Lumsden Point General Cargo Facility

Construction and Dredge Management Plan

301012-01660 – DMP-REP-01

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PROJECT 301012-01660 - LUMSDEN POINT GENERAL CARGO FACILITY

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CUSTOMER APPROVAL	DATE
A	Issued for internal review	A Byron	P Mellor	N/A	30 May 2013	N/A	
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ACRONYMS

ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ANZECC	Australian and New Zealand Environment Conservation Council
AQIS	Australian Quarantine Information System
BPP	Benthic Primary Producer
BPPH	Benthic Primary Producer Habitat
BHPBIO	BHP Billiton Iron Ore
CRIMP	Centre for Research on Introduced Marine Pests
CD	Chart Datum
CAMBA	China-Australia Migratory Bird Agreement
CDMP	Construction and Dredge Management Plan
CNMP	Construction Noise Management Plan
CLGs	Cumulative Loss Guidelines
DEC	Department of Environment and Conservation
DER	Department of Environment Regulation
DoE	Department of Environment
DPW	Department of Parks and Wildlife
DMMA	Dredge Material Management Area
EAG	Environmental Assessment Guideline
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPBC Act	Environmental Protection and Biodiversity Act 1999 (Cwlth)
EPA	Environmental Protection Authority
FTP	File Transfer Protocol
FIC	Finucane Island
FMG	Fortescue Metal Group
ha	Hectare
IMO	International Maritime Organisation
JAMBA	Japan-Australia Migratory Bird Agreement

KPIs	Key Performance Indicators
LAI	Leaf Area Index
LAU	Local Assessment Unit
MGA	Map Grid Australia
MPL	Marapikurrinya Pty Ltd
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric Turbidity Units
NOx	Nitrate and Nitrite
P	Phosphorous
PCBs	Polychlorinated Biphenyls
PAHs	Polycyclic Aromatic Hydrocarbons
PHPA	Port Hedland Port Authority
ROKAMBA	Republic of Korea-Australia Bird Agreement
SKM	Sinclair Knight Merz
SWC	South West Creek
SEC	South East Creek
SRC	Stingray Creek
SOx	Sulfates and Sulfides
SSC	Suspended Sediment Concentrations
TMF	Tiered Management Framework
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
VOCs	Volatile Organic Compounds
WA	Western Australia
WAPC	Western Australia Planning Commission

1. INTRODUCTION

1.1 Project Overview

The Port Hedland Port Authority (PHPA) has identified Lumsden Point as a potential site to develop a General Cargo Facility both to alleviate trade growth pressures on berths 1, 2 and 3 and to accommodate potential marine supply trades supporting the offshore oil and gas and other industries.

The facility will focus primarily on the import of general cargo goods such as containers, cement and ammonium nitrate, and is being developed to ease congestion at the port's current general cargo berths in response to significant growth associated with expansion in the iron ore mining sector.

The proposed works the Lumsden Point General Cargo Facility (the project) will include:

- two Handymax berths totalling a length of 500 m;
- dredging of up to -13.5 m CD for the berth pocket;
- dredging of up to -12.0 m CD for the access channel;
- causeway access along an existing land-based connection;
- an area of land immediately behind the berths; and
- disposal of dredge spoil onshore to an approved Dredge Material Management Area (DMMA).

A general layout of the Lumsden Point General Cargo Facility is provided in Figure 1.

The project is located at Lumsden Point, which is situated at the junction of South East Creek and South Creek within Port Hedland port's inner harbour (Figure 1). It is located approximately 5 km south of the Port Hedland townsite and adjoins the existing light industrial area of Wedgefield. The FMG Anderson Point port facility, iron stockpile and offloading facilities are to the west of the project and DMMAs B and C are located to the south.

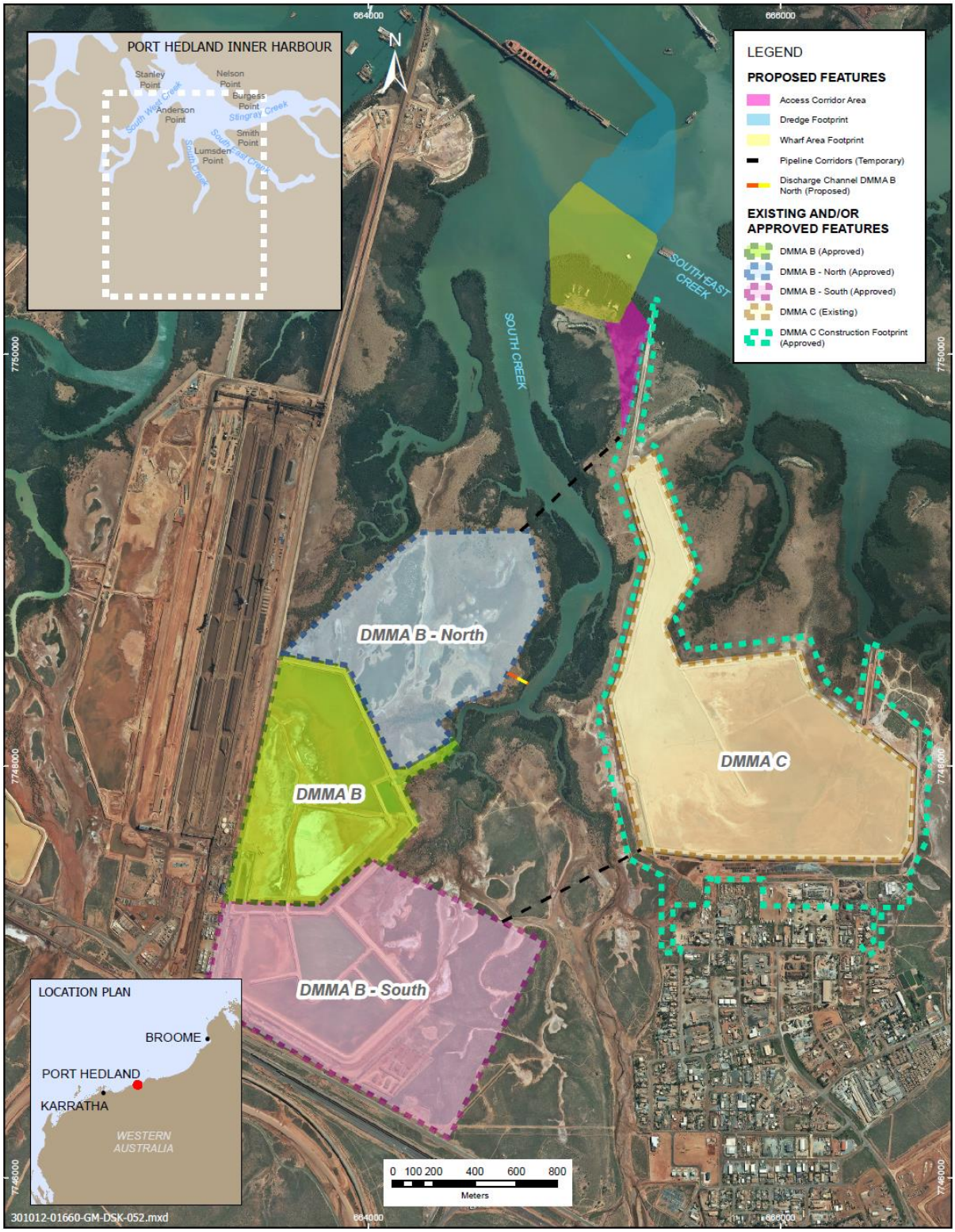


Figure 1: General layout of the proposed Lumsden Point General Cargo Facility

1.2 Objectives

The objective of this Construction and Dredging Management Plan (CDMP) is to provide a framework for the environmental management of construction and dredging activities. It is designed to minimise the environmental risks to a level that is as low as reasonably practical.

This CDMP presents the potential impacts, management measures, objectives and actions with the associated key performance indicators (KPIs) to be implemented throughout the project. The plan outlines the proposed monitoring and inspection programs to assess any environmental impacts of the Lumsden Point General Cargo Facility and allows for the effective and timely implementation of contingency measures, if required.

1.3 Plan revision and distribution

If a significant change in the duration or nature of the construction and dredging works occurs, this CDMP will be reviewed. The review will include a reassessment of the environmental risks posed by the works and the corresponding management strategies.

If the CDMP becomes a condition of any statutory approval, any significant revision to the CDMP will need to be approved by the relevant regulatory authorities.

2. ROLES AND RESPONSIBILITIES

The PHPA is responsible for implementing the proposal and adhering to the commitments made within this CDMP. Table 1 identifies the responsibilities associated with the key management positions during dredging activities.

Table 1: Roles and Responsibilities

Element	Description
Project Manager	• Overall responsibility for implementation of the CDMP. • Overall responsibility for compliance with statutory requirements.
Construction Manager	• Day-to-day implementation of the CDMP. • Directs construction contractors with respect to environmental controls. • Day-to-day coordination of the Project. • Ensures adequate training of all staff within area of responsibility.
Dredging Contractor – Project Manager	• Prepares and implements an EMP in accordance with the requirements of this CDMP and the existing PHPA EMP. • Implements the management actions as required. • Ensures adequate training of all staff within area of responsibility. • Ensures all equipment is adequately maintained and correctly operated.
Environmental Coordinator	• Provides advice on dredging, dredge material management and construction-related environmental issues. • Oversees implementation of environmental controls, monitoring programs, inspections and audits. • Completes compliance reporting requirements. • Coordinates the training and induction process. • Implements the environmental monitoring programs and inspections. • Prepares environmental monitoring reports. • Provides advice with respect to environmental issues as required.
All persons involved in project	• Comply with the requirements of this CDMP. • Comply with all legal requirements under the approvals documents and relevant Acts. • Exercise a duty of care to the environment at all times. • Report all environmental incidents.

3. LEGISLATIVE REQUIREMENTS AND GUIDELINES

3.1 International conventions and agreements

International agreements applicable to this CDMP may include, but are not limited to:

- The 1996 London Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (ratified by Australia in 2000);
- The International convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78) (International Maritime Organisation);
- The International Convention for the Control and Management of Ships' Ballast Water and Sediments (International Maritime Organisation (IMO);
- United Nations Convention of the Law of the Sea;
- ANZECC Code of Practice for Antifouling and In-water Cleaning and Maintenance;
- The Convention on the Conservation of Migratory Species of Wild Animals (Secretariat of the Convention for the Conservation of Migratory Species of Wild Animals 1979);
- Japan-Australia Migratory Bird Agreement (JAMBA), 1974;
- China-Australia Migratory Bird Agreement (CAMBA), 1986; and
- Republic of Korea-Australia Bird Agreement (ROKAMBA), 2002.

3.2 Commonwealth legislation and guidelines

3.2.1 Environment Protection and Biodiversity Conservation 1999 (EPBC Act)

The EPBC Act establishes a process for the assessment and approval of proposed actions that are likely to have a significant impact on matters of national environmental significance or on Commonwealth land. Possible impacts on endangered species or listed migratory species may trigger the Act.

The Lumsden Point General Cargo Facility is not expected to significantly impact on any matters of national environmental significance and therefore has not been referred to the Commonwealth Environment Minister for approval under the EPBC Act.

3.2.2 Australian and New Zealand guidelines for fresh and marine water quality (ANZECC/ARMCANZ 2000)

The Australian and New Zealand guidelines for fresh and marine water quality (ANZECC/ARMCANZ 2000) advise on activities that may affect water quality. These guidelines provide criteria for establishing levels of ecological protection for marine areas based on existing levels of disturbance, but also recommend deferring to locally developed consultative guidelines where they exist and are relevant.

3.2.3 Other Commonwealth legislation

Other applicable Commonwealth legislation and guidelines include, but are not limited to, the following Acts, Regulations (and relevant amendments):

- Australian Quarantine Regulations 2000;
- *Dangerous Substances Act 2004*;
- *Fisheries Act 1952*;
- *Marine Act 1982*;
- *National Environment Protection Council Act 1994*;
- *National Environmental Protection Measures (Implementation) Act 1998*;
- Navigable Waters Regulations 1958;
- Port and Harbour Regulations 1966;
- *Protection of the Seas (Prevention of Pollution from Ships) Act 1983*;
- Australian Ballast Water Management Requirements 2001;
- *Quarantine Act 1908*;
- *Seas and Submerged Lands Act 1973*;
- National Strategy for Ecologically Sustainable Development (Commonwealth Government of Australia 1992b);
- National Water Quality Management Strategy (Commonwealth Government of Australia 1992c);
- Intergovernmental Agreement on the Environment (Commonwealth Government of Australia 1992a); and
- National Strategy for Conservation of Australia's Biological Diversity (Commonwealth of Australia 1996).

3.3 State legislation

The key Western Australian legislation and regulations relevant to the construction of the Lumsden Point General Cargo Facility includes:

- *Environmental Protection Act 1986*; and
- Environmental Protection Regulations 1987.

Other legislation and regulations that may also apply to the project include:

- *Aboriginal Heritage Act 1972*;
- Environmental Protection (Clearing of Native Vegetation) Regulations 2004;
- Environmental Protection (Noise) Regulations 1997;
- *Fish Resources Management Act 1994;*

- *Main Roads Act 1930;*
- *Marine and Harbours Act 1981;*
- *Native Title (State Provisions) Act 1999;*
- *Pollution of Waters by Oil and Noxious Substances Act 1987;*
- *Port Authorities Act 1999;*
- *Shipping and Pilotage Act 1987;*
- *Western Australian Marine Act 1982*; and
- *Wildlife Conservation Act 1950.*

3.4 State guidelines

Key state legislation and guidelines applicable to the proposed Lumsden Point General Cargo Facility are discussed below.

3.4.1 Environmental Protection Authority (EPA) *Guidance Statement no. 1: Protection of tropical arid zone mangroves along the Pilbara coastline*

Guidance Statement No. 1(EPA 2001) categorises Port Hedland as being covered by 'Management Area 4: Other mangrove areas — inside designated industrial areas and associated port areas'. The mangrove areas specified are defined as occurring inside areas that have been designated as industrial areas, associated ports or other development and not covered by EAG3.

The EPA's operational objective for 'Management Area 4' is that the impacts of development on mangrove habitat and their ecological function in these areas should be reduced to the minimum practicable level.

3.4.2 EPA Environmental Assessment Guideline no.3: *Protection of benthic primary producer habitats In Western Australia's marine environment* (EAG3)

EAG3 (EPA 2009a) specifically applies to development projects that are predicted to result in irreversible loss of or serious damage to marine benthic primary producer habitat (BPPH) in state waters. This guideline defines and recognises the fundamental ecological importance of benthic primary producers (BPP) and their habitats, and provides a framework for assessing environmental impacts on BPPH. The risk-based spatial assessment framework provides the means to evaluate cumulative losses (i.e. historical and proposed losses) of BPPH within defined sub-ecosystem areas called local assessment units (LAUs).

Cumulative loss guidelines (CLGs) are based on six categories of marine ecological protection, which the proponent must apply in the assessment of ecological risks to BPPH associated with a proposal. The Port Hedland industrial unit covers an area of 4,977 ha and has been termed 'Category F' under EAG3 (EPA 2009a; EPA 2009c). However, a more recent

assessment undertaken as part of the Outer Harbour Development proposal suggests that overall loss from the PHLAU may be less than the 10% cumulative loss guideline (EPA 2012).

3.4.3 EPA Environmental Assessment Guideline No. 7: *Environmental assessment guideline for marine dredging proposals* (EAG7)

EAG 7 (EPA 2011a) specifically relates to ensuring that the predicted extent, severity and duration of impacts to benthic habitats associated with significant dredging activities, which are subject to formal environmental impact assessment by the EPA, are presented in a clear and consistent manner. The statement provides guidance on the identification of impacts associated with dredging, using a specified approach to identify areas of high impact, moderate impact and zone of influence through the collection of baseline data. The statement also recommends the development of predictive models to help identify the potential extent of sediment plumes generated as a consequence of dredging and disposal activities.

3.4.4 EPA Environmental Protection Bulletin No.14: *Guidance for the assessment of benthic primary producer habitat loss in and around Port Hedland*

The Office of the EPA has confirmed that different proponents have defined different LAUs for assessing cumulative losses of BPPH within the inner Port Hedland port area via spatial analysis (EPA 2011b). Variation in LAU boundaries among proposals leads to inconsistent application of EAG3 by proponents, which flow through to the EIA process undertaken by the EPA. The overarching aim of this document is to establish a clear and common starting point for the evaluation and accounting of BPPH loss in the inner Port Hedland port area.

3.4.5 Pilbara water quality guidelines

The *Pilbara environmental values and environmental quality objectives* (DoE 2006) specify various environmental values and quality objectives to guide the management of coastal water quality in the region. These values and objectives are presented in Table 3 of the guidelines along with the applicable environmental quality criteria and references to the controls that will be implemented.

3.4.6 Other guidelines

Other applicable guidelines include, but are not limited to the following:

- Environmental Assessment Guideline 1: *Environmental Assessment Guideline for Defining the Key Characteristics of a Proposal Environmental Protection Act 1986* (EAG1) (EPA 2012);
- Environmental Assessment Guideline 6: *Revised Environmental Assessment Guideline for Timelines for environmental impact assessment of proposals* (EAG6) (EPA 2013);
- Environmental Assessment Guideline 8: *Environmental Assessment Guideline for Environmental factors and objectives* (EAG8)(EPA 2013);

- *Guidance statement 8: Environmental noise (draft)* (EPA 2007);
- *Guidance statement 41: Assessment of Aboriginal heritage* (EPA 2004); and
- *Guidance statement 55: Implementing best practice in proposals submitted to the environmental impact assessment process* (EPA 2003).

4. PROJECT DESCRIPTION

4.1 Dredging activities

The Lumsden Point General Cargo Facility involves dredging of the intertidal and subtidal areas of the inner port area of Port Hedland port adjacent to the north of Lumsden Point to establish an access channel, swing basin and berthing pocket. The dredging footprint occurs in an area of shallow bathymetry, ranging from -0 m CD to -10.0 m CD. The site is partially sheltered from wave energy but is subject to high-velocity tidal flow.

The proposed dredging will comprise the following components:

- access channel dredged to a maximum depth of -12.0 m CD;
- berth pockets dredged to a maximum depth of -13.5 m CD;
- swing basin dredged to a depth of -12.0 m with a diameter of 304 m; and
- ancillary seabed disturbance associated with dredging, including dredge anchor and spud placement.

