p>
Introduced Marine Species	<p>Baseline introduced marine species surveys of the Inner Harbour were undertaken by Fremantle Ports in conjunction with CSIRO’s Centre for Research on Introduced Marine Pests in April and May 1999 (CRIMP 2000, BMT 2022a). Of those species listed by Australian Ballast Water Management Advisory Council only two were recorded – the European fan worm (<i>Sabella spallanzanii</i>) and the mussel (<i>Musculista senhousia</i>). In addition, the dinoflagellate species (<i>Alexandrium tamarense</i>) was detected in low concentrations (CRIMP 2000, BMT 2022a).</p> <p>Ongoing introduced marine species surveys of the Inner Harbour are undertaken by Fremantle Ports in conjunction with the Department of Primary Industries and Regional Development through the implementation of the State-Wide Array Surveillance Program</p>

Value / aspect	Description
	(SWASP). The potential for establishment of introduced marine organisms at the disposal area is considered low as there is limited suitable habitat (hard substrata) (BMT, 2022a).

1.4 Condition requirements

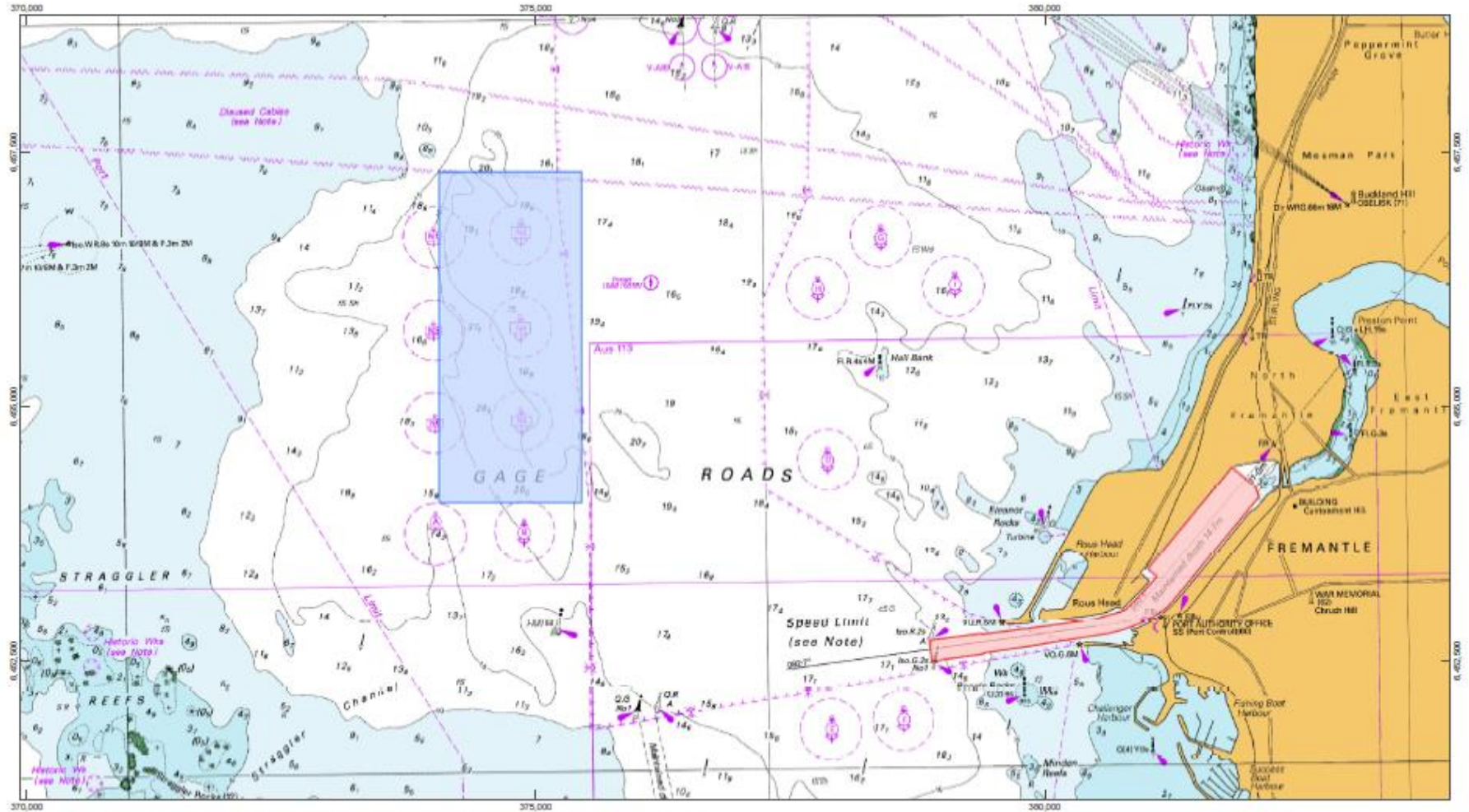
This DEMP will be used to support the Project’s Sea Dumping Permit (SDP) application to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW). A SDP is required for this project for the disposal of dredged material offshore within the established Gage Roads Disposal Area. Fremantle Ports used this site for ocean disposal in the 2010 capital dredging campaign. Significant impacts to matters of national environmental significance are not anticipated from the project and assessment under the *Environment Protection and Biodiversity Conservation Act 1999 Act (EPBC Act)* is therefore considered not required. There are no other Commonwealth approvals required for this project and Fremantle Ports does not hold any additional Sea Dumping Permits.

The project’s Environmental Impact Assessment (EIA) documentation was provided to the Department of Water and Environmental Regulation’s (DWER) EPA Services for their review. Following review of the EIA documentation, the DWER EPA Services advised that referral under Part IV of the *Environmental Protection Act 1986* was not warranted due to the low environmental impact anticipated with the small-scale Inner Harbour maintenance dredging project.

A Native Vegetation Clearing Permit (NVCP) was granted for the project for direct impacts to seagrass and macroalgae within the dredging and disposal areas (CPS 10278/1) (Figure 1.2). The NVCP provides for 1.668 ha of native vegetation to be cleared including 0.975 ha of seagrass and 0.693 ha of macroalgae within a period of five years, from 10 January 2024 to 31 March 2029. The areas approved for clearing include the area around the targeted disposal area (within the SDP area of 455 ha) of 58.8 ha which contains 0.508ha of seagrass and the dredging footprint of 98.4 ha which contains 0.467 ha of seagrass and 0.693 ha of macroalgae. NVCP conditions include keeping records of clearing and taking actions to avoid, minimise and reduce the impacts and extent of clearing. The area surrounding the targeted disposal area (where modeled sedimentation >0.1m) within the Gage Roads disposal area has been sought for clearing. In the event additional areas of the Gage Roads disposal area are required for disposal (and direct impacts to native vegetation will occur) an additional NVCP will be sought.

In 2007, Section 18 approval for Aboriginal site ID 3536 (Swan River) was granted under the *Aboriginal Heritage Act 1972* for maintenance dredging of the Inner Harbour. Department of Planning, Lands and Heritage (DPLH) advised that the existing Section 18 approval remains active but given the passage of time recommended liaising with the relevant knowledge holders to gain contemporary views in relation to the project. Fremantle Ports engaged with the Whadjuk Aboriginal Corporation (WAC) and members of their Cultural Advice Committee to discuss the project and they confirmed that the current Section 18 approval remains appropriate and subsequently provided written advice in support of the project and committed to work with Fremantle Ports to implement WACs’ dredge monitoring recommendations.

In Western Australia, the Department of Primary Industries and Regional Development (DPIRD) is the responsible agency for marine biosecurity including the control and prevention of introduced marine species through biofouling. The arrival of the dredge and associated support vessels is the most likely source of non-indigenous marine species because of biofouling on vessel hulls or through ballast water. To minimise the potential risk of transfer of non-native species to the Perth marine environment, the dredge and any associated support vessels will be required to obtain a low-risk rating from the DPIRD risk assessment tool (<https://vesselcheck.fish.wa.gov.au/>) prior to mobilising to site from an interstate or international location.



Inner Harbour Maintenance Dredging Area and Gage Roads Offshore Disposal Site

1:50,000 (A4)

0 500 1,000 1,500 m

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994 Zone 50

Legend

- Gage Roads Offshore Disposal Site
- Inner Harbour Maintenance Dredging Area

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Figure 1.1 Maintenance dredging area within the Inner Harbour (pink polygon) and the Gage Roads offshore disposal site (blue polygon).

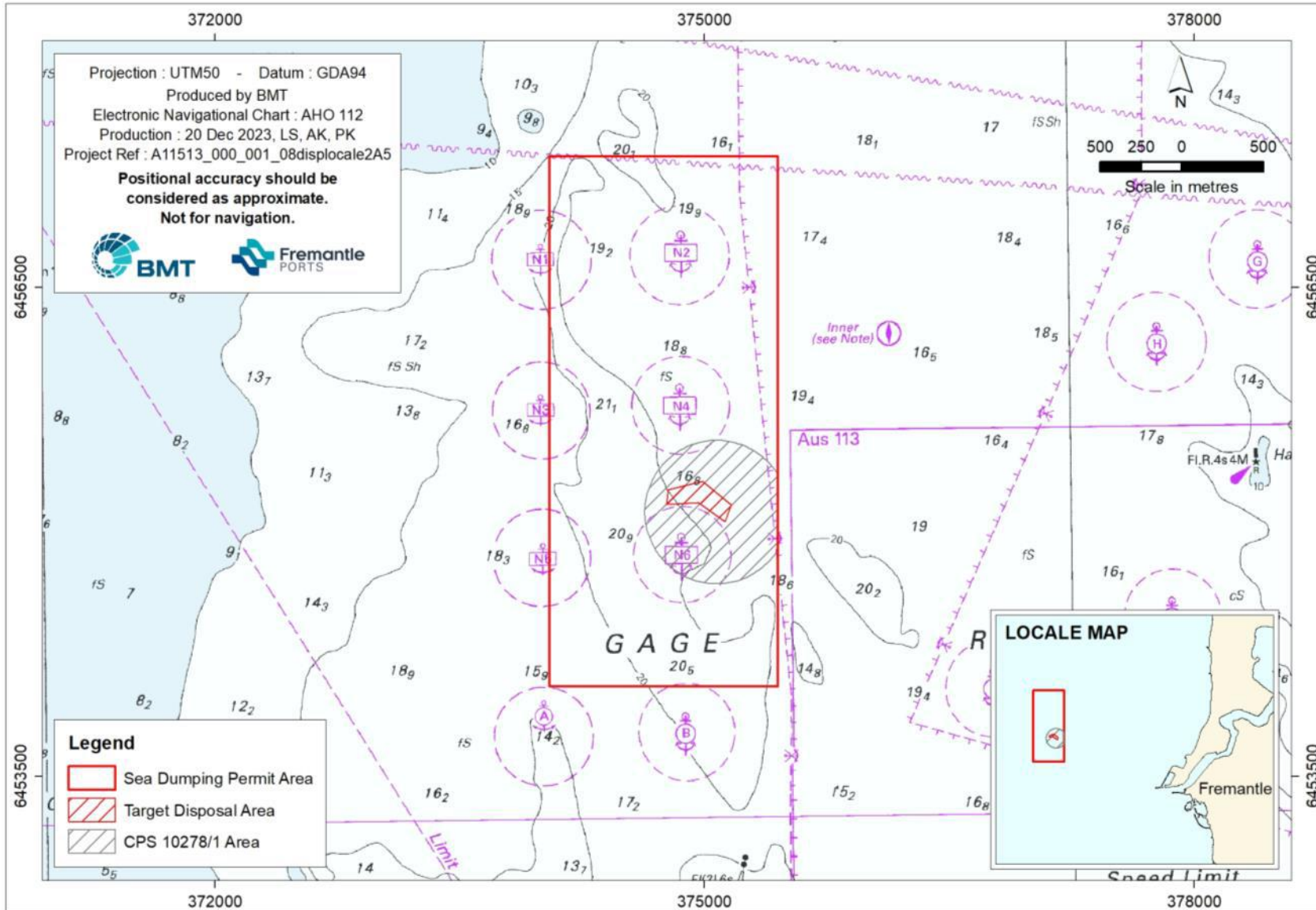
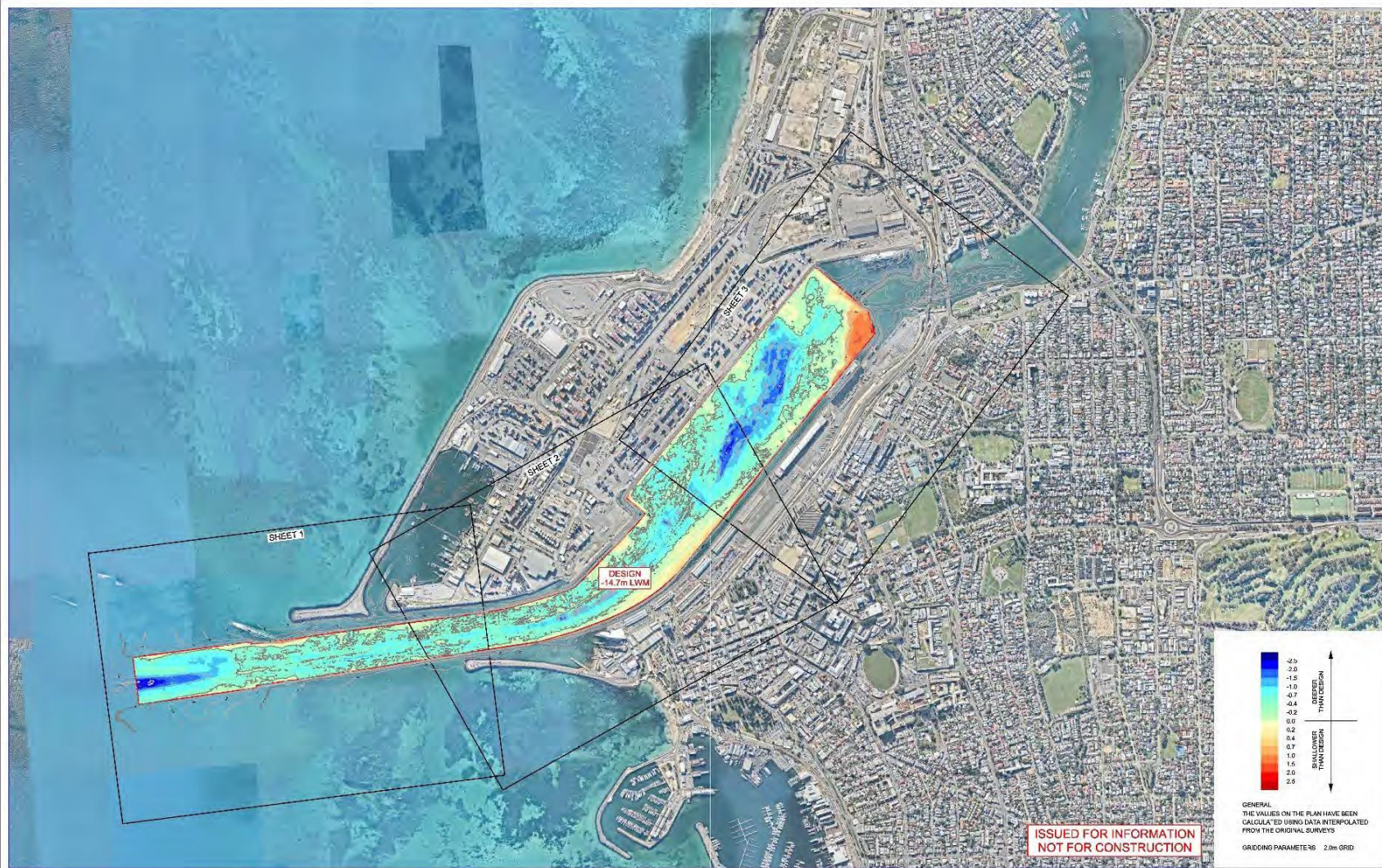