Up to 2 Mm^3 of material will need to be dredged to achieve the required design depths for safe navigation. The volume of material to be dredged includes over-dredging of 0.5 m below the maximum design depth in each dredge pocket. Maximum depth of batters has also been used in finalising a maximum dredge volume and rounded up for contingency purposes. The dredging activities are expected to be conducted over a period of approximately 20 weeks based on a dredge volume rate of 1000 m^3/hour. Dredging is proposed to be undertaken using a single cutter suction dredge.

The indicative extent of dredging required for safe navigation of vessels using the proposed Lumsden Point General Cargo Facility, including the coordinates of the proposed disturbance footprint, is shown in Figure 2.

Dredge material will be transferred via pipelines. The material will consist of both coarse and fine material. While the coarse material will settle out of suspension rapidly and constitute valuable material for reuse onshore for land-backed wharf area, the fine material will either be placed in DMMA C or as a final option be transferred into DMMA B, B North and/or B South.

4.2 Wharf development

The development of the land-backed wharf (Figure 2) located immediately behind the two Handymax berths will require an area of 26.31 ha to be reclaimed. Material for reclamation of this area will be sourced from dredge material within the proposed dredge footprint if considered suitable for reclamation purposes. If the dredge material is unsuitable, then material will be sourced offsite from a location yet to be determined. It is estimated that 28, 663 m^3 of material will be required for reclamation of the area.

The wharf will be constructed through the development of a bund wall constructed from rock sourced offsite. Once the rock wall has been completed, dredge material will be placed

within the bund wall. Following completion of the reclamation area, the wharf structure will be constructed. The wharf will be a deck-on-piles structure. Piles will be driven into the substrate, the formwork established and headstocks/decks poured and set onsite.

4.3 Access corridor

The proposed access corridor will comprise two separate causeway developments between the land-backed wharf and the onshore facilities located within the DMMA C construction boundary. A temporary access area will be developed to provide sufficient access for construction vehicles to move between both areas during construction, while a second permanent corridor will be developed for access to and from the wharf area during operation. Figure 2 provides a map showing the area in which the causeways will be located. At present the exact configuration of the two access corridor routes is undecided, however the footprint will not extend outside the existing outer boundaries displayed in Figure 2.

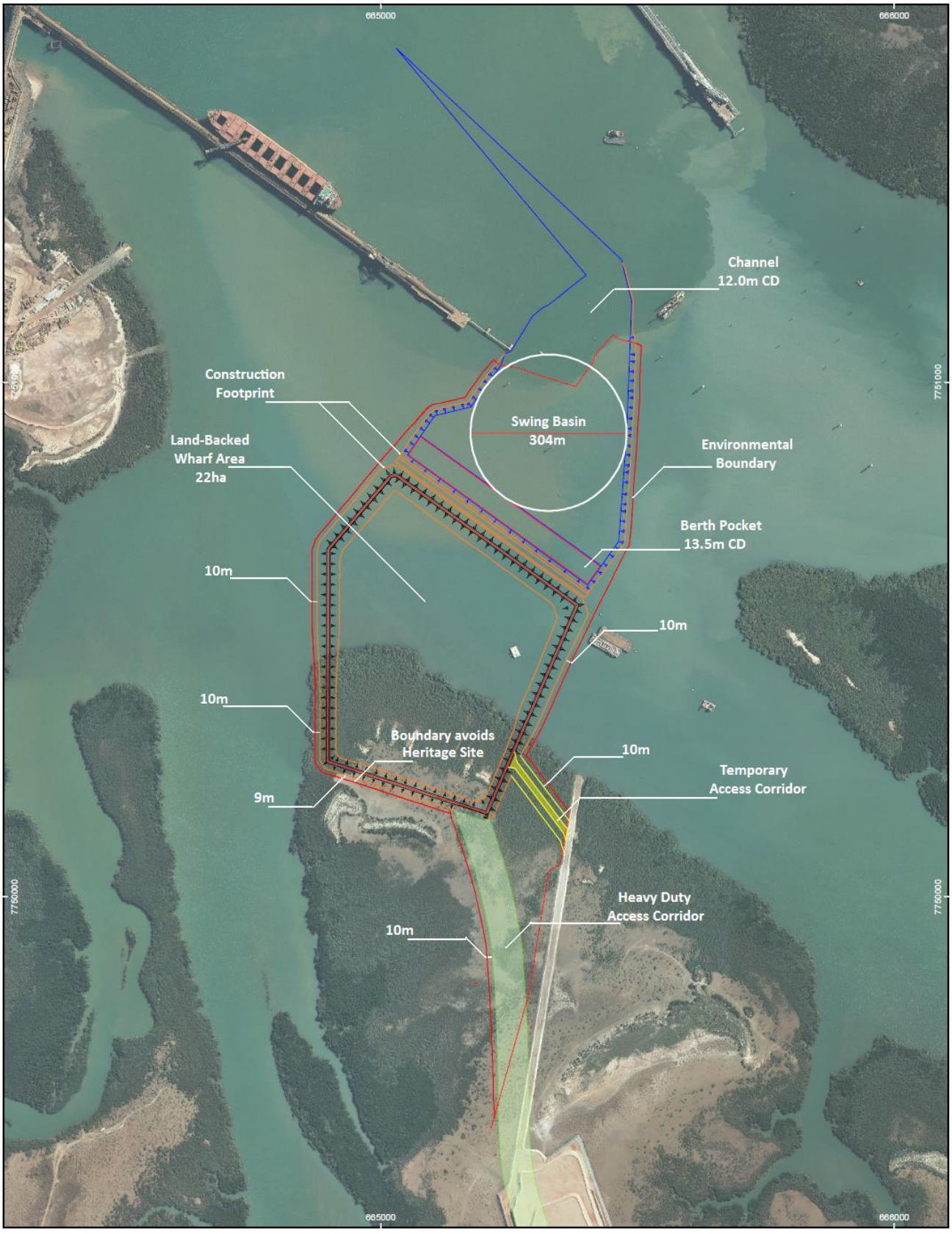


Figure 2: Proposed layout of the dredge footprint, land-backed wharf and access corridor

4.4 Disposal activities

The dredged material will be excavated by cutter suction dredge and transferred to land via pipelines (Figure 3). The material will consist of both coarse and fine material. The fines will be transferred to an approved DMMA, most likely DMMA C.

Figure 3: Cutter suction pipelines at DMMA H as part of BHPBIO's RGP6 expansion

Should fine material not be transferred to DMMA C, the alternative option is to transfer sediment to one of the three additional approved DMMA areas, namely:

- DMMA B – covering an area of 75.35 ha, which was approved under Ministerial Statement 690 for the FMG Pilbara Iron Ore and Infrastructure Project: Port and North-South Railway (Stage A);
- DMMA B North – covering an area of 80.46 ha, which was approved under Ministerial Statement 859 for the PHPA South West Creek Dredging and Reclamation Project; and
- DMMA B South – covering an area of 129.92 ha, which was approved under Ministerial Statement 771 for the FMG third berth project at Anderson Point.

Transfer of silts between the DMMAs may also be required and will assist with remediation of each DMMA to ensure they are safe, stable and suitable for their designated end land use.

Once sediments have been placed within the designated DMMA, sediments will be separated from the seawater by circulating the material between each DMMA. By increasing residence time within the DMMAs, suspended sediments will settle out of the seawater more efficiently. Dewatering from the DMMAs can then occur at the previously approved discharge location within South Creek at the boundary to DMMA B North or DMMA B (Figure 1).

4.5 Pipelines

During dredging activities, dredge material may need to be transferred between DMMAs to reduce water content within the material and/or manage the volume of material between DMMAs. At this stage it is likely that pipelines to transfer material between DMMAs will not be required. However, should pipelines be required, a 5m wide corridor will be established between the wharf area and DMMA B North and/or DMMA C and DMMA B (Figure 1).

5. STUDIES AND EXISTING ENVIRONMENT

5.1 Overview

This section describes the existing marine environment in the Lumsden Point General Cargo Facility disturbance footprint and Port Hedland inner harbour. It summarises information collected by desktop review, in addition to subtidal and marine investigations undertaken for the proposed Lumsden Point General Cargo Facility and for previous projects undertaken within the inner harbour adjacent to the proposed disturbance footprint.

5.2 Key environmental sensitivities

The key environmental sensitivities that could potentially be affected by the proposed construction activities include:

- marine water quality; and
- benthic primary producer habitat.

5.3 Marine parks and reserves

There are no marine parks or reserves in the vicinity of Port Hedland. The proposed Dampier Archipelago Marine Park is the nearest but is 225 km to the west, and the recently approved Eighty Mile Beach is 250 km to the north. Both marine parks are well outside the predicted zone of influence of proposed dredging activities.

5.4 Previous capital dredging projects

Several dredging projects have been undertaken adjacent to the proposed disturbance footprint and more widely within Port Hedland inner harbour. These include capital dredging at Anderson Point, Nelson Point and within South West Creek. The history of capital dredging in Port Hedland since 1977 is summarised in Table 2.

Table 2: Approved dredge volumes for capital dredging projects undertaken in Port Hedland inner harbour

Year	Dredge volume (m^3)	Proponent
1986	13,600,000	BHPBIO
2002	460,000	BHPBIO
2006-07	5,000,000	FMG
2008	3,400,000	FMG
2009	3,900,000	BHPBIO
2010	6,000,000	BHPBIO

Year	Dredge volume (m^3)	Proponent
2010	50,000	FMG
2011	17,000,000*	PHPA
2012	1,700,000*	BHPBIO
2012	5,880,000*	PHPA

*Staged development, dredging partially completed

5.5 Physical marine environment

5.5.1 Seabed morphology and geology

The Port Hedland area is a limestone barrier coast with a large tidal range that has evolved into a mosaic of coastal landforms inclusive of offshore limestone ridges, protected embayments (such as the inner harbour), sandy substrates with mangroves, mud flats, salt flats and a number of islands and associated reefs.

Within the inner harbour marine sediments are described primarily as Archean basement rock overlain by a sequence of Pleistocene-aged sediments (Hickman and Gibson 1982). The majority of the Pleistocene deposits consist of accumulations of terrigenous sediments including clays, silt, sands and gravels with varying degrees of cementation. A thin veneer of Holocene sediments occurs on the seabed surface within the inner harbour that are relatively homogenous across the harbour and consist of unconsolidated fine material ranging from clays and silts to fine sands that extend to a depth of 3 m.

A generalised subsurface geological profile conceptualisation from recent geotechnical investigations (Coffey 2008; WorleyParsons 2010b) within the inner harbour consists of five discrete geological horizons (from the seabed down). The horizons (or layers) recorded are presented in Table 3.

Table 3: Description of the geological profile of material within the vicinity of Lumsden Point

Horizon	Typical elevation of top of layer (m CD)*	Typical layer thickness (m)	Description/remarks
1	+2.0	3.0	Calcareous clay or silica sand, typically dark brown to grey with some shell fragments, locally fine to medium grained sand
2	+0.2	0.9	Siliceous calcarenite – low strength, pale brown, well cemented, with trace of gravel and some authigenic carbonate (reportedly not laterally continuous across the harbour)
3	-1.5	17.5	Red Beds – predominantly very weak to weak, red brown, weakly cemented calcareous sandstone, locally siltstone or claystone
4	-19.0	4.0	Calcareous conglomerate – medium to high strength, pinkish brown, very well cemented, medium to coarse grained with predominantly clay matrix, variable authigenic carbonate concentration
5	-23.0	Undetermined	Sandstone – low to medium strength, reddish brown, variably cemented, fine to coarse grained, localised authigenic carbonate cementation and traces of black manganese dioxide gravel

5.5.2 Bathymetry

The inner harbour has been substantially modified by dredging and reclamation activities since development of the port in 1965, to accommodate changes in vessel size and expansion of the port in response to increasing iron ore production in the region. The inner harbour has an average depth of -14.6 m CD and berth pockets in the port range in depth from -11.2 to -19 m CD (PHPA 2010).

Existing bathymetry and topography of the proposed disturbance footprint ranges from 2 m CD to -10.0 m CD (Figure 4).

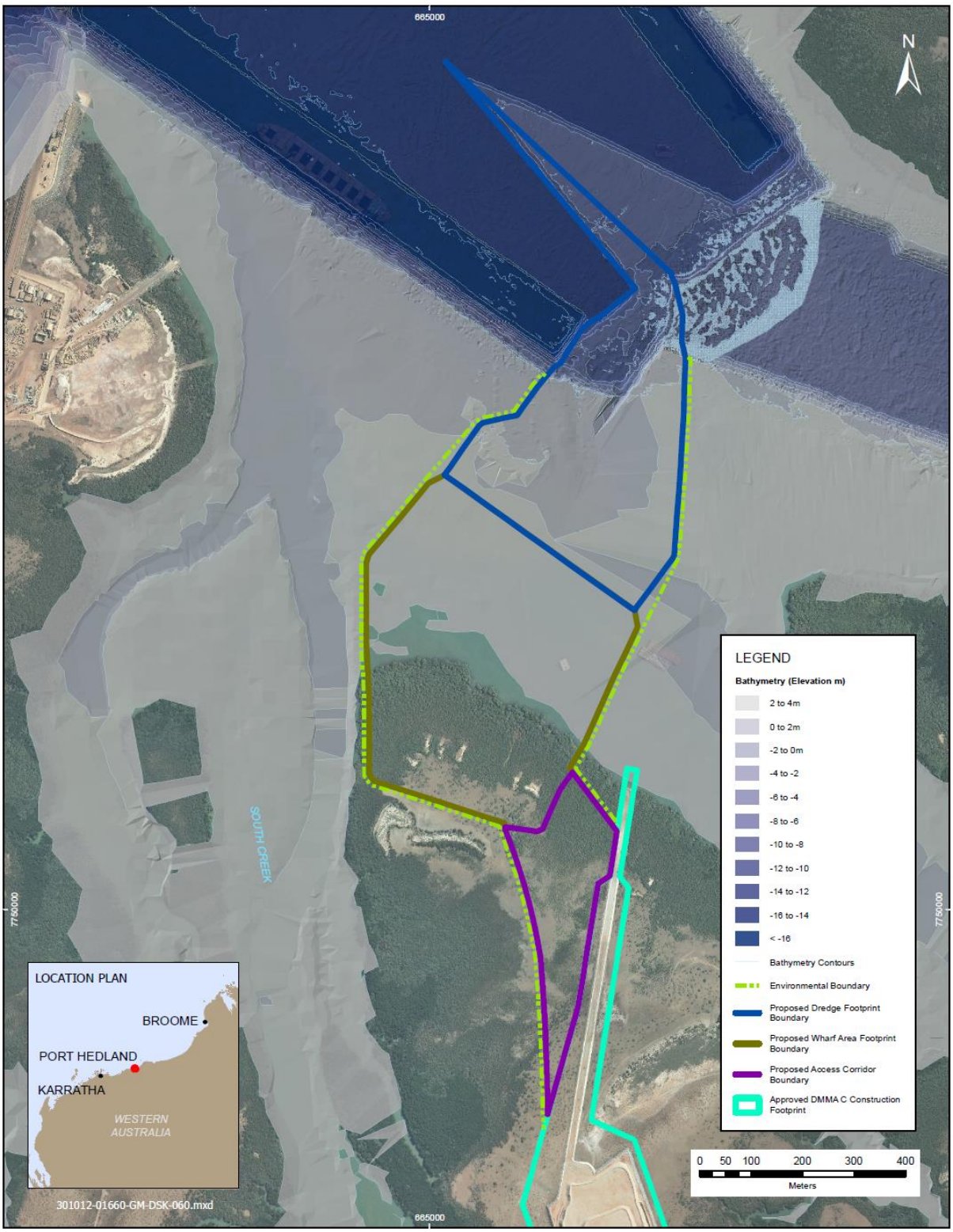


Figure 4: Existing bathymetry within and adjacent to the Project footprint

5.5.3 Hydrodynamics

Currents within Port Hedland are dominated by tidal flows due to a combination of the large tidal range that exists in the area; the narrow entrance to the port; shelter from wind and swell-driven wave currents provided by Finucane Island; and shallow, narrow creek systems that flow into the port area. The highest astronomical tide is approximately 8 m CD, with tides typically ranging from 1.5 m CD during neaps to 5.8 m CD at springs, and are predominantly semi-diurnal.

During neap tidal conditions, waters within the port are generally well mixed. Even so, some areas experience stratification due to lower current velocities and reduced mixing efficiency. During spring tides increased current velocity and movement of water in a counter-clockwise direction within the turning basin causes reduced mixing within some of the deeper areas of the turning basin (Halpern Glick Maunsell 1997). The natural littoral drift process moves sediment from west to east and the natural current direction in the local area is north-westerly to south-easterly (GHD 2007).

5.5.4 Sediment quality

Port Hedland is located within the North West Shelf marine area. The sediments of the North West Shelf typically comprise sands to sandy muds inshore, grading to coarse carbonate sands and gravels offshore (McLoughlin and Young 1985; Dix 1989; Semeniuk 1993). Inshore, sediment grain size and composition, which is typically linked to wave energy and proximity to large rivers, contains finer, lower calcium carbonate sediments naturally occurring within sheltered bays and in mangrove creeks (Semeniuk, Chalmer et al. 1982).

Seabed sediment grain size in the inner port area and creek systems that feed into the inner port are highly variable due to the presence of strong tidal currents, periodic cyclones, the protected embayment and sediment-producing organisms such as coral reefs (Talbot and Creagh 1985).

Extensive data has previously been collected within Port Hedland to define chemical sediment quality characteristics and potential risks associated with dredging, offshore disposal, land-based disposal and reclamation activities in the general area. A detailed sediment quality assessment was undertaken in the Project dredge footprint. Contaminant concentrations were analysed for a suite of parameters including metals, TPH, PAHs, PCBs, organochlorine pesticides and organophosphate pesticides from samples collected from five boreholes and nine surface samples. All samples were found to have concentrations below adopted guideline levels except for nickel and chromium. These two metals have both been found to occur at naturally elevated concentrations throughout the Port Hedland region (DEC 2006).

Acid sulfate soil (ASS) tests were also undertaken on sediments located within the proposed dredge footprint. The potential for ASS was found in three of the tested samples collected from surface sediments, however due to the increased neutralising capacity from the calcareous materials, no samples exceeded the DEC (2013) Action Criteria for net acidity – requiring no active ASS management measures to be implemented.

5.6 Marine water quality

In response to environmental management requirements for dredging and reclamation projects, extensive baseline and conformance water quality monitoring has been undertaken in recent years within the port limits. These are summarised in sections 5.6.1 and 5.6.2.

5.6.1 Physico-chemical

Due to extensive operational and construction activities occurring on a continuous basis within the inner port area, water quality data that can be considered 'baseline' can be difficult to collect. Due to the port's rapid expansion in recent years, water quality throughout the inner port has been affected by dredging and dewatering activities – causing changes to physico-chemical water quality.

The most recent relevant study undertaken to define baseline physico-chemical water quality was undertaken in 2012 for the Stingray Creek Cyclone Mooring Facility (WorleyParsons 2012c) for the inner harbour, and during the South West Creek Dredging and Reclamation Project for the discharge sites in the upper creeks (WorleyParsons 2011). Physico-chemical water quality data was collected from five sites located within the inner harbour to determine baseline conditions. Data was collected between December 2010 and March 2012 between dredging activities.

Turbidity was generally found to be higher in creeks compared with the more exposed sites located at the mouths of the creeks in the inner harbour, most likely due to an increase in fine sediments and reduced flushing from the open ocean. Sites located adjacent to the inner harbour displayed median turbidity of <7 NTU, while sites located upstream displayed median turbidity of >9 NTU.

The pH was found to be similar between sites located in or adjacent to the operating port area, while pH at sites located within the creeks was slightly lower. Within each site pH was found to show low variation.

Due to the shallow bathymetry observed at each site, temperature was found to vary depending on air temperature variation as a consequence of seasonal change. Median temperatures at each site ranged between 21.21 °C and 31.63 °C. Temperatures were generally high due to the sub-tropical climate that is found in this region of Australia.

Higher dissolved oxygen concentrations were found in areas exposed to the open ocean compared with sites located within the creeks.

5.6.2 Chemical

Baseline water quality investigations undertaken in South West Creek as part of PHPA's dredging and reclamation project (WorleyParsons 2010f) found that all metals reported concentrations below (ANZECC/ARMCANZ 2000) for 99% ecological protection, with the exception of copper and cobalt due to the laboratory limit of reporting being above the (ANZECC/ARMCANZ 2000) guidelines. Nutrients and hydrocarbons in the same study were below the 99% level of ecological protection guidelines at the monitored sites.

Baseline water quality investigations for RGP5 and RGP6 were undertaken between August 2008 and December 2009. All parameters reported concentrations below ANZECC &

ARMCANZ guidelines (2000) for 99% ecological protection, with the exception of copper, cobalt zinc and nickel. Copper, zinc and cobalt exceeded the 95% species protection (ANZECC/ARMCANZ 2000) trigger values and nickel exceeded the 99% species protection (ANZECC/ARMCANZ 2000) trigger value (BHPBIO 2010).

More recently, as part of the South West Creek dredging project, nickel concentrations in return water were monitored during dewatering activities. The monitoring program measured intermittent exceedances in of the trigger value for nickel (7 µg/L) however similar exceedances were noted in reference areas unaffected by dredging (WorleyParsons 2012b)

In the High Ecological Protection Area (HEPA) a 99% species protection is adopted and in the Moderate Ecological Protection Area (MEPA) a 90% species protection is adopted. The species protection values for certain contaminants are designated according to the ecological protection area (ANZECC/ARMCANZ 2000).

5.7 Biological marine environment

5.7.1 Benthic primary producer habitat

The marine habitats found in Port Hedland are characteristic of those found along the arid coastlines of the Pilbara. Typically, dense stands of mangroves occupy areas within the intertidal zone, where tidal inundation is sufficiently frequent to maintain adequate sediment water content and levels of salinity for colonisation by mangroves. As distance from the shoreline increases, the height and cover of mangrove vegetation decreases, giving way to saltmarsh (samphire) and bare tidal flats as sediments become dryer and more saline (Saenger 2002). Some areas between the mangrove- and samphire-dominated habitats of the upper intertidal zone support cyanobacterial mats under suitable conditions (Paling, McComb et al. 1989; Paling, Humphries et al. 2003).

Most subtidal benthic habitats within Port Hedland harbour are characterised by unvegetated substrate (78.77%), with sparse patches of turf algae, small foliaceous macroalgae and sessile filter-feeding invertebrates (SKM 2009). Habitats supporting coral communities are sparsely distributed and do not represent a high percentage cover across the inner harbour (0.09% cover). A canopy algae community comprising *Sargassum* sp. exists in dense patches in the eastern parts of Stingray Creek. No seagrass communities have been found in the harbour.

A recent benthic habitat survey undertaken within the Project footprint identified supratidal, intertidal and subtidal habitats. It was generally found that the subtidal and non-mangrove intertidal benthic communities within the Project footprint comprised a mosaic of turfing algae and macroalgae, interspersed by large areas of bare substrate. These habitats are considered typical of those found at the mouths of the creek systems surrounding the inner port area, with bare substrate and turfing algae generally the most dominant habitat types (WorleyParsons 2010c; WorleyParsons 2012b). Turfing algae appeared to be more prevalent in the deeper subtidal areas, which are subject to less influence from tidal drying than the shallow banks at the mouths of creeks. Such species are likely to rapidly recolonise suitable areas within the harbour in the event of disturbance. Furthermore, significant seasonal

change in canopy algae coverage is known to occur in Port Hedland harbour, with large algal blooms occurring in association with the wet season (WorleyParsons 2010c).

The mangrove community structure encased three of the seven known species of mangroves within the Port Hedland area. The predominant species across the disturbance footprint was *Avicennia marina*, which was found in all vegetated areas. Tree density data showed that the majority of the disturbance footprint is dense, thickly grown vegetation. This coincides with vegetation complexes closer to the waterline generally showing greater density than those farther away. No unusual or unique habitat complexes were found, with all supratidal mangrove habitats within the disturbance footprint and fringing area considered typical of those found in the surrounding creek systems of Port Hedland (WorleyParsons 2010c).

5.7.2 Marine fauna

The EPBC Act Protected Matters report generated for the Project area identified nine marine conservation significant fauna species that may potentially occur within a 10 km radius of the Project area.

Of the listed species, the following have previously been identified within the vicinity of the Project area.

Flat back turtle nesting habitat exists within Cemetery Beach, Pretty Pool and Cooke Point. These areas are not close to the Project area. Juvenile green turtles have been recorded using the waters of the harbour and the surrounding mangrove creeks for foraging.

Small numbers of dolphins and dugong may also be found in the Port Hedland area. There are no known resident populations of either occurring in the area and it is therefore not expected that these marine fauna will be present in significant numbers within the inner harbour (Prince 2001).

Port Hedland is not considered an important aggregation area for dugongs and the lack of seagrass within the Project area would suggest it is not an important feeding area.

5.7.3 Introduced marine species

A desktop report by Oceanica, and a desktop report and field survey by WorleyParsons was undertaken for the PHPA in 2010 to identify potentially introduced marine organisms within the Port and South West Creek near the proposed dredge footprint (Oceanica 2010; WorleyParsons 2010a).

Before this an introduced marine organism survey of Port Hedland port was undertaken by the Centre for Research on Introduced Marine Pests (CRIMP) in 1999. This survey identified a relatively small number of known non-indigenous or cryptogenic invertebrate species (introduced marine species), which were all common and widely distributed biofouling species and deemed low impact. However, of 470 individual invertebrate taxa recognised in the survey collections, less than 30% were identified to species level and no macroalgae were listed. As such, it is possible the number of non-indigenous species in the port is higher.

WorleyParsons undertook a biofouling survey of South West Creek by deploying biofouling collectors at four locations for three months. Twenty-six biofouling taxa were found

attached to these collectors. Seven of these taxa were possibly introduced but, as in the earlier port survey, none of these were considered high impact or invasive species of concern.

The PHPA also has an Introduced Marine Pests monitoring program with settlement arrays placed around the harbour, and samples are collected quarterly and sent to the Department of Fisheries (DoF) for analysis.

5.8 Terrestrial flora and fauna

The composition of flora and vegetation in the intertidal and supratidal areas of the Project footprint was limited to mangrove vegetation. No salt-tolerant species such as samphire and Triodia hummock grassland that are normally common to this region were identified within the footprint.

No conservation significant flora species were recorded within the footprint. Five conservation significant fauna were identified within the footprint area, namely *Ardea modesta* – eastern great egret, *Actitis hypoleucos* – common sandpiper, *Numenius phaeopus* – whimbrel, *Thalasseus bengalensis* – lesser crested tern and *Merops ornatus* – rainbow bee-eater. It is considered unlikely that the Project's development and operation will result in any significant impact on these species as they are all migratory and highly mobile, with a wide distribution. The Project is not likely to affect critical feeding or breeding habitat within the study area.

5.9 Social and regional environment

5.9.1 Planning context

The Project is located within the administrative boundary of the Port of Port Hedland. The PHPA undertook a development planning study in 2003 that was updated in 2007, which identified suitable areas for future port development. Lumsden Point was identified as a site for multi-user berths. This Project is consistent with the outcomes of this *Port Planning Study* and *Ultimate Development Plan.*

5.9.2 Recreation and tourism

Coastal recreational activities, such as sailing, fishing and diving are popular in the Port Hedland area. There are two major boat-launching areas in Port Hedland at the north-western end of Finucane Island and to the north of the PHPA's berths (WAPC 2003). The PHPA also has a jetty near the existing port area which allows commercial fishing boats access to the coast when commercial wharves are unavailable (WAPC 2003).

The marine aspects of the Project area are known to provide some recreational fishing value, although the area is not considered to be used extensively. It is likely some recreational fishers may be restricted to certain areas of South Creek and South East Creek during construction and dredging as a result of exclusion zones that may be required in accordance with safety requirements. No commercial fishing is undertaken in the area.

5.9.3 Heritage

Indigenous heritage

The Project is situated within the WC 99/003 Kariyarra Native Title Claim (the Kariyarra). Marapikurrinya Pty Ltd (MPL) manages the conduct of Aboriginal heritage surveys for the Marapikurrinya family group on behalf of the Kariyarra native title claimants for the Port Hedland area.

Ethnographic and archaeological surveys have previously been conducted over the Project footprint with members of the Marapikurrinya. The PHPA is aware of the location of each of the heritage sites and where possible has adopted engineering solutions to avoid them. One registered Aboriginal heritage site, site ID 22874 (*Marapikurrinya Yintha*) was identified in the dredge area and disturbance of this site cannot be avoided. The PHPA will provide MPL with a continued right of access within this registered site where practical for health and safety reasons. The PHPA intends to seek ministerial approval under Section 18 of the *Aboriginal Heritage Act 1972* to enable construction of infrastructure within the Project footprint for the purpose of transport, storage, import and export of general cargo. Any concerns raised by MPL would be considered by the PHPA in its management of environmental impacts as they affect heritage matters.

On 1 December 2011 the PHPA received ministerial consent under Section 18 of the *Aboriginal Heritage Act 1972* to construct DMMA B North. Any construction activities would be undertaken in accordance with the PHPA's approved *Cultural heritage management plan* for the DMMA B North area.

The PHPA is committed to on-going consultation with the MPL and to developing the Project in accordance with the requirements of the *Aboriginal Heritage Act 1972.*

European heritage

While the Database of Heritage Places lists 32 places of European heritage significance within the Port Hedland local government area, only four places are listed on the Register of the National Estate (with no formal assessment) and only two places are registered on the State Register of Heritage Places, being Dalgety House and the former District Medical Officer's Quarters. Both places are located within the Port Hedland township and therefore do not form part of the assessment for the Project.

5.9.4 Air quality and noise

In January 2009 the EPA released an Environmental Protection Bulletin (EPA 2009b) expressing concern about the levels and management of dust and noise within the Port Hedland townsite. This bulletin acknowledged that historic dust levels had been, and continued to be at that time, above accepted recommended levels and a coordinated government and industry approach was called on to manage dust and noise issues at Port Hedland.

In May 2009, at the direction of the Premier, the state government established the Port Hedland Dust Management Taskforce which in March 2010 published the *Port Hedland air quality and noise management plan* (DSD 2010). This Plan assessed the issues and drivers associated with dust and noise at Port Hedland, and documented an implementation

strategy and governance framework to guide future actions, while supporting the responsible development of Port Hedland for its residents, the port and its users.

Recommendations of the taskforce relevant to air quality and noise include:

- a commitment by the PHPA to 'develop and implement best practice port development dust management guidelines' (these guidelines have been developed (PHPA 2012)); and
- establishment of a State Environmental Policy for Port Hedland by the EPA, to monitor and manage noise using exemptions to the Environmental Protection (Noise) Regulations where appropriate.

6. IMPACT ASSESSMENT AND MANAGEMENT

6.1 Marine water quality

6.1.1 Predicted impacts

Sediment plume modelling was undertaken to identify potential impacts associated with proposed dredging activities (WorleyParsons 2013a).

The results were used to predict the extent of impacts on water quality and BPPH. This section presents the results of winter modelling because this was considered 'worst case' with respect to the predicted behaviour and dispersion of the sediment plume. Summer modelling was also conducted and is included in WorleyParsons (2013a).

These results have been interpreted using previous benthic habitat thresholds (WorleyParsons 2013b) to identify the zones of influence and impact, following the recommendations of EAG7 (EPA 2011a).

As detailed further in Section 6.2, Port Hedland inner harbour is a highly turbid environment that experiences strong currents due to the large tidal range. Field studies undertaken to monitor the health of inshore coral communities during previous dredging projects have detected little or no impact (WorleyParsons 2013b). Based on these findings and the impact assessment outlined in Section 6.2, no significant impact is predicted for the Project's dredging activities; i.e. no loss of BPPH will occur outside the disturbance footprint. The sediment plume modelling methods and results are summarised below.

The effect of the proposed dredging at Lumsden Point on suspended sediment concentrations (as a measure of turbidity) and total sedimentation levels was modelled using the simulation model MIKE 3 MT.

Two scenarios were modelled overall (summer and winter) with each scenario consisting of the following key characteristics:

- dredging duration of approximately 20 weeks;
- the release of fines into Port Hedland harbour arising from dredging (one cutter suction dredge); and
- the effects on hydrodynamics within the harbour resulting from changed bathymetry due to the proposed dredging.

These scenarios estimate the 'worst case' (based on the maximum amount of material to be dredged) for the dredging and disposal options, enabling the inclusion of management responses in the event that water quality impacts are identified. A conservative approach has been adopted by presenting the 80th percentile and 95th percentile in winter, when the dispersion of the dredge plume is greatest. The winter scenario results are summarised below and presented in Figure 5 and Figure 6.

The 50th and 80th percentiles values are considered indicative of most of the expected suspended sediment concentrations (SSCs) during the 20-week dredging campaign.

The maximum SSC predicted 20% of the time (80th percentile) is 200 mg/L within the proposed dredge footprint. SSC predicted immediately outside of the dredge footprint ranged between 40 mg/L and 200 mg/L. The highest concentrations outside the dredge footprint were observed in South East Creek with concentrations up to 200 mg/L. Concentrations of between 30 mg/L and 50 mg/L were observed in the mouth of South West Creek, throughout South Creek and in the mouth of Stingray Creek. The maximum spread (80th percentile) of the sediment plume (>20 SSC/mg/L) is predicted throughout the inner harbour extending to the entrance and up to the furthest point in each of the five creek systems (Figure 5).

The maximum SSC predicted to be exceeded 50% of the time (50th percentile) is 100 mg/L within the proposed dredge footprint. SSC immediately outside of the dredge footprint ranged between 20 mg/L and 100 mg/L. The highest SSCs outside the dredge footprint were observed in South East Creek with concentrations up to 100 mg/L. The maximum spread (50th percentile) of the sediment plume (>20 SSC/mg/L) is predicted in the mouth of South and Stingray creeks (Figure 6)

The impacts associated with turbidity and sedimentation effects were interpreted using spatially defined boundary extents for the Zone of High Impact (ZoHI), Zone of Moderate Impact (ZoMI) and Zone of Influence (ZoI) in accordance with Environmental Assessment Guideline for Marine Dredging Proposals No.7 (EPA, 2011) as shown in Figure 7.

The ZoHI is to be confined to the area of dredging for the swing basin and construction of the reclamation area. The loss of habitat associated with the dredging is not considered significant as the seabed has existing ministerial approval to be disturbed. The reclamation will result in the permanent loss of 14.7 ha of existing marine habitat.

The ZoMI is confined to buffer zone around the zone of high impact. Based on the modelling of turbidity and sedimentation, there is very little likelihood that mangroves or other benthic primary producers will be impacted beyond the ZoMI. These predictions are based on previous experience and extensive monitoring of these habitats as part of previous dredging assessments within Port Hedland.

The ZoI has been defined as the area where a TSS threshold of 5 mg/L is exceeded for more than 50% of the time. Water quality data from a range of sites within the harbour confirm that TSS (and turbidity) is naturally high and that 5 mg/L is a much more realistic concentration than 1 or 2 mg/L in trying to discern a visible plume. The CDMP for the project proposes monitoring at a number of sites across the ZoI and in close proximity to the ZoMI to demonstrate that impacts are not greater than predicted in these zones.