Figure 1.2 The targeted disposal area and the Native Vegetation Clearing Permit area (CPS 10278/1) located within the Gage Roads Offshore disposal site (BMT 2023b).



NOTES		SCALE 1: 7500						ENGINEER	K.NEERA	11/07/2022	CLIENT	FREMANTLE PORTS
1. AERIAL IMAGE FROM NEARMAP 5 JUNE 2022								DRAWN	S.WOLCHEMORE	11/07/2022	PROJECT	FREMANTLE INNER HARBOUR - MAINTENANCE DREDGING
DATUM		VERTICAL						DRAWING CHECK			TITLE	COLOUR CODED DIFFERENCES 17 NOVEMBER 2021 SURVEY TO DESIGN (-14.7m) INDEX TO SHEETS
FREMANTLE, LOW WATER MARK 1986		3.05M BELOW BENCHMARK FIC 35A						ENGINEERING CHECK			DRAWING NUMBER	A11513 - 01 - 01
0.76M RFI ON AUSTRALIAN HIGH TIDE DATUM 1971		HORIZONTAL						APPROVED FOR CONSTRUCTION			REV	A
MGP GRID OF AUSTRALIA BASED ON GDA 2020, ZONE 60												

Figure 1.3 Location of sediments to be dredged in the Inner Harbour, including dredged depth contours (BMT, 2022b).

1.5 Relevant environmental factors

An assessment of potential environmental factors against the EPA’s Statement of Environmental Principles, Factors and Objectives (EPA 2021a) was provided in the Project’s ERD (BMT 2021) to identify the environmental factors that are relevant to the Project. Based on the assessment of the potential environmental impacts, the following key and other environmental factors were identified as requiring monitoring and/or management and are applicable to this DEMP:

- marine environmental quality (key environmental factor)
- benthic communities and habitats (key environmental factor)
- social surroundings (key environmental factor)
- marine fauna (other environmental factor)

The relevant environmental factors, associated objectives, site-specific environmental values and potential environmental impacts relevant to this DEMP are summarised in Table 1.5.

Table 1.5 Environmental factors, objectives and potential environmental impacts relevant to the Inner Harbour Maintenance Dredging Environmental Management Plan

Environmental factor	EPA Objective	Proposed activities affecting the environmental factor	Potential environmental impacts to the environmental factor
Marine environmental quality	To maintain the quality of water, sediment and biota so that environmental values are protected	The dredging and disposal activities associated with the Project have the potential to modify water quality from increased water column turbidity and release of potential contaminants.	Increased water column turbidity and potential contaminants
Benthic communities and habitats	To protect benthic communities and habitats (BCH) so that biological diversity and ecological integrity are maintained	The dredging and disposal activities associated with the Project have the potential to result in direct and indirect impacts to benthic communities and habitats occurring in the vicinity of the Project area.	Direct loss Indirect loss
Social surroundings	To protect social surroundings from significant harm	The dredging and disposal activities associated with the Project has the potential to reduce Aboriginal heritage values and aesthetic and amenity values in the local area.	Aboriginal heritage values Reduced public amenity Navigational hazards Odour generation
Marine fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained	The operation of the dredge and associated support vessels poses a potential risk of marine fauna collision/vessel strike and entrainment. The mobilisation of the dredge and associated support vessels to the Project area poses a potential risk of the introduction of marine species.	Marine fauna collision/vessel strike and entrainment. Introduction of invasive marine species

1.6 Rationale and approach

This section provides the Proponent’s rationale and approach for the development of this DEMP. This DEMP has been prepared based on the potential impacts identified in the Inner Harbour Maintenance Dredging ERD (BMT 2022a) and outlines the environmental management actions and any associated monitoring and reporting to be implemented during the marine dredging and disposal works associated with the Project. For factor-specific descriptions of environmental impact assessment findings and associated assumptions/uncertainties, refer to BMT (2022a).

1.6.1 Key assumptions and uncertainties

This DEMP has been informed by findings of field surveys, hydrodynamic modelling, and environmental impact assessments.

In accordance with EPA’s Technical Guidance – Environmental Impact Assessment of Marine Dredging Proposals (EPA 2021b), impact zones have been conservatively established to determine the potential extent and significance of direct and indirect impacts to BCH as a consequence of the dredging and disposal activities (BMT 2022a), based on predictive modelling of the dredge / disposal turbid plume intensity, extent and duration (BMT 2022b) and the tolerances of benthic primary producers (EPA 2021b). The established impact zones are presented in Table 1.6 and depicted in Figure 1.4 for the disposal area and Figure 1.5 for the dredging area.

The Proponent considers that this DEMP is based on the best available information. The adaptive management process adopted by this DEMP allows for management actions and monitoring to be revised if new information becomes available.

Table 1.6 Impact zones, definitions, and boundary thresholds

Impact zone	Definition	Boundary threshold
Zone of High Impact (ZoHI)	The area where impacts on BCH are predicted to be irreversible. The term irreversible means ‘lacking a capacity to return or recover to a state resembling that prior to being impacted within a timeframe of five years or less’. Areas within and immediately adjacent to proposed dredge disposal sites are typically within the ZoHI.	<ul style="list-style-type: none"> Boundary of the dredging area within the Inner Harbour entrance channel, where the target depth is 14.7 metres chart datum. Boundary of the disposal area where modelled sedimentation >0.1 m.
Zone of Moderate Impact (ZoMI)	The area within which predicted impacts on BCH are recoverable within a period of five years following completion of the dredging and disposal activities. The ZoMI abuts and lies immediately outside of the ZoHI.	<ul style="list-style-type: none"> The area where the modelled 95th percentile of the TSS concentration is >10 mg/L . At the Gage Roads offshore disposal area, the ZoMI has a 100 m buffer zone surrounding the ZoHI at the east and the west. At the Inner Harbour, the ZoMI has a 100 m buffer zone surrounding the ZoHI at the west of the river mouth.
Zone of Influence (ZoI)	The area within which changes in environmental quality associated with turbid plumes are predicted and anticipated during dredging and disposal activities, but where these changes would not result in a measurable impact on BCH.	<ul style="list-style-type: none"> The area where the modelled 95th percentile of the TSS concentration was 2 to 10 mg/L.

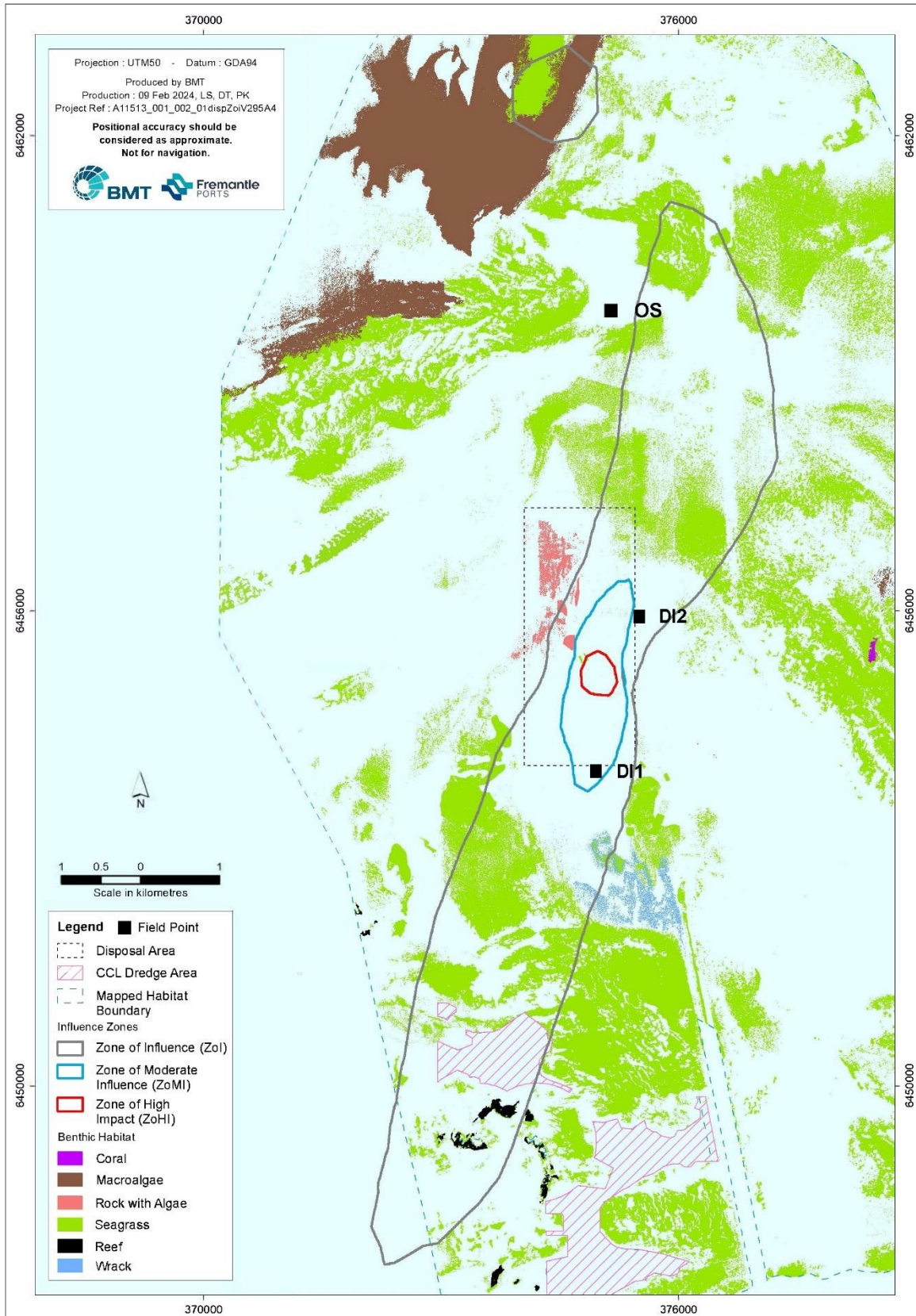


Figure 1.4 ZoHI, ZoMI and Zoi defined for the Gage Roads offshore disposal area (BMT 2023b), benthic habitat (BMT 2023a and BMT 2021) and field monitoring points.

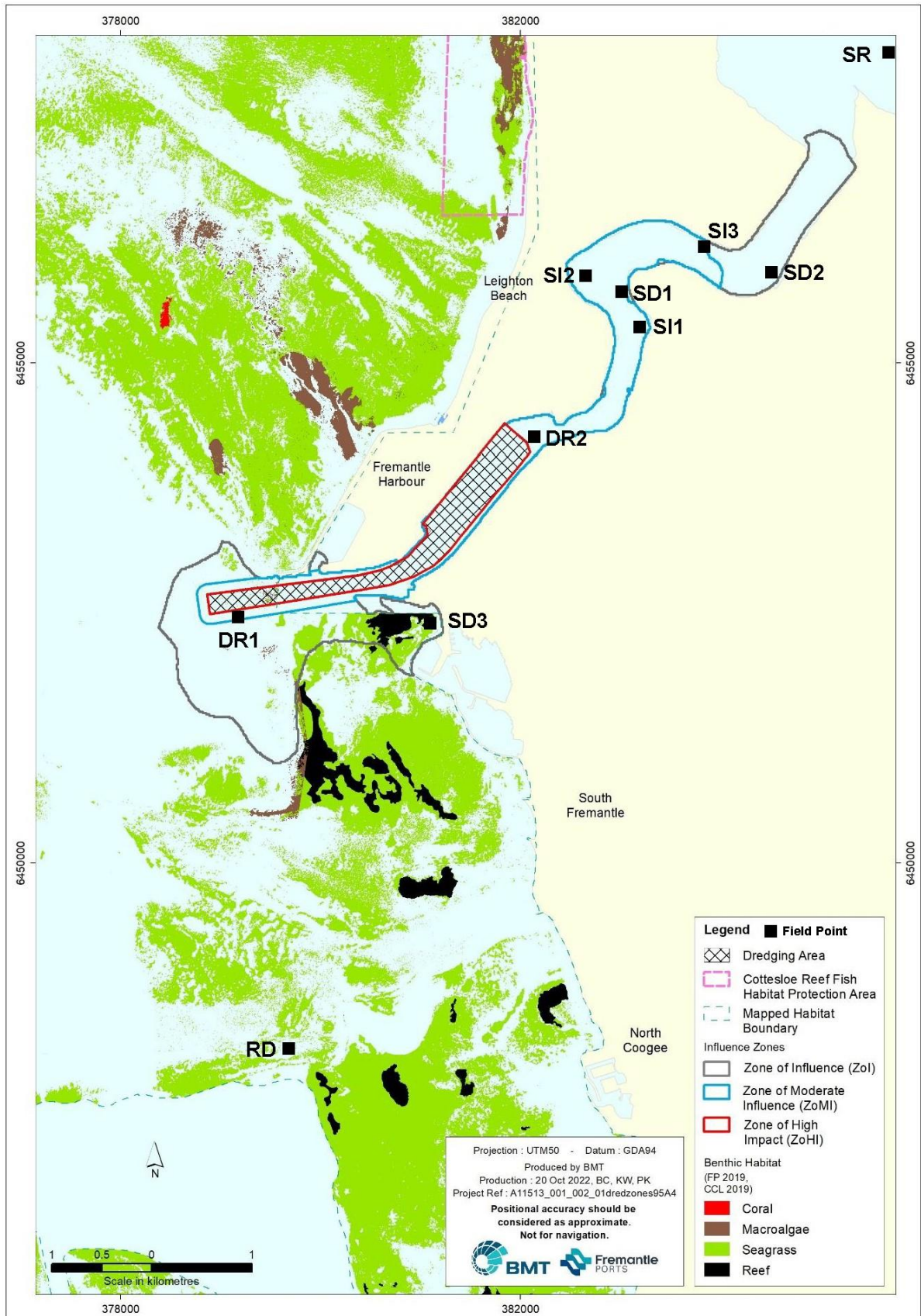


Figure 1.5 ZoHI, ZoMI and Zol defined for the dredging area (BMT 2022a), benthic habitat (BMT 2023a and BMT 2021) and field monitoring points

1.6.2 Monitoring and management approach

The Inner Harbour Maintenance Dredging ERD (BMT 2022a) and this DEMP were developed via a risk-based approach and apply the mitigation hierarchy – avoid, minimise, management and monitoring – to ensure that environmental factors are protected.

1.6.3 Rationale for provisions

This DEMP has been prepared in accordance with EPA (2021b) instructions on how to prepare dredging environmental management plans, including the following:

- outcome-based provisions: performance-based and may be used where the part of the environment is capable of objective measurement and reporting, and
- management-based provisions: relate to management actions and may be used where the part of the environment is not capable of objective measurement and reporting.

All environmental factors (marine environmental quality, benthic communities and habitats, social surroundings and marine fauna) have management-based provisions. The environmental factors of marine environmental quality, BCH and social surroundings have additional outcome-based provisions, for which conservatively derived criteria were developed based on:

- published tolerances of seagrasses to turbidity and sedimentation (Chisholm 2009, Collier *et al.* 2009, Lavery *et al.* 2009, Lavery *et al.* 2019)
- laboratory testing of sediments from the Proposal area (BMT 2022c and O2M 2022).

In accordance with the Environmental Factor Guideline – Marine Environmental Quality (EPA 2016a), a review of the environmental values was undertaken, and relevant environmental quality objectives (EQOs) were proposed (Table 1.7). The review identified two environmental values (ecosystem health, recreation and aesthetic values) and three corresponding EQOs that are considered applicable to the Proposal and in turn, have dedicated monitoring and management actions to ensure EQOs are being achieved (Table 1.7). The review identified a further three environmental values (fishing and aquaculture, cultural and spiritual, and industrial water supply values) that will be protected but are not considered applicable to the DEMP as they will be protected by ensuring maintenance of ecosystem integrity (Table 1.7).

Table 1.7 Environmental values and environmental quality objectives applicable to the Proposal area

Environmental value	Environmental quality objective (EQO)	Applicability to the Proposal	Reasoning
Ecosystem health (ecological value)	Maintenance of ecosystem integrity	Applicable	The Proposal may result in impacts to ecosystem integrity from the effects of potential physical and chemical stressors and from the effects of potential toxicants in marine waters and/or sediments and requires assessment.
Fishing and aquaculture (social use value)	Maintenance of seafood safe for human consumption	Not applicable	Maintenance of ecosystem integrity is an adequate proxy.
	Maintenance of aquaculture	Not applicable	Maintenance of ecosystem integrity is an adequate proxy. There are no aquaculture leases within the Proposal area.
Recreation and aesthetics (social use value)	Maintenance of aesthetic values	Applicable	The Proposal will cause temporary increased water column turbidity resulting in reduced visual clarity of waters at the dredging and disposal areas, and potentially at surrounding areas. The significance of reduced visual clarity of water associated with the implementation of the Proposal will depend on the intensity, extent and duration of turbid plumes generated during the Proposal and requires assessment.
	Maintenance of secondary contact recreation values	Applicable	
	Maintenance of primary contact recreation values	Not applicable	Maintenance of secondary contact recreation values is an adequate proxy, as there is a very low risk of primary contact within the Inner Harbour, Entrance Channel, or disposal area.
Cultural and spiritual (social use value)	Cultural and spiritual values of the marine environment are protected	Applicable	Maintenance of ecosystem integrity is an adequate proxy. The Swan River site will be directly affected.
Industrial water supply (social use value)	Maintenance of water quality for industrial use	Not applicable	Maintenance of ecosystem integrity is an adequate proxy. There is no industrial water supply in the Proposal area.

2 Monitoring and Management Framework

To mitigate effects associated with the proposal, the Proponent has identified proposed outcome-based conditions for protecting marine environmental quality, benthic communities and habitats and social surroundings during implementation of the Proposal (BMT 2022a). Outcome-based conditions have been developed in accordance with EPA (2021c), as presented in detail in Sections 2.1 and 2.3.

2.1 Outcome-based provisions

The following key environmental factors that may be affected by potential environmental impacts associated with the Project have been assigned outcome-based provisions:

- marine environmental quality
- benthic communities and habitats
- social surroundings.

The outcome-based provisions are outlined in Table 2.1. Monitoring methods associated with the outcome-based provisions are detailed in Section 2.3.

Table 2.1 Outcome-based provisions of the Inner Harbour Maintenance Dredging Environmental Management Plan

Environmental protection outcome	Environmental criteria	Response		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
Marine environmental quality							
Increased water column turbidity							
Environmental protection outcome #1: Maintain water clarity to meet the environmental criteria at boundary of ZoMI/ZoI to minimise social impacts on aesthetic quality from increased water column turbidity associated with dredging activity	Surface or bottom TSS (mg/L) at any individual impact site is 10 mg/L above the reference site data on the dredging activity sampling occasion	Determine if exceedance is due to dredging: • The available remote imagery, site photographs, plume sketches and drone aerial photography from the relevant monitoring period will be reviewed to ascertain whether the exceedance is in relation to the dredging or disposal operations. If there is an exceedance in relation to the dredging or disposal operations the Environmental Consultant to advise Proponent who will: - analyse dredging operations to determine and implement measures to reduce the intensity/extent of turbid plumes from dredging and disposal operations - contact DoH. - review DEMP for the next campaign of dredging operations in subsequent years. Continue monitoring and reporting. If there is an exceedance, the dredging operations will be analysed and this DEMP shall be revised for the next campaign of dredging operations in subsequent years.	Environmental Consultant	In-water plume Monitoring (Section 2.3.2))	TSS monitoring to occur during the first and main dredging campaign of 60,000 m ³ proposed to be undertaken in 2024. ~1 week before dredging operations commence. During dredging on three occasions on the 2nd, 5th and 10 th operational day. ~1 week after dredging operations. • If plumes are still 'evident' one week after the completion of dredging, post dredging monitoring is to be repeated on week 2, week 3 etc until plumes are no longer 'evident'. Plumes are considered 'evident' if TSS has not returned to <80th percentile of background data for the site (or to reference levels).	Environmental Consultant	• Monitoring data collected by the Contractor will be submitted weekly to the Environmental Consultant for review. • The Environmental Consultant will report on the receipt and/or results of monitoring data in a once-off environmental monitoring checklist (template provided in Annex B) after the dredging is completed. • Reporting against the environmental criteria will be included in a Dredging Environmental Management Plan (DEMP) compliance report prepared by the Environmental Consultant and provided to the Proponent for compliance within 3 months of Project completion.
	Median Secchi depth from Impact sites must not be reduced by 20% (equivalent to the EPA [2017] water clarity Environmental Quality Guideline [EQG])	• The available remote imagery, site photographs, plume sketches and drone aerial photography from the	Environmental Consultant	1) Water clarity Monitoring (Section 2.3.3) 2) Remote imagery (Section 2.3.4)	1) Water clarity monitoring to occur during the first and main dredging campaign of 60,000 m ³	1) Environmental Consultant 2) Environmental Consultant	• Monitoring data collected by the Contractor will be submitted weekly to the Environmental Consultant for review.

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Environmental protection outcome	Environmental criteria	Response		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
	<p>for the maintenance of aesthetic quality) during the sampling occasion; and</p> <p>Median Secchi depth from Recreation sites must not be <1.6 m (equivalent to the EPA [2017] water clarity EQG for the maintenance of primary contact recreation)</p>	<p>relevant monitoring period will be reviewed to ascertain whether the exceedance is in relation to the dredging or disposal operations.</p> <p>If it is found that the exceedance is in relation to the dredging or disposal operations the Environmental Consultant to advise the Proponent who will:</p> <ul style="list-style-type: none"> - consult with the Contractor to determine and implement measures to reduce the intensity/extent of turbid plumes from dredging and disposal operations - contact DoH. - review the DEMP for the next campaign of dredging operations in subsequent years. <p>Continue the water clarity monitoring</p>		<p>3) Site photographs (Section 2.3.5)</p> <p>4) Plume sketches (Section 2.3.6)</p> <p>5) Drone aerial photography (Section 2.3.7)</p>	<p>proposed to be undertaken in 2024. ~ 1 week prior to dredging; During dredging on days 2, 5 and 10; and ~ 1 week post dredging.</p> <p>If plumes are still 'evident' one week after the completion of dredging, post dredging monitoring is to be repeated on week 2, week 3 etc until plumes are no longer 'evident'. Plumes are considered 'evident' if TSS has not returned to <80th percentile of background data for the site (or to reference levels).</p> <p>2) Every 30 minutes during daylight hours (0700–1900) throughout the duration of dredging operations.</p> <p>3) In the event of remote imagery unit malfunction, once daily on every operational dredging day.</p> <p>4) Once daily on every operational dredging day throughout the duration of the Project (template provided in Annex B)</p> <p>5) ~1 week prior to dredging; During dredging on days 2, 5 and 10; and ~1 week post dredging. If plumes are still 'evident' one week after the completion of dredging, post dredging monitoring is to be repeated on week 2, week 3 etc until plumes are no longer 'evident'. Plumes are considered 'evident' if TSS has not returned to <80th percentile of background data for the site (or to reference levels).</p>	<p>3) Contractor</p> <p>4) Contractor</p> <p>5) Environmental Consultant</p>	<ul style="list-style-type: none"> • The Environmental Consultant will report on the receipt and/or results of monitoring data in a once-off environmental monitoring checklist (template provided in Annex B) after the dredging is completed. • Reporting against the environmental criteria will be included in a Dredging Environmental Management Plan (DEMP) compliance report prepared by the Environmental Consultant and provided to the Proponent for compliance within 3 months of Project completion.