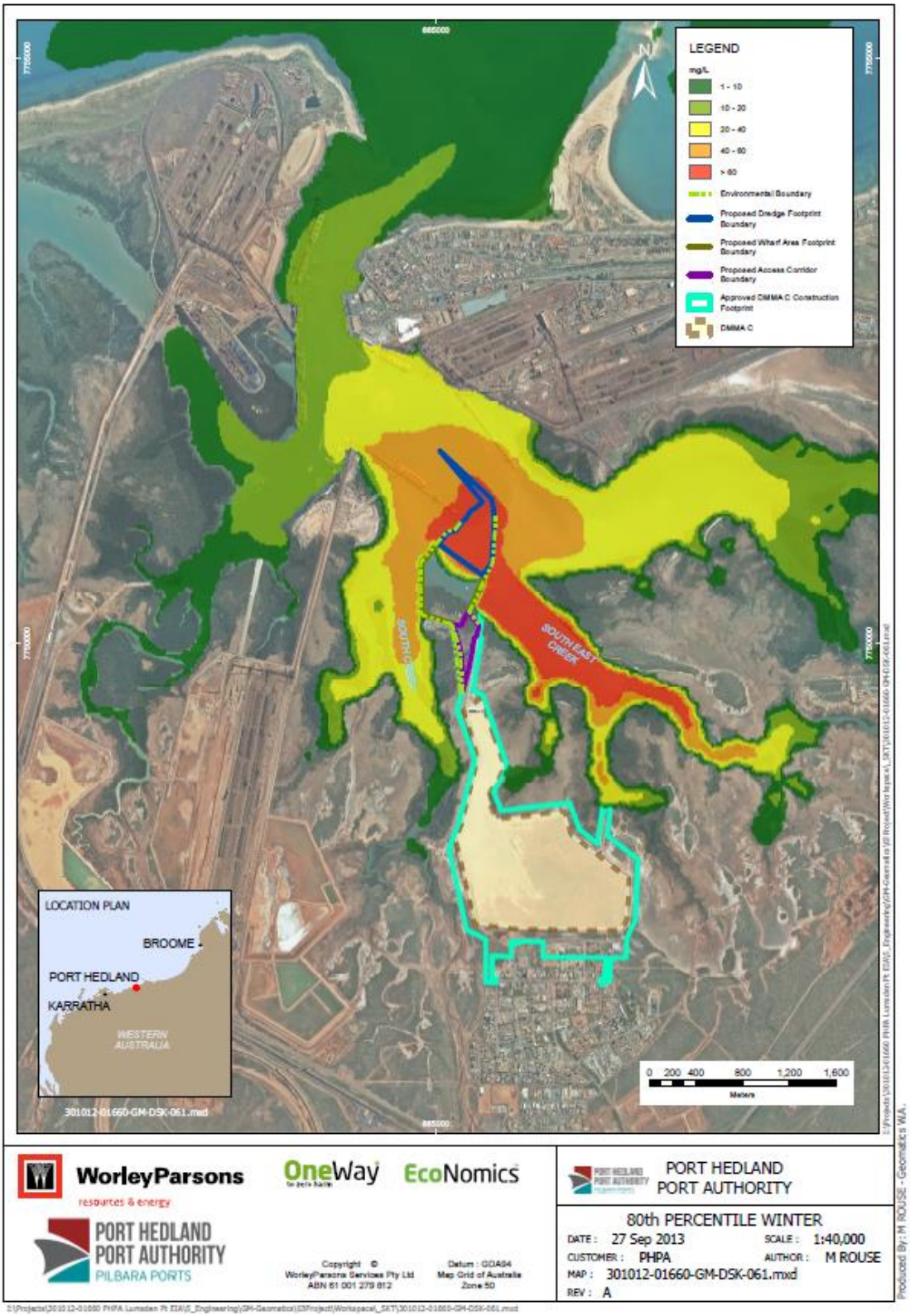


Figure 5: Predicted (80th percentile) suspended sediment concentrations (above background) during dredging

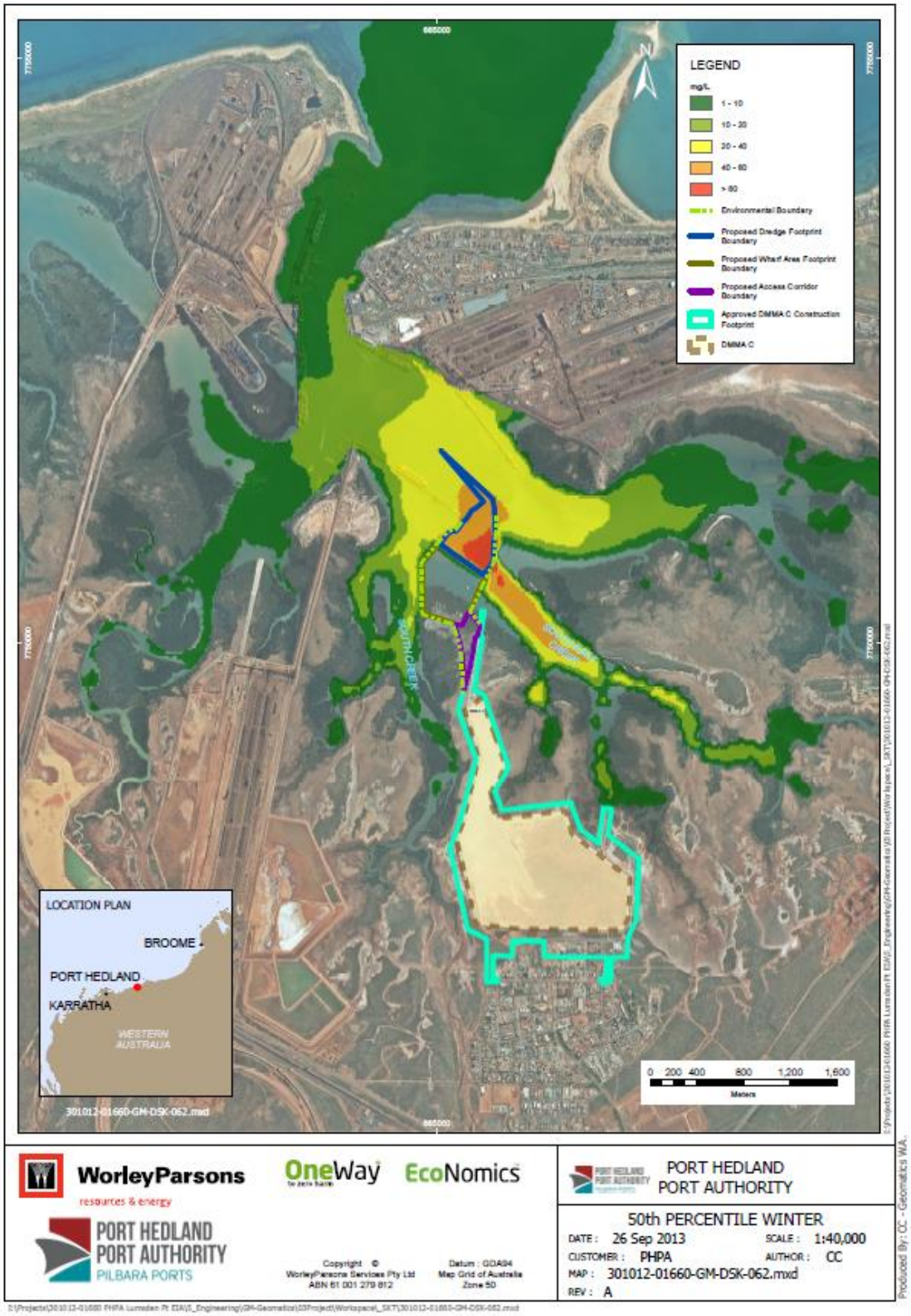


Figure 6: Predicted (50th percentile) suspended sediment concentrations (above background) during dredging

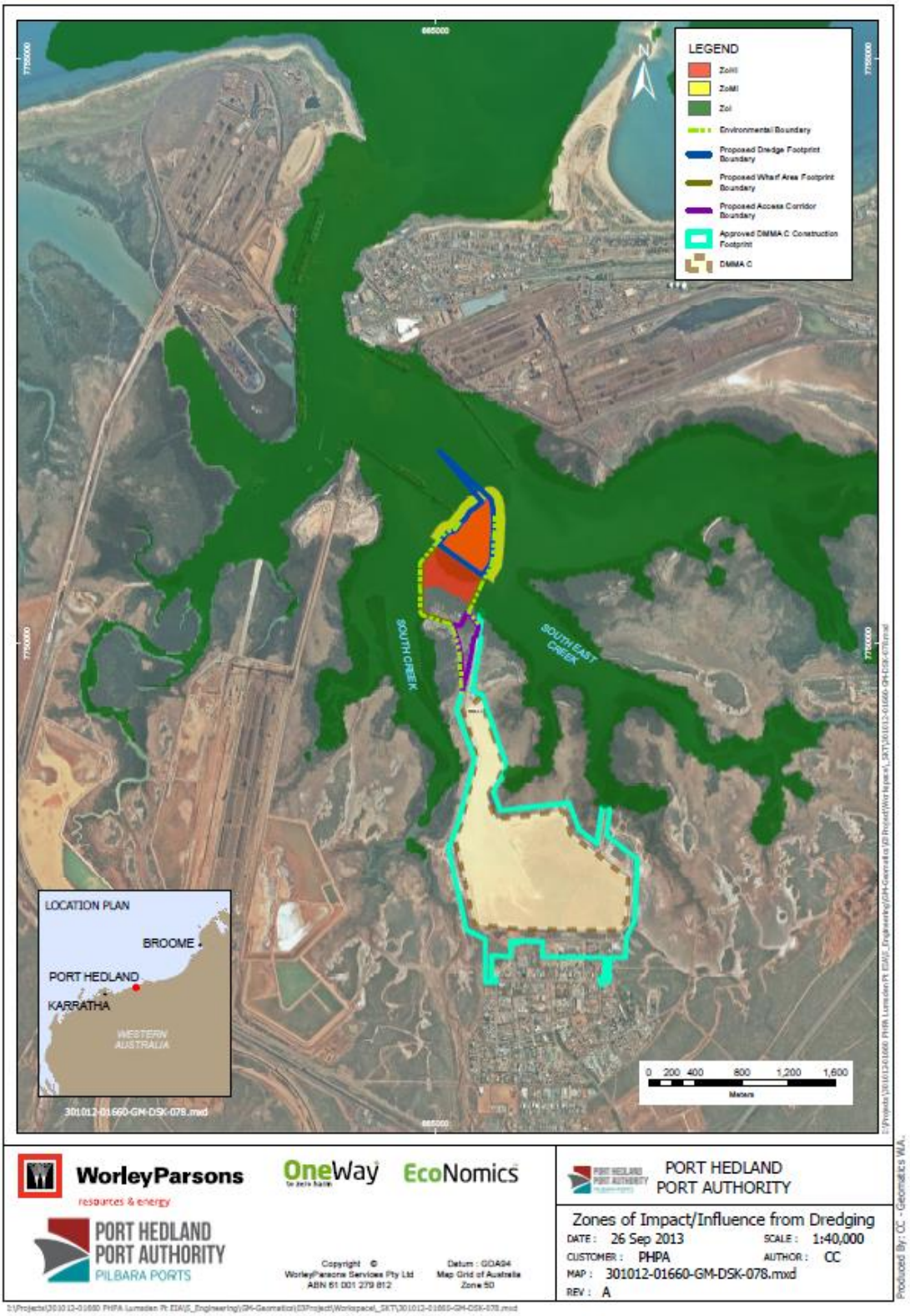


Figure 7: Predicted zones of impact and zones of influence

Other potential impacts include the release of contaminants into the water column following disturbance and the spillage of hydrocarbons during dredging and construction activities. Assessment of sediment quality data from the proposed dredging location has confirmed that contaminants are present in very low concentrations and do not exceed recommended screening levels. The use of hydrocarbons will be primarily for powering of dredging vessels and construction machinery in the form of diesel. Lower volumes of heavier based hydrocarbons in the form of lubricant and hydraulic liquids will also be used. Given the volumes to be used are relatively low, the potential risk of impact to the environment is considered low.

Potential impacts to water quality from dewatering activities include altered physical parameters in the discharge water. Trigger levels proposed for the discharge water from the DMMAs have been based on the adopted Pilbara Water Quality ecological objectives to meet a high level of ecological protection the South East Creek and South Creek.

Construction activities have the potential to cause changes in water quality via runoff from exposed/cleared areas. Due to Port Hedland's low rainfall, the potential impacts associated with these activities on water quality are considered low. Management measures that will mitigate this potential impact have been described in Section 6.1.2.

6.1.2 Management of water quality during dredging and dewatering activities

Management area	Water quality
Performance objective	To minimise the generation and migration of turbid plumes during dredging activities which may cause impacts to coral and mangrove communities through sedimentation or increases in turbidity.
Key performance indicators	• No long-term deterioration in water quality after the cessation of dredging. • No detected injury/mortality to marine fauna as a result of deterioration in water quality. • No significant hydrocarbon spills and all spills responded to in accordance with the PHPA's *Marine Oil Pollution Management Plan*. • Complaints investigated and responded to with two weeks of complaint.
Management actions	• Installation of a satellite-based vessel monitoring system on the dredge, allowing a track plot analysis to ensure maximum efficiency of the dredging effort and that no dredging occurs outside the required area. • Use of suitable dredging plant and equipment to minimise turbidity, including well-maintained floating pipelines to be used to minimise

Management area	Water quality
	leakage of turbid water during pumping of material to the DMMAs. • Maintaining calibration of the hydrographic survey systems onboard the dredge. • Implementation of the Tiered Monitoring Framework following a water quality trigger breach in accordance with the monitoring program (Figure 9 and Figure 11). • Maximise the residence time in the reclamation area to reduce the turbidity plume of the tailwater discharge. Suitable controls (e.g. weir boxes) will be used at the discharge point to control the water level and the rate of discharge. • Surface water runoff from construction site and corridors will be contained where appropriate and discharge controlled such that there are no significant, physical offsite impacts. • Regular inspection and maintenance of erosion and sediment control structures, particularly following heavy or prolonged rainfall.
Monitoring	• Implementation of the Routine Water Quality Monitoring Program (Section 7.2). • Implementation of the BPPH Monitoring and Routine Mangrove Health Program (Section 7.3 and Section 7.4 respectively). • Dredge contractor to monitor the operation on a continual basis and report any incidents that are likely to cause substantial changes to water quality.
Responsibility	• The dredge contractor is responsible for monitoring the dredging, disposal and reclamation operations and undertaking management actions assigned to them. • The PHPA is responsible for the implementation of water quality and sedimentation monitoring programs defined in Section 7.2 and Section 7.4.
Reporting	• All reporting requirements are detailed in Section 8.
Corrective action	• Revision of dredging strategy, including potential relocation of the dredge(s) and alterations to operational mode if plumes exceed predicted ranges and are considered to affect key sensitive habitats. • Implementation of the Reactive Mangrove Health Monitoring Program and Reactive Coral Health Investigation (sections 7.3 and 7.4). • Notification to the EPA, if water quality exceeds the predicted trigger values, for consideration of the need for any corrective action.

Management area	Water quality
Relevant references/ standards	• Pilbara coastal water quality objectives. • ANZECC/ARMCANZ (2000) water quality objectives.

6.2 Benthic primary producer habitat

6.2.1 Predicted impacts – direct

The total maximum area of each BPPH type that stands to be lost from completion of the Lumsden Point General Cargo Facility is summarised in Table 4. This does not include the disturbance areas already approved by other projects, including the dredge footprint that should not and has not been considered to contain BPPH. The total maximum loss of BPPH is expected to be no more than 22.22 ha, 8.34 ha of this area comprises bare substrate, and 13.88 ha of mangrove habitat. None of the 22.22 ha of BPPH is considered unique or rare within the Port Hedland locality and all types of BPP are well represented in neighbouring and adjacent areas within the Port Hedland LAU.

Table 4: Maximum BPPH loss from the Lumsden Point General Cargo Facility footprint

Habitat Type	Footprint (ha)					
	Wharf area	Access corridor	North pipeline corridor	South pipeline corridor	DMMA B-North discharge channel	Total
Mangroves	8.86	4.79	0.19	0	0.04	**13.88**
Bare Substrate	5.85	1.82	0.27	0.33	0.07	**8.34**
Total BPPH	**14.71**	**6.61**	**0.46**	**0.33**	**0.11**	**22.22**

Note: Mangrove loss includes each identified community type, density and area covered by pneumatophores

6.2.2 Predicted impacts – indirect

Impacts to BPPH from turbidity during dredging activities

During dredging, increases in turbidity can cause light attenuation at the seabed. This can limit the ability of species to photosynthesise thereby reducing the available energy that could otherwise be used for growth, survival and/or reproduction.

Sediment plume modelling undertaken predicted that SSC concentrations will increase to 200 mg/L. Generally SSC concentrations will range between 20 mg/L to 100 mg/L adjacent to dredging activities.

To identify the extent of impacts associated with increases in turbidity, light irradiance at the seabed was calculated for sites known to be dominated by BPP during previous dredging campaigns. It was found that light irradiance levels predicted for this project will be similar to those levels experienced during previous dredging projects. Given that no impacts were observed following any of the previous dredging campaigns, it is deemed highly unlikely that BPPH will be affected by temporary elevated SSC levels associated with the proposed dredging program.

Impacts to BPPH from sedimentation caused by dredging

As turbid plumes migrate from the point of disturbance, sedimentation can occur in areas that experience reduced current flow as sediments fall out of suspension due to gravity. Increases in sedimentation reduce the amount of light captured by BPPs at the seabed and can physically smother organisms.

Sediment plume modelling undertaken to predict sedimentation rates during dredging activities indicates sedimentation thickness levels between 2 mm and 200 mm (Figure 8). Mangrove communities adjacent to the Project footprint are likely to experience an increase of up to 10 mm. Other BPPs predicted to be exposed to sediment levels up to 20 mm include small coral communities located in South East Creek and the entrance to Stingray Creek and patches of turfing algae and macroalgae found throughout the inner harbour.

Predicted sedimentation levels identified during previous dredging projects and BPPH data collected after the completion of post dredging surveys showed the BPPH predicted to be influenced by the Project will not be impacted. Sedimentation levels were found to be below sedimentation levels previously predicted, which had no impact on BPPH within the Port Hedland inner harbour.

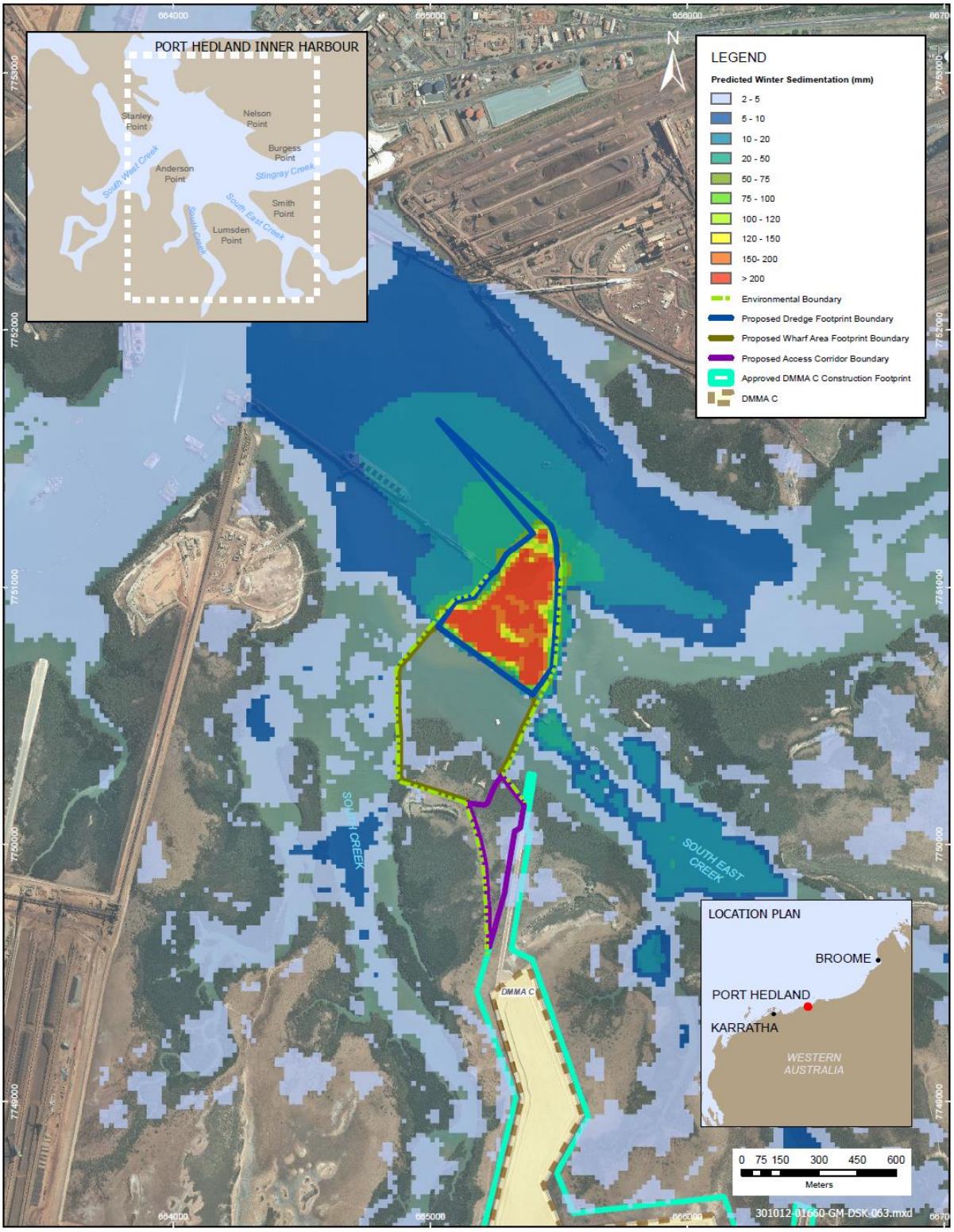


Figure 8: Total seabed thickness change after completion of dredging in the inner harbour: winter scenario.

6.2.3 Management of BPPH

Management area	Other mangrove habitats
Performance objective	To limit the direct or indirect loss of BPPH associated with the dredging activities.
Key performance indicators	To cause no impact to BPPH outside of the disturbance footprint.
Management actions	• Workforce management including briefings and instructions regarding clearing/ disturbance procedures and information on the ecological significance of BPPH in environmental awareness training. • Prohibiting access into BPPH areas outside the immediate disturbance area. • Reporting incidents with the potential to impact on BPPH. • Delineation of disturbance boundaries before dredging and construction begin through the use of GPS and route tracking flagging or other suitable techniques to avoid unnecessary disturbance of BPPH. • Where possible, scrub rolling mangroves rather than removing them to provide the maximum opportunity for vegetative recovery along the boundary of the cleared areas.
Monitoring	Monitoring to help manage potential impacts on mangroves: • Routine Water Quality Monitoring Program (Section 7.2). • Routine BPP Health Monitoring Program (Section 7.3). • Routine Mangrove Health Monitoring Program (Section 7.4). • Routine Surface Sediment Monitoring Program (Section 7.4).
Responsibility	• The dredge contractor is responsible for monitoring the dredging operations and undertaking management actions assigned to them. • The PHPA is responsible for implementation of the monitoring programs defined in Section 7.
Reporting	• All reporting requirements are detailed in Section 8.
Corrective action	• Revision of dredging strategy, including potential relocation of the dredge(s) and alterations to operational mode if sedimentation/turbidity exceeds predicted ranges and is considered to impact on BPPH. • Notification to the EPA, if water quality exceeds the predicted trigger

Management area	Other mangrove habitats
	values, for consideration of the need for any corrective action. • Implementation of Reactive Mangrove and Coral Health Monitoring Program.
Relevant references/ standards	• EAG 3 (EPA 2009a). • *Guidance for the assessment of environmental factors* (in accordance with the *Environmental Protection Act 1986*). • EAG 1(EPA 2001).

6.3 Marine fauna

6.3.1 Predicted impacts

The presence of vessels during construction may increase the likelihood of a direct collision with pollufauna, particularly marine turtles. Turtles are vulnerable to boat strike while surfacing to breathe or as a startle response to dredging noise or visual cues. They are also vulnerable to collision with boat propellers in shallow water, where there is little clearance between the keel and the benthos.

Light sources during dredging activities will include work lights, safety lights, navigational lights and vessel lighting. Turtle hatchlings use lighting cues when they hatch and move down the beach to the water's edge. Some forms of artificial lighting have been found to disorientate hatchlings and reduce their ability to access the sea following hatching. The impacts associated with disorientation of turtle hatchlings are unlikely given the large distance between the dredge footprint and marine turtle nesting beaches. Altered underwater light conditions in inshore waters may also change the levels of predation on turtle hatchlings, by attracting fish and other predators.

Dredging and piling activities that have the potential to affect marine fauna via underwater noise (e.g. cetaceans, turtles and dugongs) may range from non-injurious effects (e.g. acoustic annoyance, mild tactile detection or physical discomfort) to varying levels of injury (i.e. non-lethal and lethal injuries). The number of marine fauna that could potentially be affected by piling activities will be minimal given there is limited known habitat, feeding and or breeding areas within the inner harbour. It is unlikely that underwater noise associated with dredging activities will cause additional underwater noise impacts during dredging and operation because the shipping and vessel noise will be at a scale of magnitude less than current shipping activities within the existing port areas.

6.3.2 Management of marine fauna

Management area	Marine fauna
Performance objective	• To ensure impacts on the abundance, species diversity, geographic distribution and ecological functions of marine faunal communities are avoided or minimised through mitigation • To protect EPBC Act listed threatened and migratory species and Specially Protected (Threatened) Fauna consistent with the provisions of the *Wildlife Conservation Act 1950*.
Key performance indicators	No recorded death or injury to marine fauna during dredging and construction activities.
Management actions	Vessel collisions or entrapment: • Procedures for marine fauna interaction shall be developed for vessels to reduce the potential impacts to marine fauna. • All work-site personnel shall be inducted regarding the proper response to fauna interaction (including unexpected encounters). • The Dredge Contractor shall appoint an individual on each vessel who is trained in faunal observation and distance estimation to be responsible for undertaking marine fauna observations. • The construction workforce and all vessels will be limited to designated areas. Recreational boating, fishing, diving, spear-fishing, fossicking, (i.e. collecting shells and any other biological or natural material e.g. animal bones) will be prohibited during the Project.
	Underwater noise: • Visual observations for marine turtles, dugongs and dolphins must be undertaken to the extent of the exclusion zone for at least 15 minutes before the start of and during piling activities. • Soft 'fairy taps' start procedures: as far as practical, piling activities must be initiated at the soft 'fairy taps' start level and then built up to full impact force. The soft 'fairy taps' start procedures may only begin if no marine turtles, dugongs or dolphins have been sighted within the exclusion zone during the pre-start-up visual observations. • prior to the commencement of operations each day, a 300 m radius around the worksite will be inspected for the presence of turtles and marine mammals. • Equipment and vessels shall operate in accordance with appropriate industry and equipment standards including specifications for noise levels. Regular maintenance will be conducted to the manufacturer's

Management area	Marine fauna
	specifications. Equipment covers, mufflers and other noise suppression equipment shall also be maintained and in good working order at all times. • Dredging and piling activities will be ceased if a significant marine mammal or reptile is sighted within the 'monitoring zone' of 300 m radius around the dredge or piling barge. • The use of thrusters and excessively noisy equipment will be avoided wherever practicable and engines, thrusters and auxiliary plant will not be left in 'stand by' or 'running' mode unnecessarily.
	Artificial lighting: • Where practicable, vessel loading and unloading in nearshore areas shall be conducted during daylight hours. Where this is not practicable, artificial lighting shall be reduced to the minimum required for safe operations. • Outside artificial lighting on vessels will be kept to a minimum (i.e. navigational lights and where safety dictates necessary deck lighting). Lighting should be switched off when not in use and automatic timers/sensors installed where possible. • Only necessary artificial lights shall be used. 'Unnecessary lighting' includes lighting in unused areas, decorative lighting or lighting that is brighter than needed.
Monitoring	Marine fauna observations: • Before starting dredging activities, the PHPA must check, using binoculars from a high observation platform on the vessel, for marine turtles within the monitoring zone. • If any turtles, cetaceans or dugongs are sighted in the monitoring zone, dredging activities must not start in the monitoring zone until 15 minutes after the last marine mammal/turtle is observed to leave the monitoring zone or the dredge is to move to another area of the dredge site to maintain a minimum distance of 300 m between the vessel and any marine mammal/turtle identified during observations. • Monitor light spill during dredging and construction activities.
Responsibility	• The Dredge Contractor is responsible for implementation of management actions. • The Dredge Contractor is responsible for maintaining all equipment to ensure underwater noise levels are kept to a minimum. All incidents associated with elevated noise that could affect marine fauna must be reported to the PHPA Environment Manager.

Management area	Marine fauna
Reporting	• All reporting requirements are detailed in Section 8.
Corrective action	• Revision of dredging strategy, including potential relocation of the dredge(s) and alterations to operational mode. • Notification to the EPA, if water quality exceeds the predicted trigger values, for consideration of need for any corrective action.
Relevant references/ standards	The *Australian National Guidelines for Whale and Dolphin Watching* (Department of Environment and Heritage 2006).

6.4 Introduced marine species

6.4.1 Predicted impacts

The increase in the number of vessel movements associated with dredging and construction could represent an increased threat of exposure to introduced marine species (IMS). The introduction of non-indigenous species could lead to irreversible detrimental impacts to the composition and function of the natural ecosystem through changes in competition, predation, or habitat modification. The Project provides opportunities for IMS to establish in two ways: on structures installed as part of the new facility infrastructure, and on Project vessels working in the harbour during the 20-week dredging period. The former will offer the highest chance of colonisation when first immersed, with likelihood decreasing with time as exposed surfaces are colonised by established native marine flora and fauna communities. The risk of Project vessels being colonised may increase during the Project as antifouling systems age and become damaged during operation.

Of the seven pest species designated as the basis for management of domestic ballast water movements, none is currently listed as present in Port Hedland, which means that water taken up as ballast or entrained in Port Hedland is deemed low risk for discharge in other Australian ports and coastal waters. The proposed dredge vessel that will be used during dredging has not yet been identified. Quarantine measures will have already been undertaken before dredging takes place.

6.4.2 Management of introduced marine species

Management area	Introduced marine species
Performance objective	Minimise the risk of introduction of unwanted marine organisms consistent with the Australian Quarantine Inspection Services (AQIS) guidelines for ballast water management (AQIS 2008) and ANZECC Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance (ANZECC 1997).

Management area	Introduced marine species
Key performance indicators	No introduction of an invasive IMS during dredging and construction activities.
Management actions	Before mobilisation and during dredging: • Comply with the Department of Agriculture requirements, state and federal legislation and particular provisions presented in this referral for dredges. • Any vessels coming to Port Hedland for the Project from other Australian locations that carry ballast or entrained water are required to have the risk status of that water assessed, considering the location of uptake and time of year, and to manage the water in accordance with the requirements of the National System for the Prevention and Management of Marine Pest Incursions, if it is deemed to be high risk. • Any vessels coming to Port Hedland for the Project from overseas or domestically should be subject to a biofouling risk assessment following guidance within the *Western Australian marine pest management guidelines* and the *National Biofouling Management Guidance for Non-Trading Vessels* document. Vessels assessed as posing a risk should be inspected to ensure they are free of biofouling and preferably dry-docked for cleaning and repair/renewal of the antifouling system immediately before departure for Australia. • All areas where mud and sediments can collect, including anchor and chain lockers and hoppers, should be inspected and cleaned before a vessel's departure for Port Hedland. Anchor chains, cables, and other gear that has been deployed overboard should also be inspected and cleaned of any attached or entangled marine growth. These procedures should be repeated before departure from Port Hedland to prevent translocation of species away from this region.
Monitoring	• Monitoring and surveillance of the dredge vessel and barges in accordance with Department of Agriculture and PHPA quarantine requirements.
Responsibility	• The dredging contractor is responsible for complying with existing PHPA quarantine requirements and management.
Reporting	• All reporting requirements are detailed in Section 8.
Corrective action	• Implementation of contingency measures as required by PHPA quarantine requirements. • Notification to the EPA and DoF if a marine pest species is

Management area	Introduced marine species
	introduced.
Relevant references/ standards	• *Australian Quarantine Act 1908* • *Australian Ballast Water Management Requirements* (AQIS 2008) • *National Biofouling Management Guidance for Commercial Vessels* (DAFF 2009a) • *National Biofouling Management Guidance for Non-trading Vessels* (DAFF 2009b) • *ANZECC Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance* (ANZECC 1997) • *Environmental Protection Act 1986* (WA) • *Fisheries Resources Management Act 1994* (WA) • *Western Australian marine pest management guidelines* (DoF 2012) • The PHPA's Introduced Marine Pest Guidelines.

6.5 Terrestrial flora and fauna

6.5.1 Predicted impacts

The mangrove and intertidal area in the Project footprint is tide dominated and is in constant transition between marine and terrestrial habitats. It has high habitat value for fauna species and its open ground provides habitat for foraging marine/aquatic migratory waders (WorleyParsons 2012a). According to the EPBC Act Protected Matters report generated to identify potential matters of significance that may occur within 10 km of the Project footprint, two endangered and two vulnerable species, 47 migratory-listed bird species and 38 fauna species protected under EPBC Act can potentially occur in the study area. Additionally, five conservation significant species were recorded in the survey: the eastern great egret, the common sandpiper, the whimbrel, the lesser crested tern and the rainbow bee-eater (WorleyParsons 2012a).

No significant impacts on the migratory bird species recorded are anticipated, given they can move away from disturbance. Dredging and construction activities are unlikely to affect critical feeding or breeding habitat and similar habitat occurs across Port Hedland and the broader Pilbara region.

Potential hydrocarbon spills from the dredging vessels may affect the local fauna as direct contact with diesel can affect marine birds by ingestion as well as cause hypothermia from matted feathers. Construction activities may also result in minor hydrocarbon spillages from plant and equipment, which could affect water quality and disturb local fauna. These are, however, unlikely to occur.

Light emissions from the dredging operations and construction activities have the potential to attract seabirds and extend their foraging time through the night. However, these activities are not expected to increase light emissions significantly over that which the port already experiences. Nevertheless, management measures should be implemented to reduce any excess light.

The vegetation communities and fauna habitats recorded are not considered of conservation significance and are isolated and segregated from the local area due to existing infrastructure and disturbances

6.5.2 Management of terrestrial flora and fauna

Management area	Terrestrial flora and fauna
Performance objective	To ensure impacts on the abundance, species diversity, geographic distribution and ecological functions of terrestrial fauna are avoided or minimised through mitigation. To protect EPBC Act listed threatened and migratory species and Specially Protected (Threatened) Fauna consistent with the provisions of the *Wildlife Conservation Act 1950*.
Key performance indicators	No recorded death or injury to terrestrial fauna during constructions activities. No long-term deterioration in the terrestrial habitat after cessation of the construction activities.
Management actions	Before mobilisation and during construction operations: • workforce management including briefings and instructions regarding clearing/disturbance procedures in environmental awareness training; • construction workforce and vehicle movement will be limited to designated areas; • speed restrictions, driver awareness and removal of road kill shall be enforced to minimise potential impacts arising from vehicular movement; • noise emissions and use of lighting during construction shall be minimised where practicable; and • design night-lighting so as to not shine directly onto mangrove habitats (low-pressure sodium vapour lamps are recommended). During dredging operations: • artificial lighting shall be reduced to the minimum required for safe operations; and

Management area	Terrestrial flora and fauna
	• outside artificial lighting on vessels will be kept to a minimum and lighting should be switched off when not in use and automatic timers/sensors installed where possible.
Monitoring	• Shore-based contractor to monitor the operation on a continual basis and report any incidents with local fauna.
Responsibility	• Both the dredge and shore-based contractors are responsible for complying will the relevant management strategies during construction in accordance with their contractual responsibilities. • The PHPA is responsible for reporting as detailed in Section 7.
Reporting	• All reporting requirements are detailed in Section 8.
Corrective action	• Revision of general earthworks operational mode if any activity leads to death or injury to terrestrial fauna.
Relevant references/ standards	• *Wildlife Conservation Act 1950* (WC Act). • *Environmental Protection Act 1986* (EP Act). • *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Schedule 3 • Environmental Protection (Clearing of Native Vegetation) Regulations 2004

6.6 Air quality

6.6.1 Predicted impacts

The Project requires an estimated volume of two million cubic metres of dredge material to be disposed of onshore, and has the potential to generate significant volumes of fine material. Given the fine material will be placed into existing or approved DMMAs, any dust impacts associated with these areas will be managed under each of their respective Ministerial Statement.

The wharf area will reclaim approximately 25 ha of land using either dredge material from the dredge area or, if this material is found to be unsuitable for reclamation material, an alternative source will be identified. The placement of material in this area has the potential to generate dust emissions which could potentially cause changes to ambient air quality. In addition, construction activities – principally land clearing, the use of earth-moving machinery for bund wall construction and vehicle and equipment traffic on unsealed roads and laydown areas – also has the potential to generate dust.

While modelling of potential levels of dust generated from the proposed development has not been undertaken for this Project, dust modelling was undertaken for the development of BHP Billiton's DMMA H for the Nelson Point dredging program. This investigation found that

uncontrolled dust generated from DMMA H would not change the cumulative dust levels predicted at the Port Hedland Hospital monitoring location (BHPBIO 2009). DMMA H covers an area of 204 ha, while the proposed wharf area for reclamation covers an area of 25 ha. Hence the impact of dust will be minimal. Sufficient management actions have been incorporated below in Section 6.6.2.

Other gaseous emissions such as NOx and SOx, particulates (PM10) and volatile organic compounds (VOCs) are expected to be minimal during the Project's construction and operation and only associated with fuel combustion from the operation of construction machinery and the exhaust emissions of marine vessels. Emissions of VOCs due to combustion and evaporation during welding works, as well as evaporation from paints and solvents used onsite, are likely to be in small quantities and localised in effect.