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Environmental protection outcome	Environmental criteria	Response		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
Increased sediment contaminants							
<p>Environmental protection objective #2 Ensure dredge sediment quality of the Inner Harbour is maintained to prevent the release of potential new contaminants.</p>	<p>Sediments of Inner Harbour sites sampled as part of the annual Marine Quality Monitoring Program (MQMP) are within Environmental Quality Criteria.</p> <p>The sediments are tested for nitrogen, phosphorus, heavy metals, tributyltin, hydrocarbons and organochlorine pesticides.</p> <p>The Environmental Quality Criteria adopted for review of the sediment results are the same as implemented for the MQMP, specifically:</p> <p>i. Median total concentration should not exceed the <i>Australian and New Zealand Guidelines for Fresh and Marine Water Quality</i> (ANZG, 2018) default guideline value</p> <p>ii. Total concentration at individual sample sites should not exceed the ANZG (2018) guideline value high (if so, a new sampling area should be defined to assess the extent of contamination in accordance with the <i>Environmental Quality Criteria Reference Document for Cockburn Sound</i> (EPA, 2017).</p>	<p>If there is an exceedance of the MQMP environmental quality criteria, the dredging operations will be analysed and if necessary, the DEMP will be updated in light of changes to sediment quality prior to the next campaign of dredging operations in subsequent years.</p>	Proponent	Fremantle Ports annual MQMP	Annually Jan to March each year for duration of maintenance dredging program.	<p>a) Environmental Consultant</p> <p>b) Proponent</p>	<p>a) Reporting against the environmental criteria of the 2024 MQMP will be included in the Dredging Environmental Management Plan (DEMP) compliance report prepared by the Environmental Consultant and provided to the Proponent for compliance within 3 months of Project completion.</p> <p>b) If there is an exceedance of MQMP environmental criteria the dredging operations will be assessed and this DEMP shall be revised for the next campaign of dredging operations in subsequent years.</p>
Benthic communities and habitat							
Indirect loss							
<p>Environmental protection outcome #3: Maintain light levels to meet the environmental criteria at the ZoMI/ZoI boundary to avoid indirect loss of seagrass from increased water column turbidity associated with sediment disposal</p>	<p>Median Light attenuation coefficient (LAC) from any Impact site caused by dredging operations exceeds:</p> <p>>0.1084 above the median of baseline measurements from the same site (LAC equivalent of a TSS concentration of 10 mg/L); and,</p> <p>>0.1084 above the median of pooled reference site measurements (LAC equivalent of a TSS concentration of 10 mg/L).</p>	<p>If there is an exceedance, the dredging operations will be analysed and this DEMP shall be revised for the next campaign of dredging operations in subsequent years.</p>	Environmental Consultant	Light attenuation monitoring (Section 2.3.1))	<p>Light attenuation monitoring to occur during the first and main dredging campaign of 60,000 m³ proposed to be undertaken in 2024.</p> <p>~1 week prior to ~1 week after dredging operations.</p> <p>• If plumes are still 'evident' one week after the completion of dredging, post dredging monitoring is to be repeated on week 2, week 3 etc until plumes are no longer 'evident'. Plumes are considered 'evident' if TSS has not returned to <80th percentile of background data for the site (or to reference levels).</p>	Environmental Consultant	<p>• Reporting against the environmental criteria will be included in a Dredging Environmental Management Plan (DEMP) compliance report prepared by the Environmental Consultant and provided to the Proponent for compliance within 3 months of Project completion.</p>

2.2 Management-based provisions

The following relevant (key and other) environmental factors that may be affected by potential environmental impacts associated with the Project have been assigned management-based provisions:

- marine environmental quality (key environmental factor)
- benthic communities and habitats (key environmental factor)
- social surroundings (key environmental factor)
- marine fauna (other environmental factor)

The management-based provisions are outlined in Table 2.2. Monitoring methods associated with the management-based provisions are detailed in Section 2.3.

Table 2.2 Management-based provisions of the Inner Harbour Maintenance Dredging Environmental Management Plan

Environmental protection objective	Management Target	Management		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
Marine environmental quality							
Hydrocarbon spills and waste generation							
Environmental protection objective #1: No hydrocarbon spills or release of waste into the environment from dredging and sand disposal	No reported hydrocarbon spills or release of waste into the environment from dredging and disposal	A clean and tidy work area will be maintained with safe storage of all potentially hazardous substances.	Contractor	Inspections will be completed during site visits	Weekly or once off throughout the duration of dredging and disposal operations	Proponent	<ul style="list-style-type: none"> Review records and site inspection logs will be maintained by the Proponent and submitted to the Environmental Consultant within a month of completion of the project. Reporting against the management target will be included in a Dredging Environmental Management Plan (DEMP) compliance report prepared by the Environmental Consultant and provided to the Proponent within 3 months of Project Completion In the event of a hydrocarbon spill that is likely to impact on coastal waters, Fremantle Ports' Vessel Traffic Service (VHF Channel 12 or 08 9431 6333) and/or Department of Transport's (DoT's) Maritime Environmental Emergency Response Unit (24-hour reporting number: 08 9480 9224) will be notified immediately (within 1-hour of receiving notification of the incident)
		Fuels and oils will be stored in contained areas and any fueling will occur within a bunded area.	Contractor	Inspections will be completed during site visits	Weekly or once off throughout the duration of dredging and disposal operations	Proponent	
		There will be a spill kit available on site with all necessary materials for mitigating an accidental hydrocarbon spill.	Contractor	Inspections will be completed during site visits	There will be a spill kit available on site with all necessary materials for mitigating an accidental hydrocarbon spill	Proponent	
		The Contractor will prepare a Construction Environmental Management Plan (CEMP) that includes oil spill contingency procedures to be implemented in the event of an accidental hydrocarbon spill.	Contractor	Review of the CEMP provided by the Contractor will be completed.	Once-off prior to the commencement of dredging operations	Proponent	
		Work areas will be clear of waste/rubbish following demobilisation from site	Contractor	Inspections will be completed during site visits	Weekly or once off throughout the duration of dredging and disposal operations	Proponent	
		The dredge and any associated support vessels will be required to obtain a low risk rating from the Department of Primary Industries and Regional Development (DPIRD) risk assessment tool (https://vesselcheck.fish.wa.gov.au/) prior to mobilising to site from an interstate or international location.	Contractor	Review of the DPIRD risk assessment tool reports provided by the Contractor will be completed	Once-off prior to the dredge and any associated support vessels mobilising to site	Proponent	
Benthic communities and habitat							
Direct loss							
Environmental protection objective #2: Ensure no permanent loss of BCH outside of the zone of high impact (ZoHI)	No dredging and sediment disposal outside of the defined areas of the Native Vegetation Clearing Permit (NVCP) and Sea Dumping Permit (SDP) areas.	The dredge will have an accurate positioning system installed and the position of the dredge will be monitored during dredging operations.	Contractor	Review of the dredge position data provided by the Contractor will be completed	Weekly or once off throughout the duration of dredging operations	Proponent	<ul style="list-style-type: none"> The Proponent will report on the receipt and/or results of the dredge position data in a once-off monitoring checklist after the dredging is completed (template provided in Annex C) Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to the
		Disposal position logs including details of the timing and position will be maintained.	Contractor	Review of the disposal position logs provided by the Contractor will be completed	Weekly or once off throughout the duration of dredging operations	Proponent	
		The dredge will be fitted with a green valve that will be used during 30-minute overflow periods of dredging.	Contractor	Review of the dredge logs and Inspections will be completed during site visits	Weekly or once off throughout the duration of dredging operations	Proponent	

Environmental protection objective	Management Target	Management		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
		A targeted disposal area will be provided to the Contractor. The targeted disposal area will be positioned within the Native Vegetation Clearing Permit (NVCP) and the Sea Dumping Permit (SDP) areas.	Proponent	Review of the disposal position logs provided by the Contractor will be compared to the NVCP and SDP areas.	Weekly or once off throughout the duration of dredging operations	Proponent	Proponent within 3 months of Project completion · The Proponent will keep records of the clearing of native vegetation associated with dredging and disposal activities and provide these upon request from the CEO of DWER.
		Dredging in 2024 to occur from 1 April to 31 August to reduce the impacts on seagrass as their dormancy stage occurs during /winter because of a reduction of sunlight. Dredging in subsequent years to be undertaken in any month (due to small scale of operations).	Proponent	Dredge works planning and monitoring if operational delays are experienced	Once-off prior to the commencement of dredging operations	Proponent	
Social surroundings							
Public and navigational safety							
Environmental protection objective #3: No public or navigational safety incidents from dredging and disposal	Any / all reported community concerns about a potential safety hazard, near miss, or incident as a result of public or navigational safety issues associated with dredging and disposal are addressed in-line with the Communications Plan.	A public complaints register will be developed and maintained with responses provided to any public complaints within 1 week of receipt	Proponent	Review of the public complaints register will be completed	As required (in the event of receiving notification that a public complaint has been received)	Proponent	Site inspection logs will be maintained by the Contractor and provided to the Proponent (Annex C). The Proponent to advise the Department of Health (DoH) of any excursions or complaints that have potential for public health implications, as soon as possible. This will assist facilitation of appropriate community health advice and messaging. · The Proponent will provide the Environmental Consultant a summary of any public complaints received after the dredging is completed. • Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to the Proponent within 3 months of Project completion. · In the event of a navigational safety incident, Fremantle Ports' Vessel Traffic Service (VHF Channel 12 or 08 9431 6333) will be notified immediately (within 1-hour of receiving notification of the incident). • In the event of public or navigational safety incident, the relevant dredging and/or disposal activities will be suspended until the appropriate measures are implemented to prevent further related incidents from arising again
		A Temporary Notice to Mariners (TNTM) from DoT's Marine Safety Branch will be obtained at least 14 days prior to the commencement of works to inform the public of potential navigational hazards associated with dredging and disposal. The contractor is also to consult with Fremantle Ports in relation to this notice.	Proponent	Review of the TNTM published on DoT's website will be completed	Once-off prior to the commencement of dredging operations	Proponent	
		The dredge, associated support vessels and any associated marine equipment will be fitted with the appropriate marine safety equipment, markers and/or lighting to the satisfaction of Fremantle Ports' Harbour Master.	Contractor	Review of the inspection logs provided by the Contractor will be completed	Once-off prior to the commencement of dredging operations	Proponent	
		The Contractor will comply with the relevant requirements in Fremantle Ports' Port Information Guide (Fremantle Ports 2018) while operating in Fremantle Ports' limits	Contractor	Inspections will be completed during site visits	Weekly or once off throughout the duration of dredging operations	Proponent	

Environmental protection objective	Management Target	Management		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
Reduced visual amenity, odour generation and noise							
Environmental protection objective #4: Minimise social impacts from potential reduced public amenity, odour generation or noise associated with dredging and sediment disposal	Any / all community concerns raised in relation to reduced public amenity, odour generation or noise associated with dredging and sediment disposal are addressed in-line with the Communications Plan.	A public complaints register will be developed and maintained with responses provided to any public complaints within 1 week of receipt	Proponent	Review of the public complaints register will be completed. Incidents and complaints will be managed in line with Fremantle Ports Incident and Complaints Management procedures. Incidents and complaints will be investigated and where relevant corrective actions identified to prevent reoccurrence. Where relevant, water quality monitoring will be used to inform investigations into reduced amenity complaints. If noise and/or vibration complaints are received Fremantle Ports will engage a suitably qualified consultant to undertake monitoring. Where required, Inspections will be undertaken to monitor noise and odour complaints until rectified and/or operations are completed.	As required (in the event of receiving notification that a public complaint has been received) The relevant regulatory authorities and/or stakeholders will be notified and consulted with as required. The Proponent to advise DoH of any complaints that have potential for public health implications within 24hrs (e.g. water clarity or turbidity events or other conditions).	Proponent	<ul style="list-style-type: none"> Review records will be maintained by the Proponent and provided to the Environmental Consultant. The Proponent will provide a summary of any public complaints received after the dredging is complete. Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to the Proponent within 3 months of Project completion.
		Change management provisions to allow moving of the dredge to a different site if there is actual or anticipated feedback from the community	Proponent	Review of the public complaints register will be completed	As required (in the event of receiving notification that a public complaint has been received)	Proponent	
		The operation of machinery associated with dredging and sediment disposal activities will occur within an active port area and noise generation should be overseen by the Noise Management Plan (NMP)	Contractor	Review of the Noise Management Plan and approval provided by the Proponent will be completed	Once off prior to the operation of machinery associated with dredging and sediment disposal in accordance with Australian Standards 1269 and 2436 and <i>Environmental Protection (Noise) Regulations 1997 (DEP 1997)</i>	Proponent	
		The dredge and any associated support vessels and equipment are to be regularly	Contractor	a) Review of the Noise Management Plan and approval provided by the	a) Once off prior to the operation of machinery	a) Proponent b) Contractor	

Environmental protection objective	Management Target	Management		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
		maintained to reduce any unnecessary noise and vibration at the source. Plant and equipment are to be operated in accordance with industry standards and have been serviced as per manufacturer specifications.		Proponent will be completed. b) Where there are complaints about noise review and implement additional actions to minimise noise output.	associated with dredging and sediment disposal. b) As required (in the event of receiving notification that a public complaint has been received).		
		The Contractor will prepare a Construction Environmental Management Plan (CEMP) that includes plume, odour and noise contingency procedures to be implemented in response to a community complaint to minimise social impacts associated with reduced public amenity.	Contractor	Review of the CEMP provided by the Contractor will be completed.	Once-off prior to the commencement of dredging operations	Review of the CEMP provided by the Contractor will be completed.	
Disturbance to Aboriginal heritage							
Environmental protection objective #5 Aboriginal stakeholder dredge monitoring recommendations are implemented	Aboriginal representative's dredge monitoring recommendations are implemented in-line with stakeholder consultation as documented in the Communications Plan.	Provide berth access for Aboriginal representative/s to undertake a smoking ceremony adjacent to the dredge vessel prior to commencing dredging works	Proponent	Whadjuk representative/s undertake a smoking ceremony prior to commencing dredging works	Once off prior to the commencement of dredging operations in 2024	Whadjuk Aboriginal Corporation Proponent	Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to the Proponent within 3 months of Project completion.
		Facilitate dredge vessel access for a Whadjuk Ranger to undertake dredge works monitoring throughout the operation (during daylight hours)	Proponent Contractor	A Whadjuk / Noongar Ranger to monitor the dredge works during dredging operations	Daily (during daylight hours) throughout the duration of dredging operations from 2024 to 2029.	Whadjuk Aboriginal Corporation Proponent	
		Facilitate scientific vessel access for a Whadjuk Ranger to undertake dredge plume monitoring during in-water monitoring	Proponent Environmental Consultant	A Whadjuk / Noongar Ranger to monitor the dredge plume during in-water monitoring	On five occasions during the in-water monitoring undertaken in 2024 prior to, during and after the dredging operations	Whadjuk Aboriginal Corporation Proponent	
Marine Fauna							
Introduced Marine Species (IMS)							
Environmental protection objective #6: No introduction of IMS to the Project site from the arrival of the dredge and any associated support vessels	No reported observations of IMS on the dredge and any associated support vessels at the Project site	The dredge and any associated support vessels will be cleaned and/or visually inspected for IMS prior to mobilising to the Project site from any location	Contractor	Review of the inspection logs provided by the Contractor will be completed	Once-off prior to the dredge and any associated support vessels mobilising to site	Proponent	<ul style="list-style-type: none"> Review records will be maintained by the Proponent and submitted to the Environmental Consultant. Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to the Proponent within 3 months of Project completion. In the event of a sighting of suspected IMS, the suspected IMS will be isolated and reported to DPIRD's FishWatch (24-hour reporting number: 1800 815 507) immediately (within 24- hours of receiving notification of the sighting)
		The dredge and any associated support vessels will be required to obtain a low risk rating from the Department of Primary Industries and Regional Development (DPIRD) risk assessment Tool (https://vesselcheck.fish.wa.gov.au/) prior to mobilising to site from an interstate or international location	Contractor	Review of the DPIRD risk assessment tool reports provided by the Contractor will be completed	Once-off prior to the dredge and any associated support vessels mobilising to site	Proponent	
	No new IMS identified at the Project site attributed to the project	Proponent	Continue to implement the State-Wide Array Surveillance Program (SWASP) in cooperation with the Department of Primary Industries and Regional Development (DPIRD)	Review SWASP results during and following the completion of the dredging operation.	Throughout the five-year maintenance dredging project and a year following the completion of the operation.	Proponent	