6.6.2 Management of air quality

Management area	Air quality
Performance objective	To ensure best practice for managing air emission levels during onshore construction activities.
Key performance indicators	Non-exceedence of relevant air quality emission standards and guidelines.
Management actions	Before mobilisation and during construction: • staff induction program to ensure all employees are made aware of the need to minimise dust generation; • regular watering of unsealed roads, exposed surfaces, active construction areas and stockpiles; • minimisation of traffic on unsealed roads; • re-vegetation and establishment of groundcover; • general housekeeping practices to ensure that there is no accumulation of waste materials within the construction site that may generate dust; • restriction of vehicle movements and vehicle speeds to reduce gaseous and dust emissions; • regular monitoring and maintenance of plant and equipment so that it remains in good working condition and gaseous emissions are kept to a minimum; and • all equipment will be switched off when not in use.
Monitoring	• All reporting requirements are detailed in Section 8.
Responsibility	• All reporting requirements are detailed in Section 8.

Management area	Air quality
Reporting	• Assessment and amendment of management practices to remove risk of reoccurrence
Corrective action	• *Environmental Protection Act 1986* (EP Act).
Relevant references/ standards	To ensure best practice for managing air emission levels during onshore construction activities.

6.7 Noise and vibration

6.7.1 Predicted impacts

The key sources of potential offsite noise emissions are associated with piling activities during construction of the marine structures and operation of the cutter suction dredge. Construction and dredging noise will be managed in accordance with existing procedures that have been applied in other recent expansion projects in the Port Hedland. This will include developing a Project-specific *Construction noise management plan* (CNMP) in accordance with the Environmental Protection (Noise) Regulations 1997 with approval of the CNMP by the Town of Port Hedland. Offsite noise emissions from the proposal are not expected to be significant.

6.7.2 Management of noise and vibration

Management area	Noise and vibration
Performance objective	To ensure best practice for managing noise and vibration levels during dredging and onshore construction activities.
Key performance indicators	Received noise levels at receptor sites not to exceed thresholds.
Management actions	• The construction work and dredging activity will be carried out in accordance with the Environmental Protection (Noise) Regulations 1997 and the control of noise practices set out in Section 6 of Australian Standard 2436-1981 *Guide to noise control on construction, maintenance and demolition sites.* • The equipment used for the construction will be the quietest reasonably available. • Regular monitoring and maintenance of plant and equipment will be undertaken so that it remains in good working condition and noise

Management area	Noise and vibration
	emissions are kept to a minimum. • All equipment will be switched off when not in use. • All employees and contractors will be made aware of the need to minimise noise.
Monitoring	• Monitoring will be detailed in the noise management plan developed before construction and dredging activities begin.
Responsibility	• Shore-based contractors are responsible for complying will the relevant management strategies during construction in accordance with their contractual responsibilities. • The PHPA is responsible for reporting as detailed in Section 8.
Reporting	• All reporting requirements are detailed in Section 8.
Corrective action	• Assessment and amendment of management practices to remove risk of reoccurrence.
Relevant references/ standards	• Environmental Protection (Noise) Regulations 1997. • *Guidance statement 8: Environmental noise (draft)* (EPA 2007). • Australian Standard 2436-1981 *Guide to noise control on construction, maintenance and demolition sites.*

6.8 Waste management

6.8.1 Predicted impacts

Solid and liquid wastes generated during dredging and construction have the potential to negatively impact on the surrounding environment if appropriate waste management measures are not put in place. Solid and liquid wastes that may be generated by the Project include:

- packaging material (plastic wrapping, pallets etc.);
- concrete;
- scrap metal;
- waste oil, hydrocarbons and hazardous materials (see Section 6.9);
- recyclable materials (paper, cardboard, aluminium);
- general food packaging and scraps; and
- domestic sewage.

Although no discharge of waste to the marine environment within the 12 nm limit is to take place, the potential exists for accidental discharges of small quantities of solid or liquid

wastes to the marine environment. Accidental waste discharges arising from dredge vessels and land-based activities (not including hydrocarbons) could include:

- deck drainage, which may comprise primarily rain water and wash down water, but may include small amounts of waste material;
- potentially contaminated drainage, including drainage from machinery spaces and bilges; and
- engine cooling water.

The accidental discharge of waste material (without appropriate dilution or treatment) to the marine environment may:

- contaminate food sources;
- result in additional nutrients and pathogens in the water column (potentially leading to algal blooms or toxicity); and
- cause death or injury of marine fauna if ingested or entangled.

Solid wastes that may be generated during construction include plastics, materials packaging, scrap metal, containers, wood, and food waste.

6.8.2 Management of wastes

Management area	Waste management
Performance objective	To ensure best practice management for the handling and storage of all waste and hazardous materials related to the dredging.
Key performance indicators	No long-term impact on the environment during dredging and construction activities.
Management actions	• Controlled wastes shall be managed as per the Environmental Protection (Controlled Waste) Regulations 2004 (WA). • Waste from vessels operating with the Harbour will be managed in accordance with the PR-E11 PHPA Guidelines for Ship Waste Discharge within Port Limits.
	• Waste management requirements shall be communicated to personnel (i.e. through inductions, pre-starts and/or Job Hazard Analyses [JHAs]). • Communication systems on vessels shall be capable of handling the volumes generated and be maintained regularly so they are efficient and fully operational at all times. • Solid and liquid wastes and hazardous materials shall be stored in appropriately labelled drums or tanks.

Management area	Waste management
	• Hazardous substances handling is to be carried out by suitably trained personnel only. • Hazardous material storage areas shall be engineered and designed to handle the volumes and operating conditions (both normal and upset conditions) specifically required for each substance, including product identification, transportation, storage, control and loss prevention (e.g. bunding and drainage). • Incompatible products will not be stored together. • Empty liquid waste containers shall be segregated from other wastes and stored in designated areas.
Monitoring	• Regular visual inspections of vessels and the construction area will be undertaken. • Records of waste stream statistics (e.g. amount, type, etc.) will be kept.
Responsibility	• Both the dredge and onshore contractors are responsible for complying will the relevant management strategies during construction in accordance with their contractual responsibilities.
Reporting	• All reporting requirements are detailed in Section 8.
Corrective action	• Implementation of contingency measures as required by the PHPA's waste management guidelines and the PHPA's *Marine Oil Pollution Management Plan.*
Relevant references/ standards	• The PHPA's existing waste management guidelines. • Environmental Protection (Controlled Waste) Regulations 2004. • IMDG requirements. • MARPOL 73/78 Annex II. • MARPOL 73/78 Convention Annex IV (sewage) and Annex V (garbage).

6.9 Hydrocarbon management

6.9.1 Predicted impacts

Hydrocarbons used during the dredging will include diesel and smaller amounts of lubricating oil and grease for dredging equipment. Diesel is a 'light oil' and small spills of 2000 to 20 000 L will usually evaporate and disperse within a day or less; for larger spills, a residue of up to one-third of the amount spilled will usually remain after a few days.

Direct contact with diesel can affect marine birds by ingestion during preening and hypothermia from matted feathers, although the oil evaporates so rapidly that the number of birds affected is usually small (NOAA 2006). Small spills have the potential for serious impact if they occur close to a large nesting colony or are transported into an area with a large bird population (NOAA 2006).

Given large seabird colonises are unlikely to be nearby, only localised impacts are predicted should diesel be spilt. Therefore it is likely that only invertebrates and fish may be exposed and subsequently affected by such incidents, although the area of spill extent is thought to be minimal given the small volumes of fuel that will be used during dredging activities.

Land-based activities including construction of the wharf area and access corridor could result in a minor hydrocarbon spillage from plant and equipment. However, the Project is unlikely to require significant volumes of hydrocarbons to be stored onsite.

6.9.2 Management of hydrocarbons

Management area	Hydrocarbon spills
Performance objective	To ensure hydrocarbons are handled and stored in a manner that minimises the potential impact on the environment through leaks, spills and emergency situations.
Key performance indicators	No impact to flora or fauna as a result of hydrocarbon spills resulting from dredging and construction activities.
Management actions	• Hydrocarbon spills will be managed in accordance with the requirements of the PHPA's *Marine Oil Pollution Management Plan.* • Dredge vessels: tanks and machinery shall be equipped with measurement and overflow protection (i.e. flow and level meters, relief valves, overflow protection valves and emergency shut-off). • Land-based plant and equipment shall be appropriately maintained and serviced in accordance with industry standards. • Industry standards, port authority and pollution prevention regulations shall be adhered to during: – refuelling; – transfer; – storage; and – handling of hazardous materials (e.g. bunding, level gauges, overflow protection, drainage systems and hardstands). • Hydrocarbons (including hydrocarbon wastes) shall be stored in appropriately labelled drums or tanks and in bunded areas that can contain 110% of material stored within. • Equipment will be designed and operated to prevent spills and leaks

Management area	Hydrocarbon spills
	through the provision of in-built safeguards such as relief valves, overflow protection, and automatic and manual shut-down systems. • Controlled wastes shall be managed as per the Environmental Protection (Controlled Waste) Regulations 2004 (WA). • Establish comprehensive vessel refuelling procedures to avoid or reduce the possibility of a release include as a minimum the requirements for: – adhering to all port authority and pollution regulations; – refuelling during daylight hours where possible, depending on sea conditions; – refuelling within established safety boundaries and during weather/sea/visibility conditions that will minimise potential release risk; – training personnel involved with refuelling or fuel transfer in their roles, functions and responsibility, including emergency response; – maintaining open communication channels; – deploying spill prevention systems in accordance with established procedures and regulatory requirements; and – maintaining emergency response equipment to ensure that it is readily available. • All personnel will be familiar with the use of oil spill clean-up kits and dispose of waste in the prescribed manner. • Controlled wastes shall be managed as per the Environmental Protection (Controlled Waste) Regulations 2004 (WA).
Monitoring	• The dredge and construction contractor shall undertake regular maintenance and systematic inspection of vessels, plant and equipment, with particular attention to hydrocarbon storage areas and bunding to reduce the likelihood of equipment failure, spills and leaks. • The dredge and construction contractor shall keep maintenance and inspection logs/records for all vessels, major plant and equipment. Records may be requested by the PHPA at any time.
Responsibility	Both the dredge and land-based contractors are responsible for complying will the relevant management strategies during construction in accordance with their contractual responsibilities.
Reporting	All reporting requirements are detailed in Section 8.
Corrective action	Implementation of contingency measures as required by the PHPA's *Marine Oil Pollution Management Plan.*

Management area	Hydrocarbon spills
Relevant references/ standards	• The PHPA's *Marine Oil Pollution Management Plan*. • Environmental Protection (Controlled Waste) Regulations 2004 (WA).

7. MONITORING PROGRAMS AND INSPECTIONS

Environmental attributes most susceptible to dredging and construction activities associated with the Project include:

- water quality;
- BPP health; and
- mangrove health.

In addition to the management actions to be put in place during dredging and construction, environmental monitoring of the marine environment will also be undertaken to verify the predicted impacts and to ensure they do not exceed their predicted magnitude.

The following monitoring is proposed for the Project:

- physical water quality monitoring using telemetry-based water quality loggers and collection of in situ water samples;
- monitoring of sedimentation; and
- coral/mangrove health, abundance and diversity.

The aim of monitoring will be to identify any change in the abundance, diversity and health of corals at several key locations for the duration of dredging, disposal and reclamation activities.

Data collected in the field will be reported to the EPA, along with a series of conclusions and recommendations for management and monitoring to ensure any impacts are rapidly identified and mitigated.

7.1 Tiered Management Framework

The Tiered Monitoring Framework (TMF) has been developed in conjunction with the management performance indicators, management triggers, and monitoring programs described in sections 7.2, 7.3 and 7.4, Figure 9, Figure 10 and Figure 11

The TMF's main objective is to ensure that a set of compulsory and optional management actions are in place during dredging and reclamation that can be implemented should:

- environmental monitoring detect a change in water quality, mangrove health and/or BPP health that are greater than the changes seen 'naturally' across reference sites; that is, quantifiable changes which can be attributed to dredging activities (i.e. compared with reference sites), or
- where development activities are considered to be of a higher environmental risk, warranting more conservative management.

A diagram of the proposed TMF for water quality/BPP health, sedimentation/mangrove health management and dewatering water quality monitoring has been provided in Figure 9, Figure 10 and Figure 11, respectively for the predicted area of impact. As part of the TMF, a set of water quality and sedimentation monitoring triggers have been developed (Section

7.2.1 and 7.4.1 respectively) to provide a proactive management strategy for the protection of coral and mangrove communities during the monitoring program. These water quality/sedimentation triggers will be continually reviewed during dredging to ensure they remain relevant and applicable to the health of subtidal BPPs and mangroves within the predicted impact areas.

7.2 Routine Marine Water Quality Monitoring Program

Water quality will be monitored at locations that may be affected by sediment plume (impact sites) and at various reference sites. Should water quality monitoring at the impact and reference sites identify that changes to water quality as a consequence of dredging activities have the potential to affect subtidal BPPs within the study area, a subtidal BPP habitat survey will be undertaken.

7.2.1 Development of trigger levels

Trigger values are levels that when exceeded trigger further investigation to determine whether management is required to prevent environmental harm. The objective in setting triggers is to be able to monitor TSS concentrations that can act as a signal or proxy for determination of ecological impacts within a defined impact zone. The exceedence of that initial level would then trigger a series of predetermined management responses. The underlying basis for the threshold is that a tangible risk of impact is evident once the threshold has been exceeded (McArthur et al. 2002).

Trigger levels proposed for the inner harbour dredging have been based on baseline water quality data collected within the inner harbour during baseline conditions. The trigger level that will be adopted for water quality monitoring will be the median value greater than the 80th percentile calculated from baseline data. The median value will be defined as the rolling median calculated over a spring and neap tidal cycle (14 days).

As such, should the rolling median exceed the 80th percentile of baseline data, then the median will be compared with reference data to determine whether the observed exceedence is as a consequence of dredging or from natural variability. This will be used to trigger a management response (Figure 9).

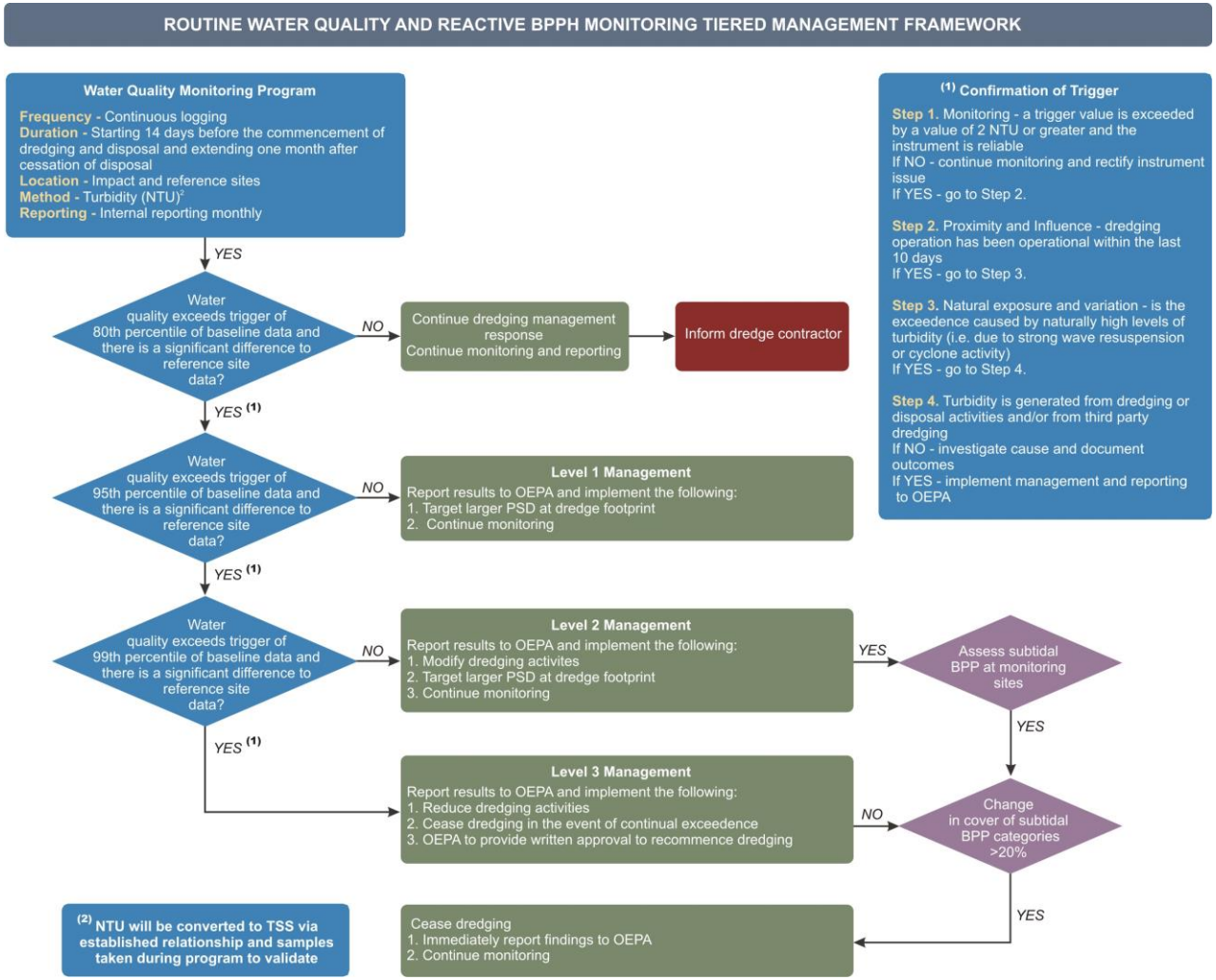


Figure 9: Water quality and reactive coral monitoring Tiered Management Framework

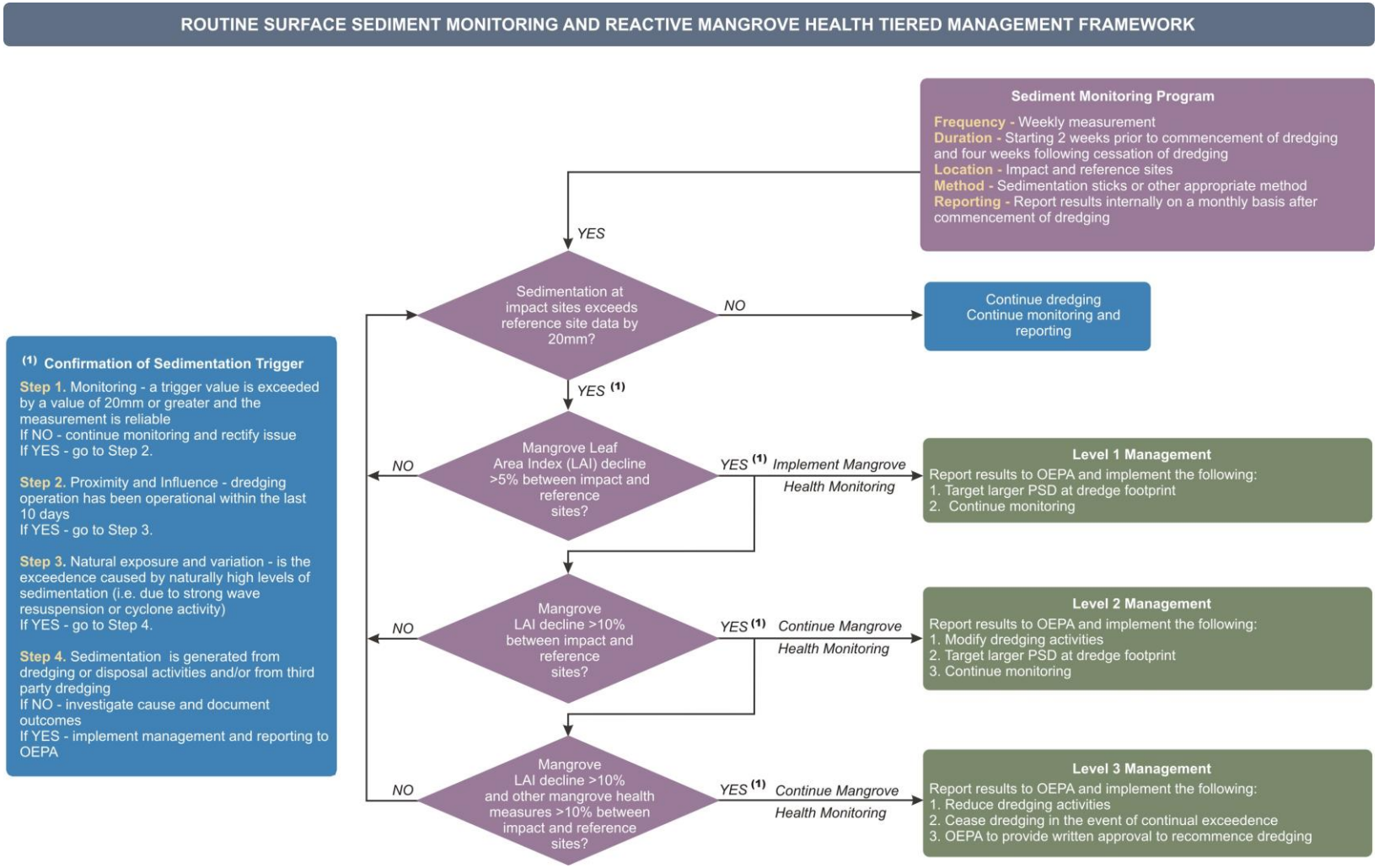


Figure 10: Routine surface sedimentation monitoring and reactive mangrove health Tiered Management Framework

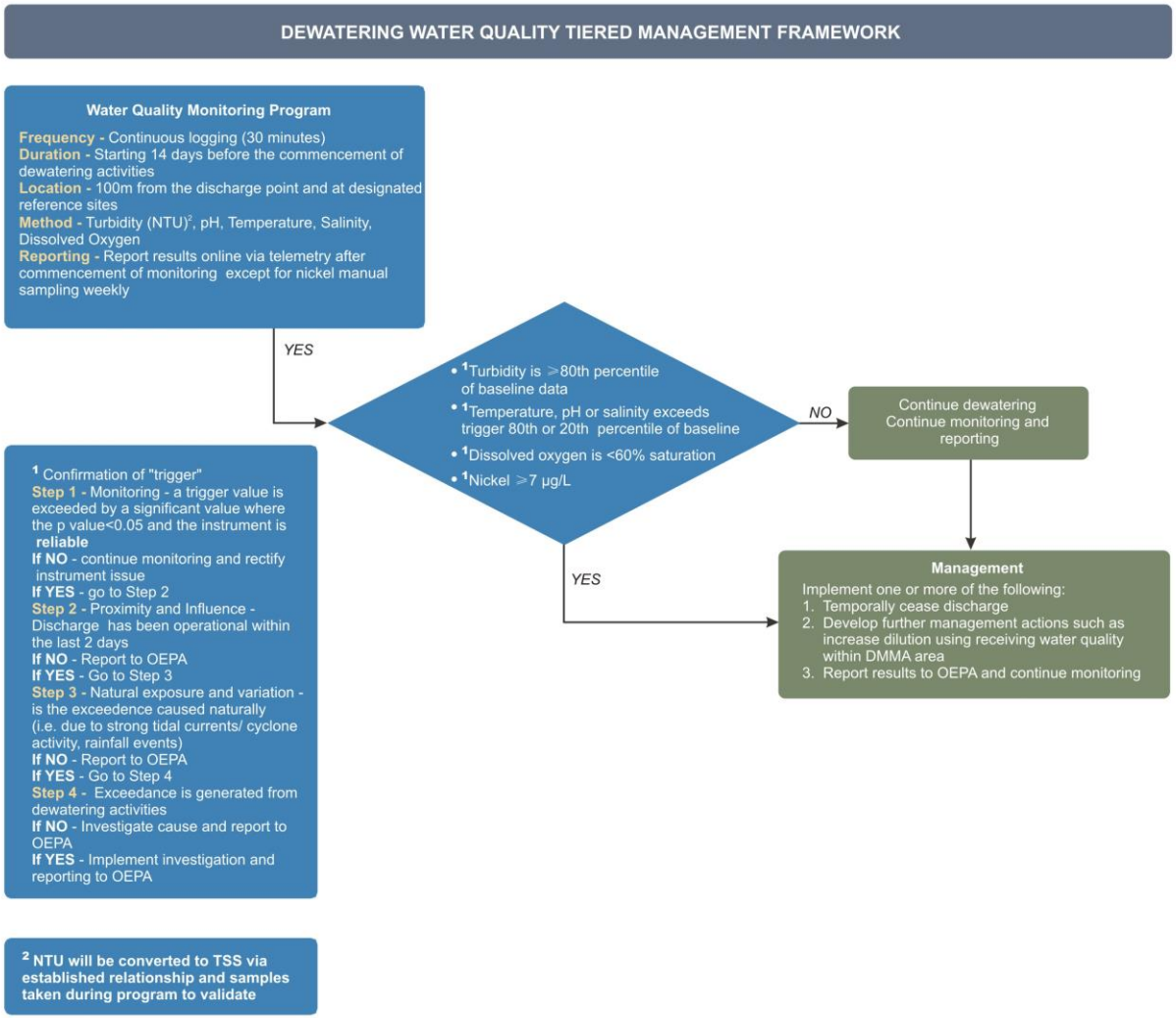


Figure 11: Dewatering Monitoring Tiered Management Framework

7.2.2 Monitoring site locations

Three water quality impact sites – South-West Creek (SWC), Stingray Creek (SRC) and South East Creek (SEC) – have been established within the predicted area to be influenced by dredging activities (within Port Hedland inner harbour). One reference location has also been identified to provide comparison of data to monitoring locations during dredging activities (Table 5). These water quality sites are located in areas where coral communities are found within the DoE (2006) zone of high level of ecological protection, to ensure sensitive receptors are not being impacted by the activities.

Table 5 provides the geographic coordinates for each site, data to be collected at each site and the site's function adjacent to the dredge footprint.

Table 5: Proposed water quality monitoring sites for dredging

Site name	Position (MGA Zone 50)		Details
	Easting	Northing	Water quality data collection
Water quality monitoring sites			
South West Creek (SWC)	662430	7750687	Telemetry and logging
South East Creek (SEC)	666086	7749980	Telemetry and logging
Stingray Creek (SRC)	666449	7751169	Telemetry and logging
Reference sites			
Salmon Creek (SOL)	661272	7751257	Telemetry and logging
Dewatering water quality monitoring sites			
South Creek (SCD)	664417	7748194	Telemetry and logging
South Creek 2 (SCD 2)	666417	7748590	Telemetry and logging
South East Creek (SECD)	664824	7748458	Telemetry and logging

Return water from the DMMAs will be discharged to the environment via designated discharge points (Figure 12). The water quality of return water will be managed and monitored in order to meet a 'high' level of ecological protection in South East Creek and South Creek (Figure 11).

Potential water quality sites for monitoring of return water discharge are also shown in Figure 12. Indicative coordinates for sites are shown in Table 5, however these may be repositioned to find a suitable position for the deployment in order to ensure loggers are not exposed during periods of low tide.

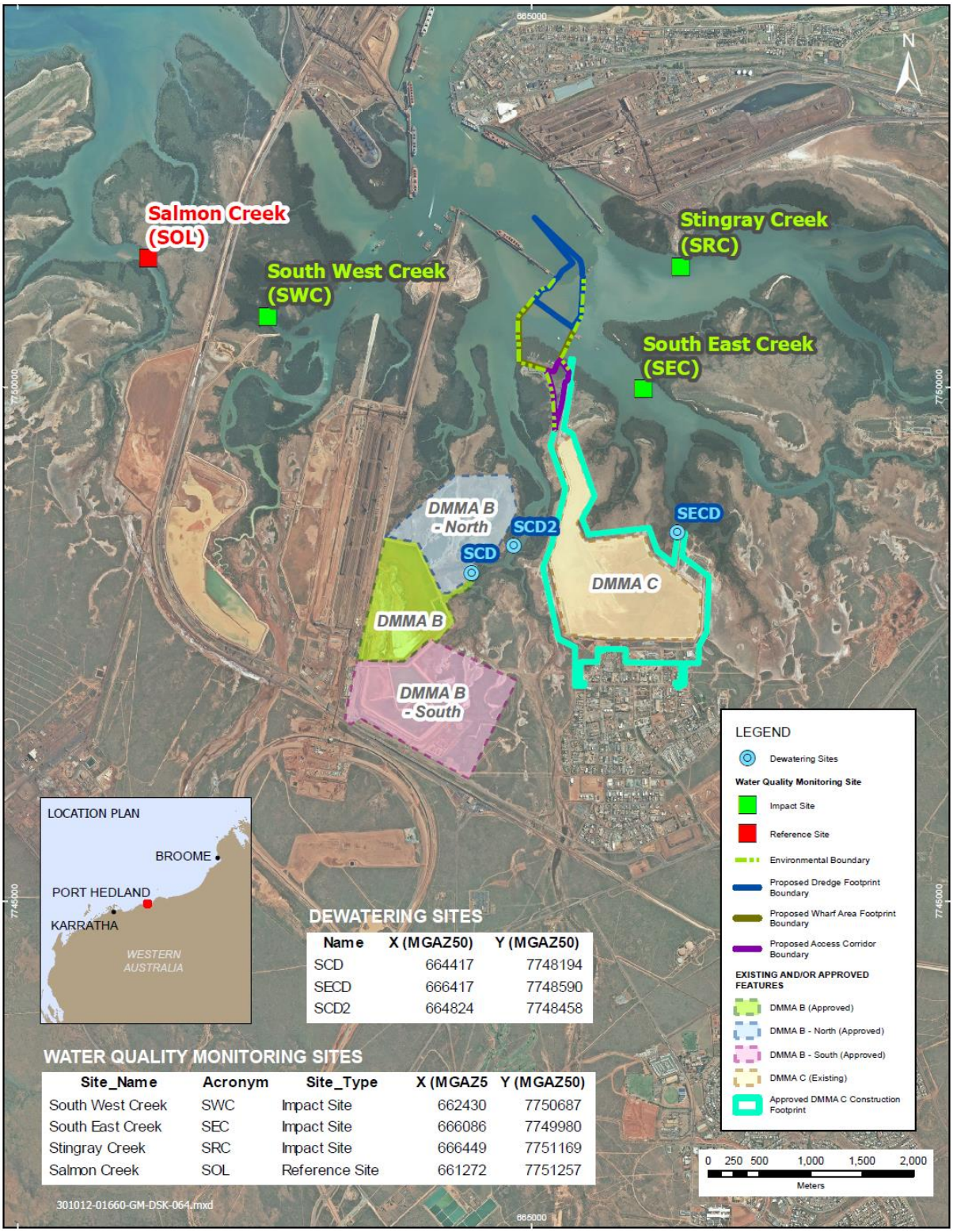


Figure 12: Location of proposed water quality monitoring sites associated with dredging activities

7.2.3 Frequency

Pre dredging

Baseline turbidity data was collected between December 2010 and March 2012 at each site. This data is considered sufficient for the development of trigger levels to be used during dredging activities.

During dredging

Data from the telemetered loggers will be evaluated daily during dredging. Management response actions including subtidal BPP health monitoring will be implemented should trigger levels be exceeded (trigger response outlined in Figure 9). Routine maintenance of telemetry loggers will be carried out on a monthly basis or before if a problem with data collection or accuracy is identified within a specific logger system.

Post dredging

Water quality monitoring data from the loggers will continue to be downloaded until water quality levels return to pre dredging levels after the cessation of dredging, or one month following completion of dredging.

7.2.4 Parameters and procedures

Physico-chemical analysis

Turbidity will be measured at monitoring locations associated with dredging activities. At all locations turbidity data will be collected using in situ water quality loggers with telemetry capability. Logging systems at the inshore sites will be located approximately 1 m above the seabed on a steel frame at each specified monitoring location.

For inshore sites, the logger units associated with dredging will be set up to measure turbidity every 30 minutes.

Data will be downloaded daily using the telemetry system deployed with the logger. Loggers will be calibrated monthly to ensure accurate datasets are acquired.

Correlation of TSS and NTU

Correlation of TSS and turbidity is undertaken to validate whether predicted zones of impact from modelling are a true representation of the plume extent during dredging activities. Water samples will be collected with a 1 L Van Dorn bottle and measured for NTU and TSS for a single event during the dredging program. Two sites will be selected in the immediate vicinity of the dredge. Replicated samples will be collected from the surface, mid and bottom of the water column at each site and analysed for:

- TSS (samples sent to the laboratory);
- NTU (measured both onsite and with samples being sent to the laboratory); and
- particle-size distribution (samples sent to the laboratory).

Samples will be sent to a National Association of Testing Authorities (NATA) accredited laboratory for quantitative analysis. Results may also be used to compare measured

turbidity values and those predicted in the numerical model (i.e. indication of modelling accuracy).

7.2.5 Data analysis and reporting

Water quality data collected daily during the dredge monitoring program will be used to provide early warning of potential water quality deterioration at the monitoring sites. The likelihood of a link between dredging and water quality decline will be assessed in terms of the following factors:

- location of and status of dredging activities in relation to the site(s) at the time of the exceedence;
- hydrodynamic conditions; for example, wind, tide, wave and swell state at the time of the exceedence;
- effects of extreme weather events in the region; and
- spatial extent of water quality decline.

7.3 Subtidal BPP monitoring

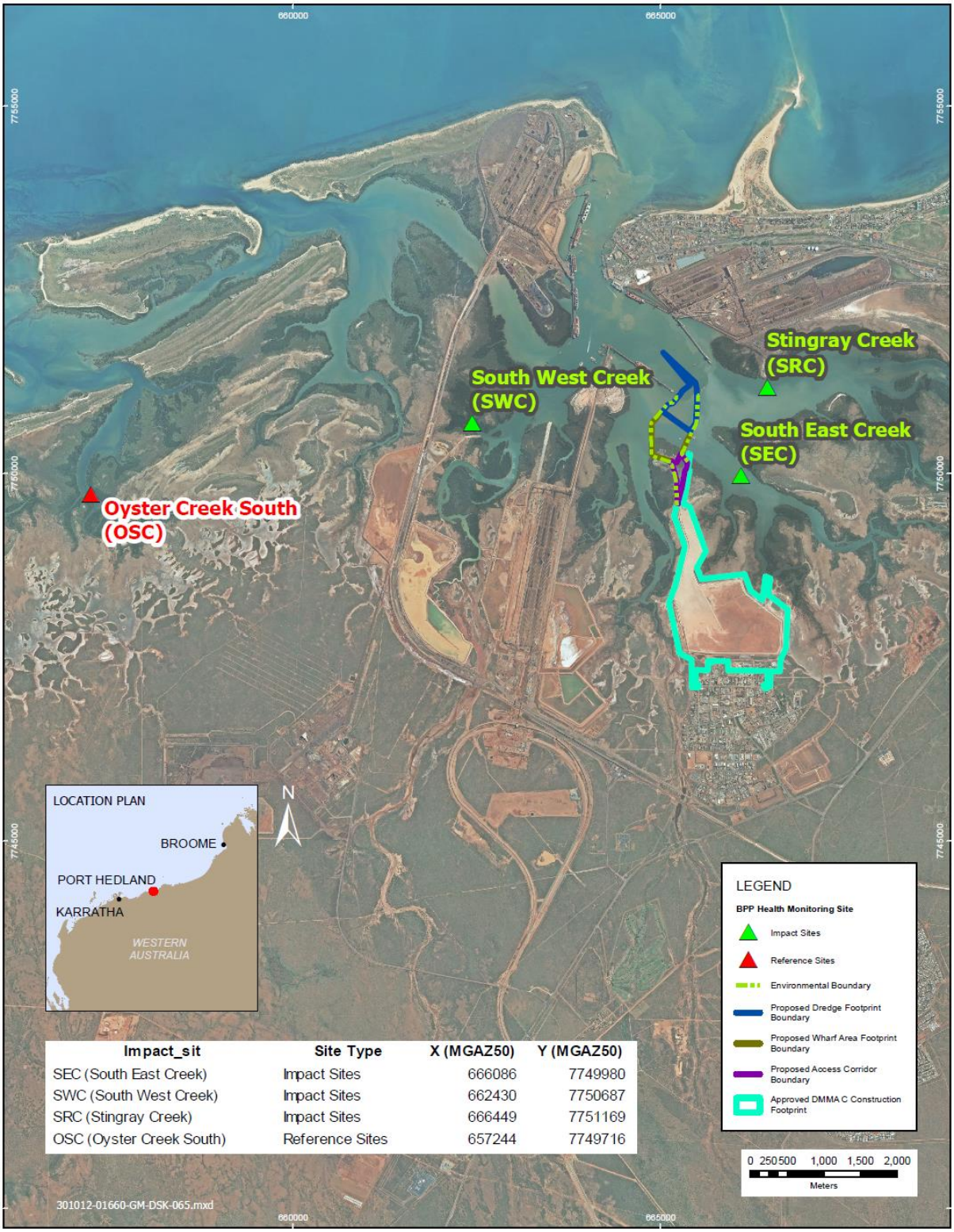
The subtidal BPP Health Monitoring Program will be undertaken should water quality trigger levels be exceeded during dredging activities and at reference sites.