Environmental protection objective	Management Target	Management		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
							and actions will be taken as directed by DPIRD. • In the event a new IMS is detected and attributed to the maintenance dredging project, the Proponent will inspect potential areas of spread including within the dredging and disposal area (if suitable habitat exists).
Marine fauna collision/vessel strike and entrainment							
Environmental protection objective #7: No collision/vessel strike or entrainment with marine fauna from the operation of the dredge	No reported collision/vessel strike or entrainment incidents with marine fauna from the operation of the dredge	a) Vessel Masters responsible for operating the dredge will be suitably trained to understand marine fauna behaviours, actions and reporting requirements in the event of marine fauna injury or mortality and provisions under <i>Environmental Protection and Biodiversity Conservation Regulations – Part 8 Division 8.1: Interacting with cetaceans</i> . b) Turtle Exclusion Device will be fitted to the Dredge vessel. c) In the event the management target is not met the operation will be reviewed and associated controls implemented to ensure measurement targets are met.	Contractor	a) Review of the training records provided by the Contractor will be completed b) Contractor to provide confirmation that Turtle Exclusion Device has been fitted to the Dredge Vessel.	a) Once-off prior to the commencement of dredging operations (Section 2.3.8) b) Once-off prior to the commencement of dredging operations	Proponent	<ul style="list-style-type: none"> Site inspection logs (Annex D) will be maintained by the Proponent and provided to the Environmental Consultant. The Proponent will report on the receipt and/or results of the marine fauna observation and interaction logs in a once-off environmental monitoring checklist and provide records to the Environmental Consultant after the dredging is complete (template provided in Annex C) Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to the Proponent within 3 months of Project completion. In the event of marine fauna injury or mortality resulting from a reported collision/vessel strike or entrainment including from the operation of the dredge, the contractor will advise the Proponent immediately. The incident will be noted in Fremantle Ports Incident Management System and a record of the incident provided to the Environmental Consultant. The Proponent will contact DBCA, DWER and DCCEEW regarding the incident.
	Monitor fauna behaviour and movement · If fauna proceeds towards dredge, cease dredging until fauna is outside of monitoring zone · Implement soft-start procedures on recommencement of dredging	a) The suitably trained Vessel Master(s) responsible for operating the dredge will document any observations and/or interactions with marine fauna within the monitoring zone (area within a 300m radius from the dredge) and the corrective actions taken using the marine fauna observation and interaction logs (templates are provided in Annex D) b) In the event the management target is not met the operation will be reviewed and associated controls implemented to ensure measurement targets are met.	Contractor	Marine fauna observation monitoring	Continuous: presence of significant marine fauna enters the 300 m monitoring zone (Section 2.3.8)	Contractor	
	Monitor fauna behaviour and movement · Delay commencement of dredging until fauna is outside of monitoring zone	a) The suitably trained Vessel Master(s) responsible for operating the dredge will document any observations and/or interactions with marine fauna within the monitoring zone (area within a 300m radius from the dredge) and the corrective actions taken using the marine fauna observation and interaction logs (templates are provided in Annex D). b) In the event the management target is not met the operation will be reviewed and associated controls implemented to ensure measurement targets are met.	Contractor	Marine fauna observation monitoring	Daily/pre-start (Section 2.3.8)	Contractor	

Environmental protection objective	Management Target	Management		Monitoring			Reporting
		Action	Responsibility	Action	Timing/frequency	Responsibility	
Marine Environmental Quality							
Plume management (for four dredging campaigns of 5,000m³ from 2025 to 2029)							
<p>Environmental protection objective #8: No visible plume caused by dredging or disposal operations during the four subsequent dredge campaigns from 2025 to 2029.</p>	<p>No visible plume occurs outside of the Inner Harbour dredging area and the Gage Roads offshore disposal area during the four subsequent dredge campaigns from 2025 to 2029 that is caused by dredging or disposal operations.</p>	<p>During the four subsequent dredge campaigns from 2025 to 2029, the Contractor to advise the Proponent if a visible plume is observed from the dredging and / or disposal operations.</p> <p>The Proponent will review the available remote imagery, site photographs, plume sketches from the relevant monitoring period to ascertain whether a visible plume is observed outside of the Inner Harbour dredging area and / or the Gage Roads offshore disposal area.</p> <p>If the observed plume outside of the Inner Harbour dredging area and / or the Gage Roads offshore disposal area is in relation to the dredging or disposal operations the Proponent will:</p> <ul style="list-style-type: none"> - Consult with the contractor to analyse operations to implement measures to reduce the intensity/extent of the plume. - Contact DoH. - Continue monitoring until plume is no longer visible. 	<p>Contractor & Proponent</p>	<p>1) Remote imagery (Section 2.3.4)</p> <p>2) Site photography (Section 2.3.5)</p> <p>3) Plume sketches (Section 2.3.6)</p>	<p>1) Every 30 minutes during daylight hours (0700–1900) throughout the duration of dredging operations.</p> <p>2) In the event of remote imagery unit malfunction, once daily on every operational dredging day.</p> <p>3) Once daily on every operational dredging day throughout the duration of the Project (template provided in Annex B)</p>	<p>1) Proponent 2) Contractor 3) Contractor</p>	<ul style="list-style-type: none"> • Monitoring data collected by the Contractor will be submitted weekly to the Proponent for review. • The Proponent will report on the receipt and/or results of monitoring data in a once-off environmental monitoring checklist (template provided in Annex B) after the dredging is completed. • Reporting against the management target will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to the Proponent within 3 months of Project completion.

2.3 Monitoring methods

The monitoring methods proposed for the first and main dredging campaign in April 2024 to remove 60,000m³ are documented in Table 2.3. The monitoring methods include light attenuation monitoring, in-water plume monitoring, water clarity monitoring, remote imagery monitoring, site photographs, plume sketches, drone aerial photography and marine fauna observation monitoring.

The subsequent four dredging campaigns to remove additional 5,000 m³ per year from 2025 to 2029 are expected to be completed over one operational day. The environmental impacts are expected to be insignificant due to the small volume compared to the first dredging campaign in April 2024 to remove 60,000 m³, as detailed by BMT (2022a). It is expected that the sediment plume during the additional dredging campaigns will be limited to the immediate surroundings of the operations on a short-term duration basis, similar to the sediment plumes that arise from routine port operations. Therefore, light attenuation monitoring, in-water plume monitoring, water clarity monitoring and drone aerial photography are not considered necessary for the small-scale dredging campaign. Monitoring proposed for the small-scale dredging includes remote imagery monitoring, site photographs, plume sketches and marine fauna observation monitoring (Table 2.3).

Fremantle Ports will continue to implement annual monitoring of introduced marine species and sediment quality throughout the maintenance dredging campaign from 2024 to 2029 (Table 2.3), and monitoring results will be utilised to inform the annual review of this DEMF (Section 4).

Table 2.3 Monitoring methods proposed for Inner Harbour Maintenance Dredging campaign in 2024 and the four subsequent dredge campaigns in 2025 to 2029.

Year	Volume	Monitoring Methods	Section
2024	60,000m ³	Light attenuation monitoring	2.3.1
		In-water plume monitoring	2.3.2
		Water clarity monitoring	2.3.3
		Remote Imagery	2.3.4
		Site Photographs	2.3.5
		Plume sketches	2.3.6
		Drone aerial photography	2.3.7
		Marine Fauna observations	2.3.8
2025 to 2029	5,000m ³	Remote Imagery	2.3.4
		Site Photographs	2.3.5
		Plume sketches	2.3.6
		Marine Fauna observation	2.3.8
2024 to 2029 (ongoing)	n/a	Introduced Marine Species	2.3.9
		Sediment Quality monitoring	2.3.10

2.3.1 Light attenuation monitoring

Sub-sea light loggers will be deployed to monitor light attenuation at five impact sites adjacent to seagrass habitats and at three reference sites located outside of the ZoI, specifically at Disposal (DI1, DI2, OS), Dredging (RD, DR1) and Estuary (SI1, SI2, SR) monitoring sites (Table 2.3, Figure 1.4, Figure 1.5). The deployment period for the loggers will be ~1 week before through to ~1 week after dredging operations. The loggers will measure integrating light count data at ~15-minute intervals within the period from ~2 hours after sunrise to ~2 hours before sunset to ensure the sun is at a sufficient angle to minimise the reflectance of incident light from the water surface (EPA 2005). The integrating light count data downloaded from the loggers will be processed to LAC as per the EPA (2005) Manual of Standard Operating Procedures. The LAC data will be analysed as appropriate for comparison against the environmental criteria for the light attenuation monitoring in Table 2.1. The Environmental Consultant will be responsible for implementing the light attenuation monitoring, data analysis and reporting.

2.3.2 In-water plume monitoring

Water sampling for turbidity will be completed during the first and main dredging campaign of 60,000m³ proposed to be undertaken in 2024 ~1 week before, during and ~1 week after the dredging campaign. Prior to dredging, the correlation between TSS and Nephelometric Turbidity Unit (NTU) will be defined such that real-time turbidity measures may be assessed against modelled / predicted TSS contours, using samples collected from the Project area. The in-water monitoring program will comprise:

- monitoring of NTU one week before dredging / disposal activities
- monitoring of NTU during dredging / disposal activities on three occasions, on the 2nd, 5th and 10th operational day.
- monitoring of NTU one week after the completion of dredging / disposal activities. Noting, if plumes are still 'evident' one week after the completion of dredging, post dredging monitoring is to be repeated on week 2, week 3 etc until plumes are no longer 'evident'. Plumes are considered 'evident' if TSS has not returned to <80th percentile of background data for the site (or to reference levels).

Monitoring will involve the lowering of a sensor through the water column three times to calculate a median value for surface and bottom NTU, at each Impact and Reference site. To determine an exceedance of the criterion, median TSS (converted from NTU using the laboratory defined relationship) will be compared to trigger thresholds defined in Table 2.1.

The Environmental Consultant will process the data to determine whether the criteria have been exceeded (Table 2.1). An exceedance will be confirmed by using the following multiple lines of evidence approach to determine whether there is a link between dredging and disposal activities and elevated turbidity at sensitive receptor monitoring locations:

- analysis quality assurance and quality control (i.e. human error)
- function checks on the multi parameter water sensor
- comparison of data to modelled parameters within the ZoI i.e. >2 mg/L above background (reference sites) and/or baseline (pre-dredging baseline data collected at the same site)
- effects of natural metocean or weather conditions that could be affecting this site that are not related to dredging and disposal (e.g. storm activity).
- If the surface or bottom TSS (mg/L) at any individual impact site is 10 mg/L above the reference site data on the dredging activity sampling occasion Fremantle Ports to contact Department of Health.

Detailed sampling and analysis procedures will be provided to field personnel as part of Turbidity Sampling and Analysis Plan. The proposed field points are detailed in Table 2.3 and shown in Figures 1.4 and 1.5.

The impact sites at the dredging area were positioned upstream and downstream the dredging design, while the impact sites at the disposal area were positioned at the north and at the south of the target disposal area, where the sediment plume is expected to reach the high TSS concentrations. The reference sites were positioned in areas where no sediment plume is expected to reach, and the environment are similar to those where the Proposal will be developed.

Table 2.4 Proposed field points

Field point	Acronym	Site	Positioning	E	N	Monitoring Method
Offshore Site	OS	Reference	1 km northeast from disposal Zol	375170.4994	6459810.374	LA, IW, WC
Disposal Impact 1	DI1	Impact	Disposal ZoMI	374927.2023	6453949.832	LA, IW, WC
Disposal Impact 2	DI2	Impact	Disposal Zol	375525.0489	6455931.233	LA, IW, WC
Reference Dredge	RD	Reference	2 km south of dredging Zol and 2.2 km east from disposal Zol	379701.5461	6448172.416	LA, IW, WC
Dredge Impact 1	DR1	Impact	Dredging ZoMI downstream	379188.6031	6452483.597	LA, IW, WC
Dredge Impact 2	DR2	Impact	Dredging ZoMI upstream	382137.6848	6454321.013	IW, WC
Swan River 1	SI1	Impact	Dredging ZoMI upstream	383174.668	6455322.550	LA, IW, WC
Swan River 2	SI2	Impact	Dredging ZoMI upstream	382534.649	6455918.438	LA, IW, WC
Swan River 3	SI3	Impact	Dredging Zol, upstream	383808.460	6456203.435	IW, WC
Swan River	SR	Reference	0.5 km downstream of dredging Zol	386126.708	6458010.061	LA, IW, WC
Secchi Disk 1	SD1	Recreational areas	John Tonkin Reserve, Dredging ZoMI	383171.008	6455831.729	WC
Secchi Disk 2	SD2	Recreational areas	Bicton Baths, Dredging Zol	384518.791	6455818.484	WC
Secchi Disk 3	SD3	Recreational areas	Bathers Beach, Dredging Zol	381029.579	6452414.574	WC

Note: coordinates are displayed in UTM50_GDA94; LA = Light attenuation monitoring; IW = In-water plume monitoring; WC = Water clarity monitoring.