7.3.1 Monitoring site locations

Subtidal BPP health monitoring sites have been established and summarised below in Table 6. Monitoring sites have been developed at impact locations to identify BPP communities with the potential to be affected by dredging activities (Figure 13). The sites are also within the 99% level of ecological protection zone from DoE (2006). A reference site has also been included to provide a suitable comparison to impact locations. All of these sites have already been established as monitoring sites for previous projects and therefore results can be compared to baseline data.

Table 6: Proposed subtidal BPP monitoring sites

Site name	Position (MGA Zone 50)	
	Easting	Northing
South West Creek (SWC)	662430	7750687
South East Creek (SEC)	666086	7749980
Stingray Creek (SRC)	666449	7751169
Oyster Creek South (OSC)	657244	7749715



Impact_sit	Site Type	X (MGAZ50)	Y (MGAZ50)
SEC (South East Creek)	Impact Sites	666086	7749980
SWC (South West Creek)	Impact Sites	662430	7750687
SRC (Stingray Creek)	Impact Sites	666449	7751169
OSC (Oyster Creek South)	Reference Sites	657244	7749716

Figure 13: BPP health monitoring locations associated with dredging activities

7.3.2 Frequency

Phase I – pre dredging

A baseline BPP health survey will be undertaken at least two weeks before dredging begins.

Phase II – during dredging

BPP health will be monitored at identified impact and reference sites following exceedence of adopted water quality trigger levels (trigger response outlined in Figure 10).

Phase III – post dredging

A post dredging BPP health investigation will be undertaken four weeks following the completion of dredging to define any impact between pre and post dredging/disposal activities.

7.3.3 Parameters and procedures

Pre and post dredging surveys will be undertaken to quantify the composition and mean percent coverage of BPP communities at each site.

Line-intercept surveys

Abundance surveys of the subtidal BPP communities will be made at each site. Four 20 m, haphazardly positioned, line-intercept transects will run within an area of substratum. Approximately 50 x 10 m will be recorded at each site to measure cover of the major benthic organisms in the area of maximum BPP abundance. The transects will be permanently marked with 12 mm reinforcing rod stakes driven into the bottom at 5 m intervals. To measure BPP cover, survey tapes will be stretched tightly between the stakes close to the substratum and the length of the intercept (with the tape of all benthic organisms directly beneath it) will be measured. Intercept lengths for all colonies of a species along each transect will then be totalled and converted to a percentage cover measurement.

These techniques have been used in many other surveys of subtidal BPP communities (Mapstone, Choat et al. 1989; Ayling and Ayling 1995; Ayling and Ayling 2006).

The bleaching status of all coral intercepts will be noted during these surveys in three categories: 1. Not bleached; 2. Partially bleached; 3. Totally bleached.

A permanent record will be made of the BPP community along each transect by taking an overlapping series of high-resolution digital still photographs of a 33 cm wide strip down the shoreward side of each tape.

Sediment deposition on subtidal BPP (corals)

In addition to measuring the approximate percentage of each BPP colony covered in sediment, measurements of the maximum depth of sediment will be taken, if present, on the surface of each tagged BPP colony using a set of callipers.

Wider measures of subtidal BPP health (corals)

Although line-intercept transects give a good estimate of coral cover, the sample size of BPP colonies immediately beneath the transect lines is not sufficient to encounter relatively rare

community events such as BPP disease or to assess small-scale changes in BPP health. Similarly, the health assessment using 50 tagged corals has only a limited sample size of colonies. To sample a wider area and a larger number of corals, the following components will also be measured along a 20 x 2 m strip centred on each transect line:

- Counts of the total number of coral colonies in each major coral group or species.
- Counts of bleached or partially bleached colonies.
- Counts of all sediment-damaged colonies. Many coral colonies have dead patches from a variety of causes and colonies will not be recorded as damaged if there is an actively growing edge encroaching into the dead patch.
- Counts of all diseased colonies. As for sediment damage, if there is an actively growing edge reclaiming a disease-caused dead patch that colony will not be recorded as diseased for that survey.
- Counts of all colonies showing recent partial mortality.
- Counts of all colonies suffering recent total mortality.

Coral sub-lethal stress

During the baseline, changes in the colour and hence zooxanthellae density of the tagged corals were used to assess sub-lethal stress. Colour was measured using the underwater BPP colour chart developed by Siebeck et al. (2006). Colour intensity scores for each tagged coral were recorded during each survey and these measures will be continued by the current monitoring team. A shift toward lighter colour intensity would indicate a more stressed state.

Coral size

The area of each tagged colony was measured during the baseline surveys from the colony photographs and these measures will be repeated during all ongoing surveys. This will give some indication of coral growth and hence a measure of the age of the communities. If the communities are young then this suggests that the habitat is marginal for coral growth and that colonies suffer regular mortality due to natural causes or past port development impacts.

7.3.4 Data analysis

Data will be collated within one week of completion of each BPP health investigation. The significance of any changes in the benthic abundance surveys will be tested using a repeated measures analysis of variance after each survey. Similar repeated measures tests will also be used to check the significance of changes in sediment depth on coral colonies and in the density of damaged BPP colonies.

7.4 Mangrove Health Monitoring Program

Mangrove health has the potential to be adversely affected through smothering of pneumatophores from increased deposition following re-suspension of dredged sediments.

Mangrove health checks will be undertaken should sedimentation rates exceed adopted trigger levels (Section 7.1).

7.4.1 Development of trigger levels

Based on existing literature on the effects of sedimentation on mangroves and predicted impacts to mangrove communities from sediment plume modelling, a trigger level of 20 mm above the net median sedimentation calculated from reference data against reference baseline data will be used as a preliminary trigger. If sedimentation levels at one or more of the impact sites exceed this level during dredging activities, the mangrove tagged leaf area is measured (see Section 7.4.4). Tagged leaf area data from each impact site is then compared with baseline data. If a decline is observed of >5% when compared with reference data, then a series of management actions are implemented (Figure 10).

7.4.2 Monitoring site locations

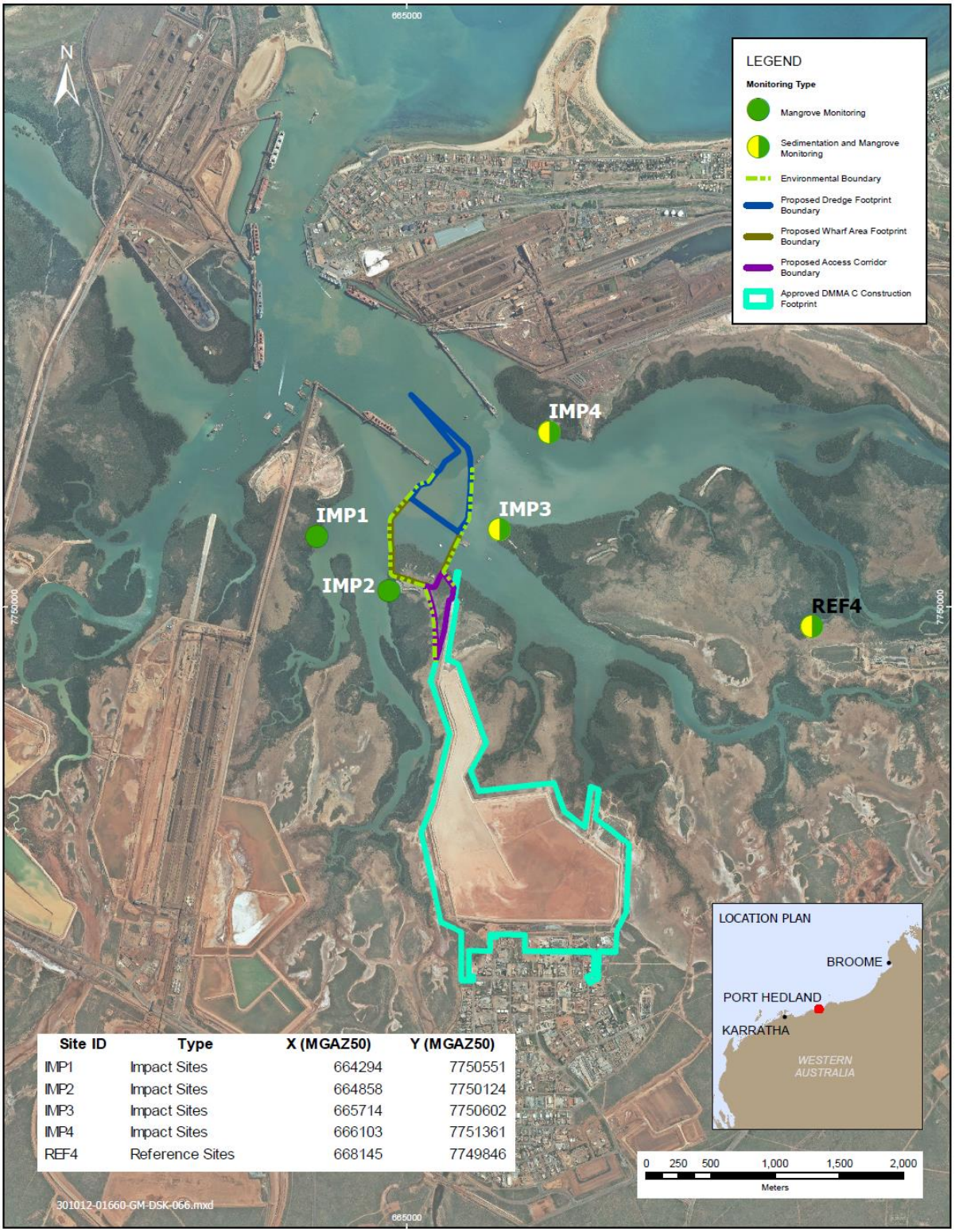
Monitoring sites will be established at four 'impact' sites adjacent to the Project dredge footprint (in an area where substantial sedimentation has been predicted). In addition, one 'reference' sites, which is comparable with impact sites and located outside the extent of any predicted impacts from dredging, will be established.

Sedimentation monitoring sites will be set up adjacent to the mangrove sites at IMP3, IMP4 and REF4.

The coordinates for each impact and reference mangrove monitoring site have been provided in Table 7 and displayed as a map in Figure 14.

Table 7: **Mangrove health monitoring site locations**

Site name	Position (MGA Zone 50)	
	Easting	Northing
IMP1	664294	7750551
IMP2	664858	7750124
IMP3	665714	7750602
IMP4	666103	7751361
REF4	668145	7749846



Site ID	Type	X (MGAZ50)	Y (MGAZ50)
IMP1	Impact Sites	664294	7750551
IMP2	Impact Sites	664858	7750124
IMP3	Impact Sites	665714	7750602
IMP4	Impact Sites	666103	7751361
REF4	Reference Sites	668145	7749846

Figure 14: Mangrove health and sedimentation monitoring sites

7.4.3 Frequency

Mangrove monitoring is proposed to be carried out at the following frequency:

- 2 weeks before the Project starts;
- 4 weeks after completion of the Project; and
- if sedimentation trigger levels are exceeded, a reactive mangrove health monitoring survey will be undertaken immediately (or as soon as practicable) after the exceedence.

Sedimentation levels will be monitored:

- continuous in situ measurement (weekly) two weeks before dredging begins;
- continuous in situ measurement (weekly) during dredging; and
- one month after dredging is finished.

7.4.4 Parameters and procedures

A series of permanent monitoring quadrats will be established in the designated impact and reference locations. The sites will be selected to encompass both low and high elevations, and all significant community types. At each site, four randomly located 4 x 4 m quadrats will be established and marked such that they can be easily revisited.

Qualitative monitoring

Qualitative monitoring of mangrove community health will be achieved using the Duke et al. (2005) classification system, which determines healthy (green leaves <10% dead/yellowing leaves), sick (yellow, wilting leaves, approximately 10–50% dead/yellowing leaves) and dead (>50% dead/yellowing leaves) mangrove characteristics in each monitoring quadrat. Photographs and a qualitative description of health attributes (e.g. disease) will also be taken from each monitoring quadrat.

Foliage density

Foliage density is measured using the plant canopy analyser. The LAI-2000 plant canopy analyser (Li-Cor, Inc., Lincoln, NE) is designed to estimate leaf area index of plant canopies indirectly from measurements of radiation above and below the canopy, based on a theoretical relationship between leaf area and canopy transmittance. Its optical sensor comprises five detectors, arranged in concentric rings that measure radiation (below 490 nm) from different sections of the sky. Canopy transmittance for these different sections is computed as the ratio between below-canopy and above-canopy readings for each detector ring. The leaf area estimate is based on the assumption of randomly distributed foliage elements.

Tagged-branch leaf area

A further measure of short-term mangrove health is gathered through the measurement of tagged-branch leaf area using a specialised handheld scanning device (measured as leaf area index). In each monitoring quadrat, five randomly oriented branches are selected and ‘tagged’ for subsequent leaf area analysis. When surveyed, each leaf on each branch is

scanned using the handheld device, providing a measurement of area, length, average and maximum width for each leaf, as well as total leaf area and leaf count for each tagged branch.

Sedimentation monitoring

Sedimentation levels will be monitored using sedimentation sticks or via similar methods such as sedimentation scanners. Sedimentation levels will be measured weekly.

Mangrove mapping

Aerial photography will be used to map the distribution, coverage and species composition of mangrove habitats situated near the Project footprint and in areas of potential indirect impacts. Aerial photography will be ortho-rectified to allow for determination of mangrove cover. Field surveys will be used to ground truth the distribution, coverage and species composition of mangrove community types in areas of change as identified through comparison of aerial photographs.

Mangrove mapping will be undertaken:

- before the Project starts to provide current information on mangrove distribution; and
- when the Project is finished.

Mangrove distribution and cover will be compared with the baseline data to confirm that the area of direct disturbance of mangrove habitat does not exceed the approved loss limit.

7.4.5 Data analysis

Mangrove health

Mangrove health data will be compared between the pre dredging and post dredging mangrove health surveys to confirm that mangrove health was not affected during dredging activities. If sedimentation trigger levels are exceeded during dredging activities a mangrove health survey will be undertaken and compared with baseline survey data. There would be no need to undertake additional mangrove surveys during dredging activities as sedimentation has been identified as the primary impact pathway likely to affect mangrove communities.

8. REPORTING

Sections 6 and 7 have identified the monitoring and management commitments that the PHPA will put in place to minimise environmental impacts during the dredging and construction activities.

Table 8 summarises the reporting requirements as part of this CDMP.

Table 8: Reporting requirement to be undertaken during dredging and disposal activities

CDMP reference	Report name	Contents	Recipient	Frequency/ schedule
	Marine water quality			
Section 7.2	Water quality monitoring report	Results of the daily monitoring of turbidity at impact and reference locations as specified in Section 7.2.5. Commentary on any trigger exceedences and resulting management measures.	EPA	Pre, during (bi-monthly) and post dredging
Section 6.9	Hydrocarbon spill monitoring	Incident report on hydrocarbon spills to marine waters (>20 litres) including response measure implemented.	DER	Following event
	Marine habitats			
Section 7.4	Mangrove health monitoring report	Report on the health of mangroves within area of influence.	EPA	Pre and post dredging
Section 7.4	Sedimentation monitoring	Monitoring of sediment deposition (weekly). Commentary on any trigger exceedences and resulting management measures.	EPA	Pre, during (monthly) and post dredging
Section 7.3	Subtidal BPP surveys	Presentation of BPPH data and comparison with baseline conditions and reference data	EPA	Pre and post dredging reactive
	Marine fauna			

CDMP reference	Report name	Contents	Recipient	Frequency/ schedule
Section 6.3	Marine fauna incident report	Details of any incident resulting in injury/mortality of marine turtles or marine mammals including time and locations of the incident, species involved (if can be identified) and activities being undertaken.	EPA DPW	Per occasion (within 24 hours of incident occurring)
Section 6.3	Marine fauna sighting report	Record of observations to determine the presence of marine fauna.	PHPA	Following event
	Introduced marine pest			
Section 6.4	Marine pest inspection checklist	Checklist of vessel components checked during vessel inspection. Statement from lead inspector on marine pest status of the vessel.	DoF	Within 72 hours of inspection
Section 6.4	Vessel quarantine report	Checklist of vessel components checked during vessel inspection. Statement from lead inspector.	DoF	Within 14 days of inspection or risk assessment
	Terrestrial fauna			
Section 6.5	Fauna incident report	All contractors must complete an environmental incident report and corrective action report as soon as practicable, but within 48 hours of the incident occurring, and forward this to the PHPA Environmental Superintendent.	DPW PHPA	
Section 6.5	Non-approved disturbance report	Any direct disturbance outside of the approved footprint will be reported the the PHPA Environment Manager and investigated as per regulatory and the PHPA requirements.	EPA PHPA	
	Air quality			

CDMP reference	Report name	Contents	Recipient	Frequency/ schedule
Section 6.6	Incident reporting	Shore-based contractors must complete an environmental incident report and corrective action report as soon as practicable, but within 48 hours of the incident occurring, and forward this to the PHPA Environmental Advisor.	PHPA	As required
	Noise and vibration			
Section 6.7		Monitoring reports shall be submitted by PHPA via the reporting schedule for each program in accordance with the construction noise management plan.	PHPA	As required
Section 6.7		Any complaints from the public will be reported by the dredge and/or shore-based contractor within 24 hrs. Remedial management will be implemented in accordance with the noise management plan.	PHPA	As required
	Waste management			
Section 6.8	Hazardous records register	Records of hazardous materials received, stored and dispensed shall be maintained and reconciled.	PHPA	As required
Section 6.8	Incident reporting	The dredge contractor shall report any incident of wastes entering the marine environment to PHPA as soon as possible (but within 48 hours) and implement appropriate clean-up procedures.	PHPA	As required

9. AUDITING

A compliance audit schedule will be developed based on the conditions contained within the various approvals documents. The PHPA will submit an environmental compliance report to the EPA as required following approval of the Project.

Each environmental compliance report will address each element of the audit program approved by the EPA and will be prepared and submitted in a format acceptable to both organisations.

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