2.3.3 Water clarity monitoring

Secchi depth measurements will be taken during the first and main dredging campaign of 60,000m³ proposed to be undertaken in 2024 at the disposal and dredge areas and at a reference area to monitor water clarity during dredging and disposal operations. Secchi depth measurements will be taken on five occasions: one week before the commencement of dredge; on days 2, 5 and 10 of the dredging operation; and one week after the dredging is finished.

Secchi depth measurements will be taken at all field points shown in Table 2.3, Figure 1.4 and Figure 1.5. Secchi depth measurements will be taken between 1100hrs and 1300hrs when sun glint on the water surface is minimal, where practical.

The Environmental Consultant will be responsible for taking the Secchi depth measurements in accordance with the following procedure:

- (1) arrive at site and collect a Global Positioning Unit (GPS) coordinate to provide evidence of the actual location where the Secchi depth measurement was collected.
- (2) lower the Secchi disk over the sunny side of the boat to avoiding shading which could impact on the visibility of the Secchi disk through the water.
- (3) lower the Secchi disk slowly through the water column and look (without sunglasses) directly down the cord until the black and white quadrants on the Secchi disk are no longer visible.
- (4) record the depth (to the nearest 0.1 m) of the Secchi disk (where the black and white quadrants are no longer visible) from the water surface using the markings on the attached rope for reference (each marking is 0.1 m apart).
- (5) if the black and white quadrants on the Secchi disk are still visible when the Secchi disk reaches the seafloor, then the depth of the Secchi disk from the water surface should be recorded with a ">" symbol before the depth (e.g., where the depth of the Secchi disk from the water surface is 2.3 m, the Secchi depth measurement should be recoded as ">2.3 m").
- (6) ensure Secchi depth measurements and GPS coordinates are recorded on the Secchi depth measurement field sheet provided in Annex A.
- (7) if the water clarity result is <1.6m at recreational area sites escalate to Fremantle Ports to contact Department of Health.

2.3.4 Remote imagery

Remote imagery units (RIUs) will be installed to monitor turbid plumes associated with the dredging and disposal operations. The RIUs will capture time- and date-stamped images to a resolution of ≥ 12 megapixels every 30 minutes during daylight hours (0700hrs–1900hrs) throughout the duration of the dredging and disposal operations. Each image captured by the RIUs will be forwarded to the Environmental Consultant in real-time. The Environmental Consultant will be responsible for coordinating installation of RIUs, reviewing the RIU imagery weekly, and notifying the Proponent in the event of a RIU malfunction (site photographs will be captured by the Contractor in contingency, as outlined in Section 2.3.3). Two RIUs will be installed within the Inner Harbour area and one RIU will be installed on the dredge vessel.

The RIUs installed within the Inner Harbour area will be positioned to capture images downstream and upstream of the dredging design, to register the behaviour of the plume during the dredging operations.

2.3.5 Site photographs

Site photographs of the dredging and/or disposal area will be captured in the event of RIU malfunction to monitor turbid plumes associated with the dredging and disposal operations. When required, site photographs will be time- and date-stamped and captured once daily on every operational dredging day throughout the duration of the Project. Site photographs will be taken at a time (nominally between 1100hrs and 1300hrs) and in a direction to minimise sun glint from the water surface, where practical. A digital camera with a resolution of ≥ 12 megapixels will be used to take the photographs. The Contractor will be responsible for capturing site photographs, when communicated of the requirement from the Environmental Consultant (via the Proponent). The Contractor will be required to submit site photographs weekly to the Environmental Consultant (via the Proponent) for review.

2.3.6 Plume sketches

Plume sketches recording the extent of visible turbid plumes at the dredging and disposal area will be completed once daily on every operational dredging day throughout the duration of the Project. Plume sketches will be completed on a pre-designed plume sketch template (Annex B) between 1100hrs and 1300hrs when sun glint on the water surface is minimal, where practical. The Contractor will be responsible for completing the plume sketches and will be required to submit the completed plume sketch templates weekly to the Environmental Consultant (via the Proponent) for review.

2.3.7 Drone aerial photography

During the first and main dredging campaign of 60,000m³ proposed to be undertaken in 2024, drone aerial photography of the dredging area will be captured to monitor turbid plumes associated with the dredging operations within the Inner Harbour and Entrance Channel. However, drone aerial photography will not be captured at the disposal area where line-of-vision (pilot requirements) of a drone cannot be maintained from shore.

Drone aerial photography will be captured on day 2, day 5 and day 10 of operations to provide a large-scale visual record of the dredging operations and to provide a view of the full extent of associated turbid plumes. The drone surveys are to extend from the dredge area upstream to field point SR. The drone surveys should be timed (as close as possible) for late in the flood tide. The Environmental Consultant will be responsible for coordinating the drone aerial photography flights and reviewing the imagery.

2.3.8 Marine fauna observation monitoring

Prior to the commencement of dredging, vessel operators will be required to undergo training to minimise the risk of marine fauna interactions during dredging and disposal activities. The training would include marine fauna behaviour and actions, and reporting requirements in the event of marine fauna injury or mortality. EPBC Regulations 2000 – Part 8 Division 8.1, Interacting with cetaceans will be included in training and adhered to, as required.

A suitably trained Marine Fauna Observer (MFO) is required to be on location during dredging and disposal activities. The MFO will be in a position to make continuous observations for the duration of works and must be trained in marine fauna observation, behaviour, and distance estimation and reporting. The MFO will have equipment suitable to detect, monitor and record marine fauna (i.e. binoculars, inclinometer, Marine Fauna Log Sheets) prior to the commencement of the works.

The Dredge Contractor will complete a pre-start (20 minutes) visual survey to ensure no marine fauna are present at the time of dredge start-up or at the time of the disposal and will be reported in a daily log. If marine fauna is sighted in the monitoring zone (the area within a 300 m radius of the dredge) during the pre-start survey, the monitoring and management actions listed in Table 2.2 must be adhered to prior to start-up procedures commencing. The MFO will record the weather conditions (i.e. sea state, wind speed and direction, cloud cover, swell, visibility) daily during dredging and disposal at the beginning and end of each shift, and at any time there is a change in conditions.

If marine fauna is sighted inside the monitoring zone, the behaviour and direction of their movement will be

monitored and recorded by the MFO on the Marine Fauna Observation Log (Annex D), and actions will be taken to cease dredging should the marine fauna continue towards the dredge plant. If an interaction with marine fauna occurs (i.e. vessel strike, interaction with dredging equipment, entering the agreed monitoring zone, injured or dead marine fauna), the MFO will complete the Marine Fauna Interaction Log (Annex D) and follow the actions listed in Table 2.2. The Marine Fauna Interaction Log will document the date, time, location, tide and weather conditions, number of individuals involved, corrective action(s) undertaken, and proposed preventative action(s) to be implemented.

During night-time and low visibility operations the following procedures for commencement of dredging will be implemented:

- The dredging activity cannot commence low visibility operations if there have been three or more marine fauna instigated shutdowns during the proceeding 24 hours. If operations were not underway during the previous 24 hours, at least 2 hours of observation (under good visibility conditions) must be undertaken with no fauna sightings recorded.
- Continuous observations are maintained with a focus on the applicable 300 m monitoring zone and if marine fauna is detected the stop work procedures apply.
- If sightings of marine fauna have been frequent or higher than anticipated during planning, the proponent will consider whether additional management measures should be employed for low visibility operations.

The Dredging Contractor will maintain all observation logs for the duration of the Project and will be submitted to the Environmental Consultant for further reporting to regulatory authorities, as required.

2.3.9 Introduced Marine Species monitoring

Fremantle Ports will continue to implement the State-Wide Array Surveillance Program (SWASP) in cooperation with the Department of Primary Industries and Regional Development (DPIRD) throughout the five-year maintenance dredging project. The SWASP includes settlement arrays, shoreline searches and crab traps, explained below.

Settlement arrays are used as an early warning system for the detection of introduced marine pests as well as a record of other marine organisms in the surveys area. The arrays are simple structures that provide extra surfaces for organisms to settle on that are then collected and examined by marine pest experts.

Shoreline searches are conducted quarterly at low tides. Running parallel to the waterline, the searches include both intertidal and beach locations. As well as examining rocks and artificial structures, searchers also examine wrack in detail as dead material present in wrack could provide an indication that a pest species is or was present in the area.

Crab traps are used to target six pest crab species that have the potential to survive in the Fremantle Port area. Artificial habitat collectors known as 'crab condos' have been added to the program to specifically target smaller crab species.

In the event of a sighting of suspected IMS, the suspected IMS will be isolated and reported to DPIRD immediately and actions will be taken as directed by DPIRD.

In the event a new IMS is detected within the Inner Harbour the Proponent will review the dredging operations and undertake inspections of potential areas of spread including the disposal area (if suitable habitat exists). The DEMP will be reviewed in consultation with DPIRD and updated accordingly.

2.3.10 Sediment quality monitoring

Fremantle Ports will continue to implement the Annual Marine Quality Monitoring Program (MQMP) throughout the five-year maintenance dredging project to ensure dredge sediment quality of the Inner Harbour is maintained to prevent the potential release of new contaminants.

Sediment quality data has been collected from Fremantle Harbour since 2001 as part of MQMP which has involved annual monitoring of sediments at locations within Fremantle Ports waters, including the Inner Harbour and Entrance Channel, where the maintenance dredging is proposed.

The MQMP looks at a wide range of environmental parameters in addition to sediment quality and provides a long-term assessment of the environment of the Port of Fremantle. The MQMP has ten sampling locations in the Fremantle Inner Harbour and Entrance Channel. Divers collect sediment cores which are tested for nitrogen, phosphorus, heavy metals, tributyltin, hydrocarbons and organochlorine pesticides.

Sediments of Inner Harbour sites sampled as part of the annual Marine Quality Monitoring Program (MQMP) are within Environmental Quality Criteria. The Environmental Quality Criteria adopted for review of the sediment results are the same as implemented for the MQMP (Table 2.1) If there is an exceedance of the MQMP environmental criteria the dredging operations will be assessed and this DEMP shall be revised for the next campaign of dredging operations in subsequent years.

3 Roles and responsibilities

The roles and responsibilities for the implementation of the management-based and outcome-based provisions detailed in Section 2 of this DEMP are summarised in Table 3.1.

Table 3.1 Roles and responsibilities of the Inner Harbour Maintenance Dredging Environmental Management Plan

Role	Responsibility
Proponent (Fremantle Ports Manager Environment)	<ul style="list-style-type: none"> Responsible for the overall implementation and compliance of this Dredging Environmental Management Plan (DEMP) Responsible for the annual review and change of the DEMP and consulting with relevant stakeholders. Responsible for ensuring the DEMP and results of monitoring are made publicly available on Fremantle Ports website. Responsible for liaison with the relevant environmental regulators and stakeholders, as required. Responsible to undertake reporting to regulatory authorities in accordance with the conditions of any approvals.
Proponent Fremantle Ports Senior Environmental Advisor (reports to Manager Environment)	<ul style="list-style-type: none"> Responsible for the management of the Environmental Consultant. Accountable for implementation and compliance with the relevant items of this Dredging Environmental Management Plan (DEMP) Accountable for the annual review and change of the DEMP and consulting with relevant stakeholders. Accountable for ensuring the DEMP and results of monitoring are made publicly available on Fremantle Ports website. Accountable for liaison with the relevant environmental regulators and stakeholders, as required. Accountable to undertake reporting to regulatory authorities in accordance with the conditions of any approvals.
Proponent Fremantle Ports Port Hydrographer (reports to Harbour Master)	<ul style="list-style-type: none"> Responsible for the management of the Contractor (Dredge Vessel) Accountable for implementation and compliance with the relevant items of this Dredging Environmental Management Plan (DEMP) Consulted for liaison with the relevant stakeholders, as required.
Environmental Consultant (Field Lead)	<ul style="list-style-type: none"> Responsible for the provision of specialist environmental advice, as required. Responsible for the implementation and compliance with the relevant items of this DEMP.
Contractor (Dredge Vessel Master)	<ul style="list-style-type: none"> Selected contractor/s engaged to undertake all, or part, of the dredging and sediment disposal. Responsible for the implementation and compliance with the relevant items of this DEMP.

4 Adaptive Management and Review

4.1 Adaptive management

Adaptive management is a systematic process for improving management practices by using the outcomes of monitoring and evaluation and incorporating learnings from these outcomes into revised management actions as necessary.

In relation to this DEMP, the Proponent is committed to:

- implementing the environmental management and monitoring actions outlined in Section 2 during the first round of dredging planned for April 2024, targeting a total volume of 60,000m³ of sediment to be removed from Inner Harbour and Entrance Channel.
- evaluating the results of the first round of monitoring during the dredging planned for April 2024 against the environmental protection objectives and outcomes in accordance with the timings and frequencies described in Section 2
- adjusting monitoring or management actions to subsequent years of dredging (2025 to 2029), in which the total volume to be removed is 5,000 m³ per year), if required, to meet the environmental protection management or outcomes defined in Section 2.

4.2 Reporting and auditing

Reporting against the environmental criteria for evaluation against the environmental protection outcomes in Table 2.1 (Outcome-based provisions) and the management targets for evaluation against the environmental protection objectives in Table 2.2 (Management-based provisions) will be included in a DEMP compliance report prepared by the Environmental Consultant and provided to Fremantle Ports within 3 months of Project completion.

Fremantle Ports are committed to undertake reporting to regulatory authorities in accordance with the conditions of any approvals.

4.3 Environmental management framework

Fremantle Ports operates an Environmental Management System (EMS) that is independently audited annually and certified to the International ISO 14001 Standard. This system helps ensure environmental impacts of operations are identified and minimised; requires identification of objectives and targets, and measurement of performance; assists us to comply with environmental legislation; and continual improvement.

Fremantle Ports' Marine Environmental Management Framework (MEMF) (BMT, 2020) provides direction to Fremantle Ports' marine environmental management responsibilities with respect to:

- identifying key risks to the marine environment, including dredge sediments and approaches to managing those risks in a manner that meets government and stakeholder expectations.
- setting specific environmental objectives and environmental targets for each key aspect of Fremantle Ports operations.
- identifying Fremantle Ports' monitoring and management programs that are in place to ensure environmental risks are being appropriately managed.
- ensuring that decision-making frameworks are in place for when environmental quality targets are not met.

- setting a schedule of evaluation and improvement for each of Fremantle Ports' environmental management programs.

Fremantle Ports Annual Marine Quality Monitoring Program (MQMP) has been in place since August 2001 with aim to assess the environmental impacts of port related activities. Sediment quality data has been collected from Fremantle Harbour since 2001 as part of Fremantle Ports Marine Quality Monitoring Program (MQMP) which has involved bi-annual monitoring of sediments at locations within Fremantle Ports waters, including the Inner Harbour and Entrance Channel, where the maintenance dredging is proposed. The MQMP looks at a wide range of environmental parameters in addition to sediment quality and provides a long-term assessment of the environment of the Port. These surveys can provide a useful check on whether sediment contamination changes during the five-year life of the proposed permit, presents any risk to the environment and if the sediment remains suitable for unconfined ocean disposal. The sediments are tested for nitrogen, phosphorus, heavy metals, tributyltin, hydrocarbons and organochlorine pesticides.

In line with the EMS and MEMF, Fremantle Ports is committed to use data from the MQMP to inform annual maintenance dredging campaigns (Section 2.3.10 and Table 2.1).

4.4 Review

The DEMP is proposed for revision following the main dredging campaign, and then on an annual basis. Review of this DEMP will be undertaken during the first and main dredging campaign of 60,000 m³ proposed to be undertaken in April 2024, and then during the four subsequent dredge campaigns in 2025 to 2029. It is considered that review and revision of this DEMP should occur in response to the following circumstances:

- further knowledge becomes available on environmental management or monitoring practices to more effectively meet the environmental protection management or outcomes (e.g. Recommendations in the DEMP compliance report).
- further knowledge becomes available in relation to identified potential environmental impacts associated with the Project (e.g. Sediment monitoring results identified in the annual MQMP).
- new potential environmental impacts associated with the Project are identified (e.g. Sediment monitoring results identified in the annual MQMP).
- there are significant changes to the dredging and/or disposal methods (e.g. Change to Fremantle Ports' operations or availability of dredge vessel).
- to address any conditions imposed by relevant regulatory authorities (e.g. Conditions of the Sea Dumping Permit).
- if required to address any concerns identified by stakeholders (e.g. Complaints management).

Upon review and revision of this DEMP, the changes made will be documented in a document revision register to be appended to the DEMP and the revision status of the document will be updated and changes communicated to relevant stakeholders as required.

The diagram of the adaptive management and review of DEMP is presented in Figure 4.1.

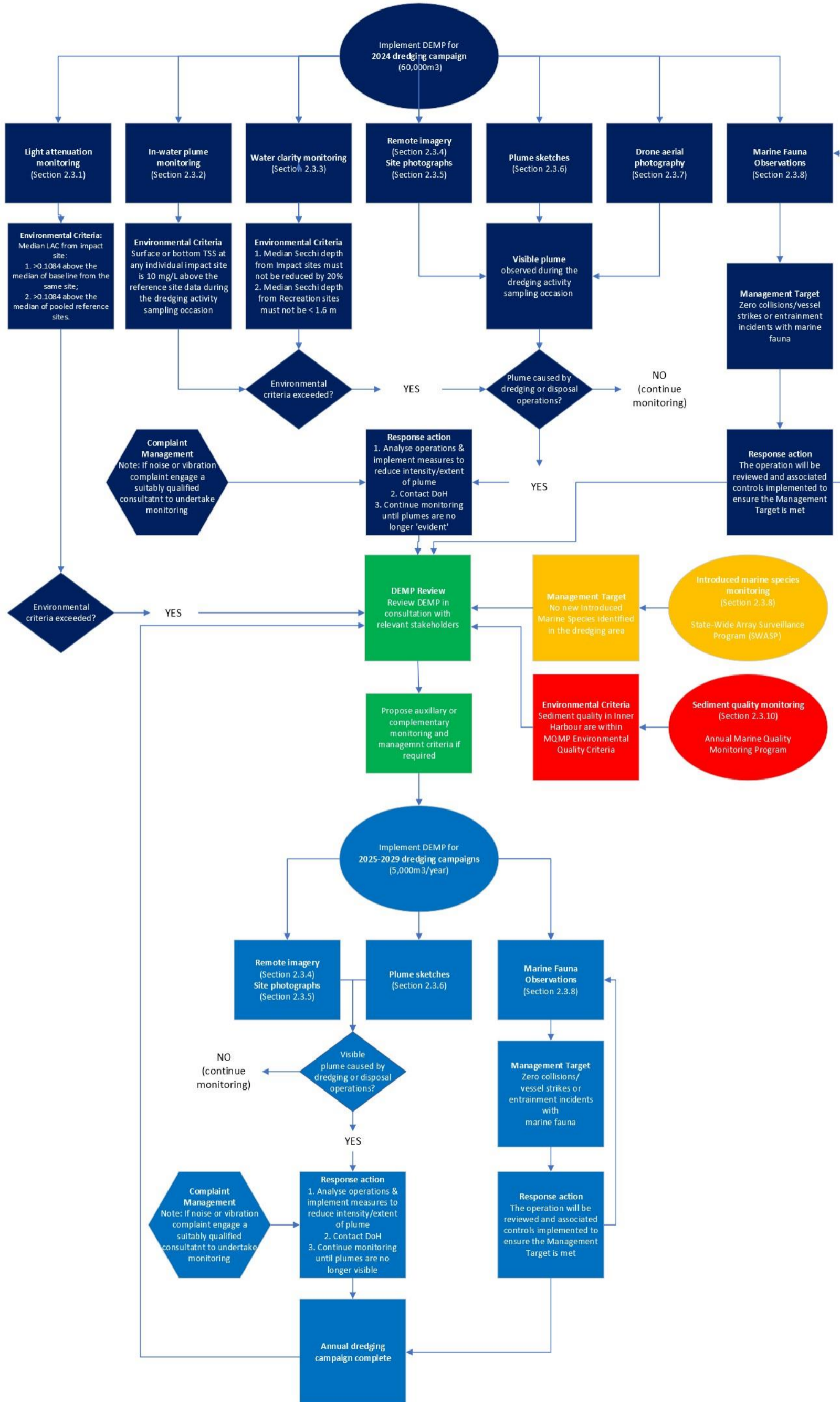


Figure 4.1 Diagram of adaptive management and review of DEMP

5 Stakeholder Consultation

The Proponent has completed stakeholder consultation for the Project including relevant regulatory, industry and community stakeholders. For a description of the stakeholder consultation process, refer to Fremantle Ports Communications Plan for the Project.

Stakeholder consultation in relation to this DEMP will occur before, during and after the implementation of the Project. The Proponent will develop and maintain a complaint register for the Project with responses provided to any public complaints within 1 week of receipt as detailed in Table 2.2. In the event of a complaint or an environmental incident, the incident will be managed in line with Fremantle Ports' Incident and Complaints Management procedures. Incidents and complaints will be investigated and where relevant corrective actions identified to prevent reoccurrence. The relevant regulatory authorities and/or stakeholders will be notified and consulted with as required.

In the review of the DEMP, consultation with the following stakeholders will occur:

- Commonwealth Department of Climate Change, Energy, the Environment and Water.
- Western Australia (WA) Department of Water and Environmental Regulation (DWER) EPA Services and DWER Marine Ecosystems Branch.
- WA Department of Biodiversity Conservation and Attractions Rivers and Estuaries Branch
- WA Department of Health.
- Fremantle Ports Inner Harbour Community Liaison Group.
- WA Whadjuk Aboriginal Corporation.
- Other stakeholders noted in the Communications Plan as required relevant to the changes made.

Fremantle Ports is committed to inform identified stakeholders (detailed in the Communications Plan including Fremantle Ports Inner Harbour Community Liaison Group) of the commencement date of dredging.

6 References

BMT (2020) Fremantle Ports Marine Environmental Management Framework (MEMF). Prepared for Fremantle Ports by BMT Commercial Australia Ltd Pty, Report No. R-1608_00-1. Perth, Western Australia, May 2020.

BMT (2021) Benthic Habitat Mapping for Inner Harbour Maintenance Dredging Project, Prepared for Fremantle Ports by BMT Commercial Australia Ltd Pty. Perth, Western Australia, June 2021.

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BMT (2022b) Fremantle Ports Inner Harbour Maintenance Dredging – Dredge Plume Modelling. Prepared for Fremantle Ports by BMT Commercial Australia Ltd Pty, Report No. R-11513-4 Perth, Western Australia, September 2022.

BMT (2023a) Benthic Habitat Mapping Technical Note Inner Harbour Maintenance Dredging Project Prepared for Fremantle Ports by BMT Commercial Australia Ltd Pty. Perth, Western Australia, August 2023.

BMT (2023b) Fremantle Ports Inner Harbour Maintenance Dredging – Variation for Plume Modelling - Technical Note. Prepared for Fremantle Ports by BMT Commercial Australia Ltd Pty. Perth, Western Australia, December 2023.

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Collier CJ, Lavery PS, Ralph PJ, Masini RJ (2009) Shade-induced response and recovery of the seagrass *Posidonia sinuosa*. *Journal of Experimental Marine Biology and Ecology* 370:89– 103

EPA (2016a) Environmental Factor Guideline – Marine Environmental Quality. Environmental Protection Authority, Perth, Western Australia, December 2016

EPA (2017) Environmental Quality Criteria Reference Document for Cockburn Sound – A Supporting Document to the State Environmental (Cockburn Sound) Policy 2015. Environmental Protection Authority, Perth, Western Australia, April 2017

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EPA (2021b) Technical Guidance – Environmental impact assessment of marine dredging proposals, EPA, Western Australia, September 2021

EPA (2021c) Environmental outcomes and outcomes-based conditions: Interim Guidance. Environmental Protection Authority, Perth, Western Australia, October 2021

Fremantle Ports (2018) Port Information Guide. Fremantle Port. Available at <<https://www.fremantleports.com.au/shipping>> [Accessed 6 August 2021]

Lavery PS, McMahon K, Mulligan M, Tennyson A (2009) Interactive effects of timing, intensity and duration of experimental shading on *Amphibolis griffithii*. *Marine Ecology Progress Series* 394:21–33






























Lavery P, McMahon K, Statton J, Vanderklift M, Strydom S, Kendrick G. (2019) Synthesis Report: Defining thresholds and indicators of primary producer response to dredging-related pressures. Report of Theme 5 prepared for the Dredging Science Node, Western Australian Marine Science Institution, Perth, Western Australia. 32 pp

O2M (2022) Supplementary Sampling and Analysis Plan Implementation Report: Fremantle Port Authority Maintenance Dredging. Prepared for Fremantle Ports by O2M, Perth, Western Australia, July 2022.



Annex A Secchi Depth Measurement Field Sheet

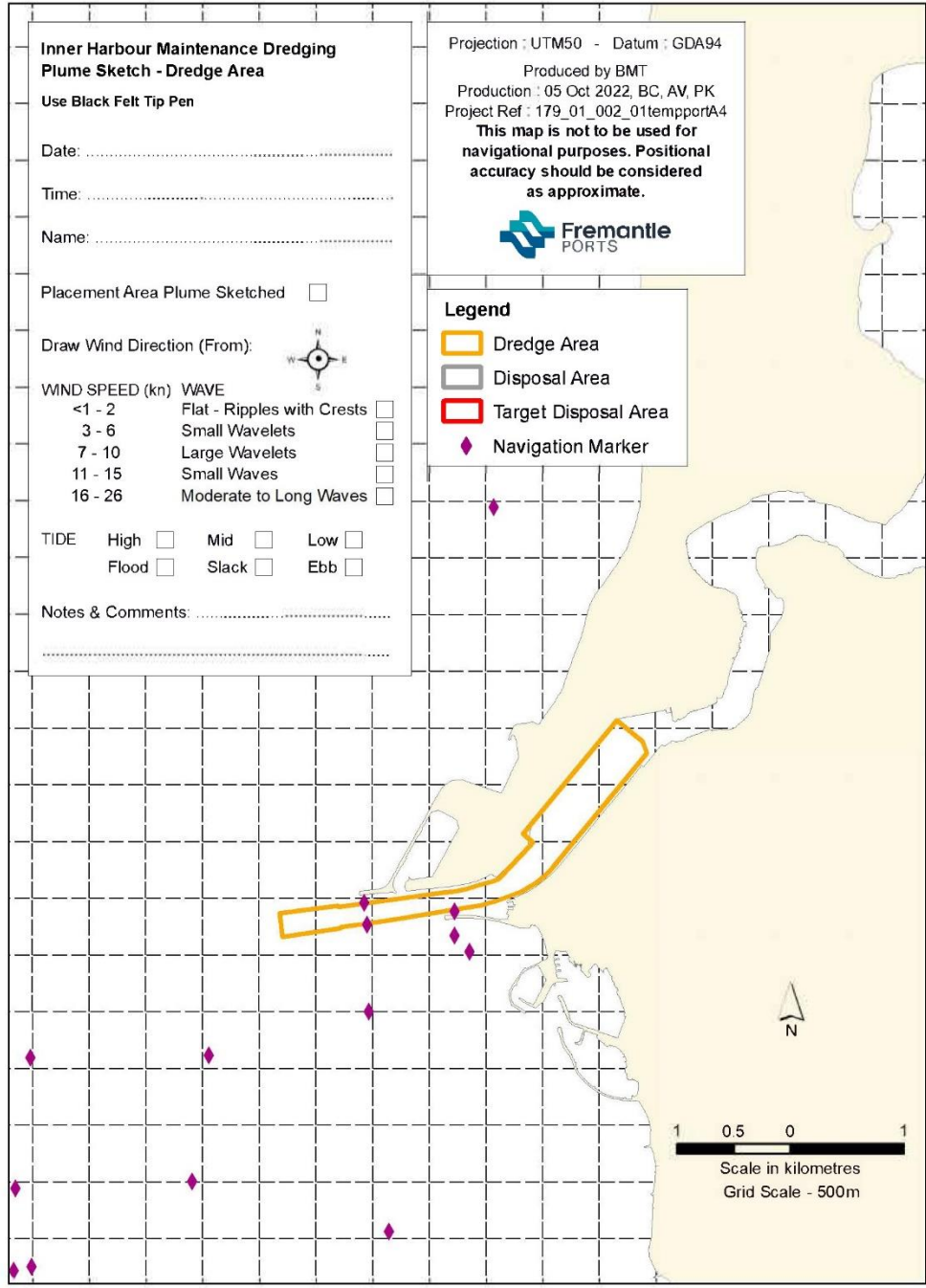
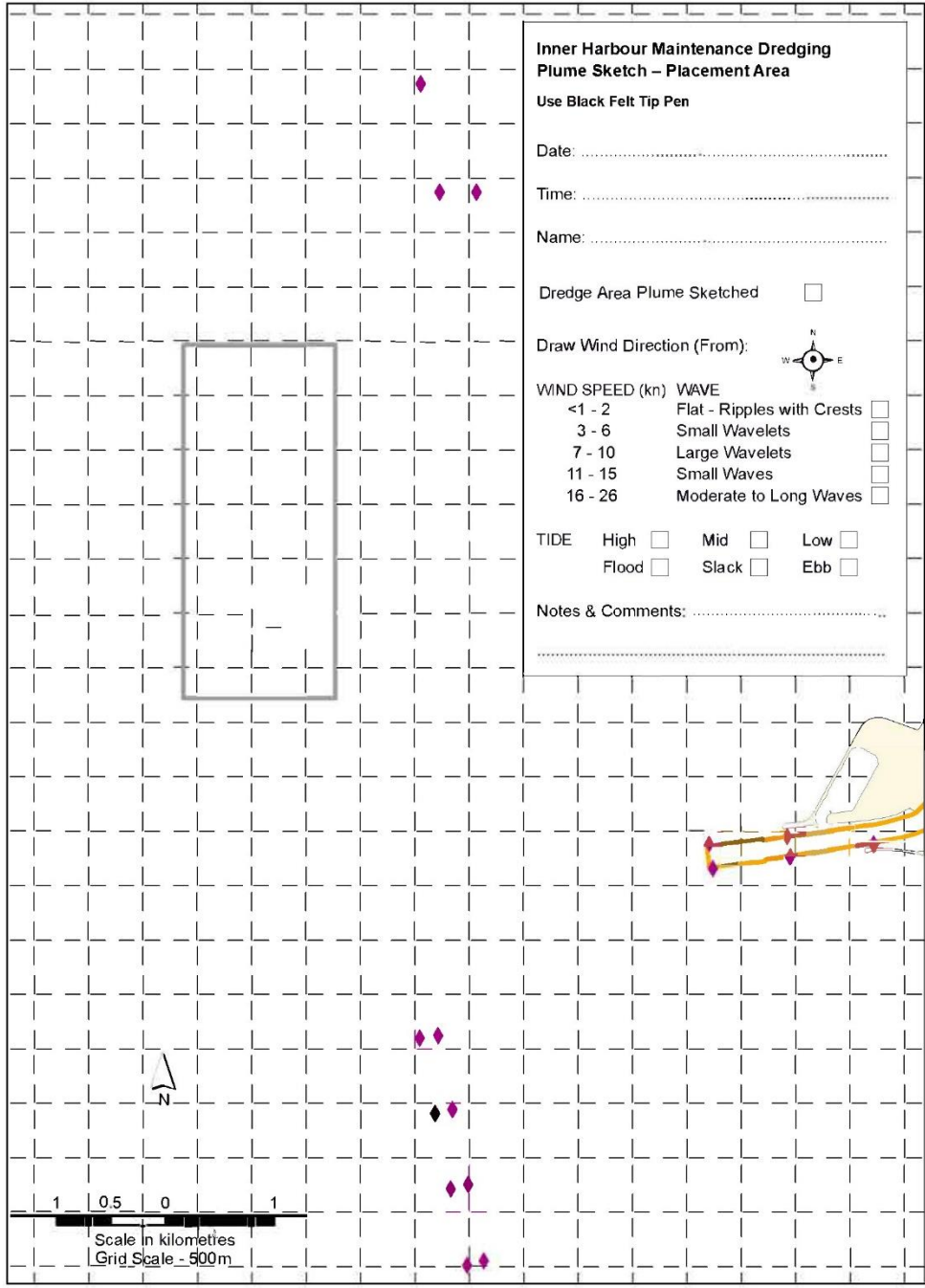
Client		Project #	
Field date(s)		Project title	
Location		Job description	
Personnel		Vessel	

FLAG and NAME	Spoken	Written	FLAG and NAME	Spoken	Written	FLAG and NAME	Spoken	Written
 A	ALFA	A	 M	MIKE	M	 Y	YANKEE	Y
 B	BRAVO	B	 N	NOVEMBER	N	 Z	ZULU	Z
 C	CHARLIE	C	 D	OSCAR	D	 1	ONE	1
 D	DELTA	D	 P	PAPA	P	 2	TWO	2
 E	ECHO	E	 Q	QUEBEC	Q	 3	THREE	3
 F	FOXTROT	F	 R	ROMEO	R	 4	FOUR	4
 G	GOLF	G	 S	SIERRA	S	 5	FIVE	5
 H	HOTEL	H	 T	TANGO	T	 6	SIX	6
 I	INDIA	I	 U	UNIFORM	U	 7	SEVEN	7
 J	JULIETT	J	 V	VICTOR	V	 8	EIGHT	8
 K	KILO	K	 W	WHISKEY	W	 9	NINE	9
 L	LIMA	L	 X	XRAY	X	 0	ZERO	0

Force	Description	Specification for use at sea*	Equivalent speed at 10 metres above sea level				Description in forecast	State of sea	Probable height of waves* /metres
			Mean		Limits				
			/knots	/ms ⁻¹	/knots	/ms ⁻¹			
0	Calm	Sea like a mirror	0	0.0	<1	0.0 to 0.2	Calm	Calm	0.0
1	Light air	Ripples with the appearance of scales are formed, but without foam crests	2	0.8	1 to 3	0.3 to 1.5	Light	Calm	0.1 (0.1)
2	Light breeze	Small wavelets, still short but more pronounced. Crests have a glassy appearance and do not break	5	2.4	4 to 6	1.6 to 3.3	Light	Smooth	0.2 (0.3)
3	Gentle breeze	Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered white horses	9	4.3	7 to 10	3.4 to 5.4	Light	Smooth	0.6 (1.0)
4	Moderate breeze	Small waves, becoming longer, fairly frequent white horses	13	6.7	11 to 16	5.5 to 7.9	Moderate	Slight	1.0 (1.5)
5	Fresh breeze	Moderate waves, taking a more pronounced long form; many white horses are formed. Chance of some spray	19	9.3	17 to 21	8.0 to 10.7	Fresh	Moderate	2.0 (2.5)
6	Strong breeze	Large waves begin to form; the white foam crests are more extensive everywhere. Probably some spray	24	12.3	22 to 27	10.8 to 13.8	Strong	Rough	3.0 (4.0)
7	Near gale	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind	30	15.5	28 to 33	13.9 to 17.1	Strong	Very rough	4.0 (5.5)
8	Gale	Moderate high waves of greater length; edges of crests begin to break into spindrift. The foam is blown in well-marked streaks along the direction of the wind	37	18.9	34 to 40	17.2 to 20.7	Gale	High	5.5 (7.5)
9	Strong gale	High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility	44	22.6	41 to 47	20.8 to 24.4	Severe gale	Very high	7.0 (10.0)
10	Storm	Very high waves with long over-hanging crests. The resulting foam, in great patches, is blown in dense white streaks along the direction of the wind. On the whole the surface of the sea takes on a white appearance. The 'tumbling' of the sea becomes heavy and shock-like. Visibility affected	52	26.4	48 to 55	24.5 to 28.4	Storm	Very high	9.0 (12.5)
11	Violent storm	Exceptionally high waves (small and medium-sized ships might be for a time lost behind the waves). The sea is completely covered with long white patches of foam lying along the direction of the wind. Everywhere the edges of the wave crests are blown into froth. Visibility affected	60	30.5	56 to 63	28.5 to 32.6	Violent storm	Phenomenal	11.5 (16.0)
12	Hurricane	The air is filled with foam and spray. Sea completely white with driving spray; visibility very seriously affected	-	-	64 and over	32.7 and over	Hurricane force	Phenomenal	14.0 (-)



Annex B Plume Sketch Template





Annex C Environmental Monitoring Checklist Template

Weekly Environmental Monitoring Inner Harbour Maintenance Dredging – Week #X

Environmental monitoring of the Inner Harbour Maintenance Dredging between XX–XX MONTH 20XX is to be in accordance with the Inner Harbour Maintenance Dredging Environmental Management Plan (DEMP; BMT 2022). See table and comments below for results of the required environmental monitoring tasks.

Environmental Monitoring Checklist

Monitoring task	Monday (XX/XX/20XX)		Tuesday (XX/XX/20XX)		Wednesday (XX/XX/20XX)		Thursday (XX/XX/20XX)		Friday (XX/XX/20XX)		Saturday (XX/XX/20XX)		Sunday (XX/XX/20XX)	
	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?
Plume sketch (dredging area)														
Plume sketch (placement area)														
Remote imagery (placement area)														
Site photograph (dredging area)														
Site photograph (placement area)														
Dredge position log														

Monitoring task	Monday (XX/XX/20XX)		Tuesday (XX/XX/20XX)		Wednesday (XX/XX/20XX)		Thursday (XX/XX/20XX)		Friday (XX/XX/20XX)		Saturday (XX/XX/20XX)		Sunday (XX/XX/20XX)	
	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?	Received?	Correct?
Placement position log														
Marine fauna observation log														
Marine fauna interaction log														
Secchi depth measurements														

Notes:

1. **Red text** indicates a non-conformance with requirements outlined in the DEMP (BMT 2021)
2. **Red italicised text** indicates partial non-conformance with requirements outlined in the DEMP (BMT 2021)
3. **Black bold text** indicates that data was not collected for a valid reason e.g. non-operational machinery, poor weather
4. 'N/A' indicates there was no requirement for data to be collected in accordance with the requirements of the DEMP (BMT 2021)

Comments on environmental monitoring non-conformances:

Comments on other environmental issues:

Environmental monitoring data still to be received:

References:

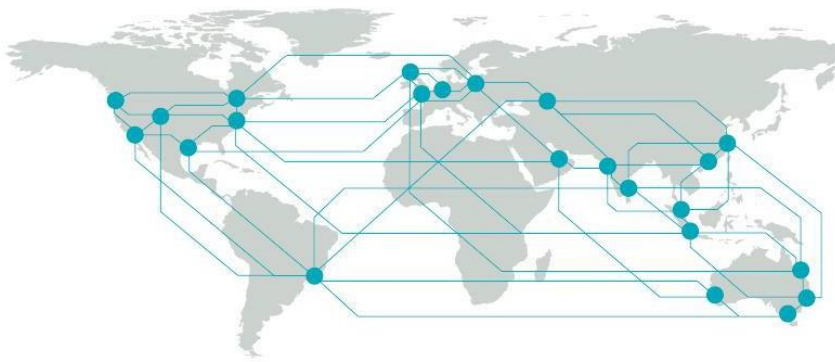
BMT (2022) Inner Harbour Maintenance Dredging Environmental Management Plan. Prepared for Fremantle Ports by BMT Commercial Australia Pty Ltd, Report No. R-11513-6, Perth, Western Australia, October 2022.



Annex D Marine Fauna Observation and Interaction Logs

Date		Location		Page #		Of	
MFO(s)		Skipper		Vessel			
Shift start time		Operation in progress at shift start	<input type="checkbox"/> Dredging <input type="checkbox"/> Dumping <input type="checkbox"/> Transit	Shift end time			
Interactions this shift?	<input type="checkbox"/> Y <input type="checkbox"/> N	If yes, how many interaction logs?					

Position			Pod Information								Comments Behaviour observed (swim speed, direction change)	Weather Conditions							Relative bearing – bow of the vessel is 0° Actual swim direction Where the fauna is headed, N, S, E, W – based on true north Fauna type: HB - Humpback WH - Other whale T - Turtle DO - Dolphin DU - Dugong S - Shark U - Unknown Glare levels: 0 – No glare 1 – Gentle glare 2 – Brighter glare 3 – Mirror like glare Visibility: 0 – No visibility 1 – Limited visibility 2 – Visibility ok 3 – Visibility perfect		
GPS Waypoint	Time	Vessel Heading(°)	Cue	Relative Bearing	Distance	Actual Swim dir.	Fauna type	# of fauna	Pod number	Observer (initials)		Glare			Sea state	Wind speed (kts)	Wind direction	Cloud cover (0-8)		Swell	Visibility (0-3)
												From	To	Strength (1-3)							



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