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Report:
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LONG TERM DREDGING SEA DUMPING PERMIT PORT OF DAMPIER

Prepared for Pilbara Iron Pty. Ltd • September 2019

LONG TERM MONITORING AND MANAGEMENT PLAN

Document Information

REPORT NO.	MSA239R01
TITLE	Long Term Dredging Sea Dumping Permit Port of Dampier: Long Term Monitoring and Management Plan
DATE	September 2019
JOB	MSA239
CLIENT	Pilbara Iron Pty Ltd (Pilbara Iron)
USAGE	This Long Term Monitoring and Management Plan (LTMMP) for dredging has been developed to set out the monitoring and management actions under a (seven year) Long Term Dredging Permit.
PRECIS	Pilbara Iron conducts maintenance and emergency dredging within the berths, swing basins and departure channels associated with its East Intercourse Island and Parker Point port facilities in the Port of Dampier. This dredging is required to maintain the design depths of these areas so that they remain navigable. This plan sets out the environmental monitoring and management actions to be undertaken by Pilbara Iron over a seven year period to ensure that the environmental effects of dredging are appropriately managed.
KEYWORDS	Dredging, management, Dampier

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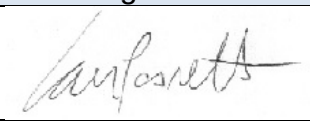
Prepared	Iain Posnett		30/06/2016
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2: Minimal	Prima facie check undertaken for completeness and sense	☐
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Glossary

Acronym	Definition
BPPH	Benthic Primary Producer Habitats
CAMBA	China Australia Migratory Bird Agreement
CSD	Cutter Suction Dredge
DAF	Commonwealth Department of Agriculture and Fisheries
DAMP	Dampier Archipelago Marine Park
DER	Department of Environment Regulation
DIA	Department of Indigenous Affairs
DoF	Department of Fisheries
DoP	Department of Planning
DoT	Department of Transport
DotEE	Department of the Environment and Energy (previously the Department of the Environment)
DPA	Dampier Port Authority – now PPA
DPaW	Department of Parks and Wildlife
DSD	Department of State Development
EII	East Intercourse Island
EMS	Environmental Management System
FID	Frequency Intensity Duration
HSEQ	Health, Safety, Environment and Quality
JAMBA	Japan Australia Migratory Bird Agreement
LAT	Lowest Astronomical Tide
LTMMP	Long Term Monitoring and Management Plan
MMA	Mermaid Marine Australia
NAGD	National Assessment Guidelines for Dredging
PAH	Polycyclic Aromatic Hydrocarbons
Pilbara Iron	Pilbara Iron Pty Ltd
PP	Parker Point
PPA	Pilbara Ports Authority
RTIO	Rio Tinto Iron Ore
SAP	Sampling and Analysis Plan
SDP	Sea Dumping Permit
SST	Sea Surface Temperature
TACC	Technical Advisory and Consultative Committee
TRH	Total Recoverable Hydrocarbons
TSHD	Trailer Suction Hopper Dredge
WC	Water Corporation
WEL	Woodside

1 Background

1.1 Purpose and Context

Pilbara Iron Pty Ltd (Pilbara Iron, the Proponent) intends to carry out maintenance and emergency dredging of its port infrastructure within the Port of Dampier under a (seven year) Long Term Dredging Permit (LTDP). The Proponent is a wholly owned company of Rio Tinto Limited (Rio Tinto) and is a management arm for the Rio Tinto Iron Ore product group that operates and maintains all mining, rail, power and port facilities in the Pilbara wholly owned and joint venture operations.

This Long Term Monitoring and Management Plan (LTMMP) for dredging has been developed to manage the environmental performance of maintenance dredging that may be carried out under the LTDP. Maintenance dredging within the berths, swing basins and departure channels associated with the Parker Point (PP) and East Intercourse Island (EII) port facilities in the Port of Dampier is required to maintain the design depths of these areas, so that they remain navigable.

In Australian waters, ocean disposal of dredged material is regulated by the Commonwealth Department of the Environment and Energy (DotEE) under the *Environment Protection (Sea Dumping) Act 1981* (the Sea Dumping Act) by applying the National Assessment Guidelines for Dredging (the NAGD) (Commonwealth of Australia 2009).

The NAGD(2009) contains provision for the granting of LTDPs for maintenance dredging on the following basis:

- An assessment of the applicant's capacity to meet their obligations under the *Sea Dumping Act 1981* and any permit granted;
- Establishment of a Technical Advisory and Consultative Committee (TACC) for long-term management; and
- Development and implementation of a satisfactory LTMMP for the loading and disposal activities, and provide a Sampling and Analysis Plan (SAP) to support future applications.

In order to identify whether proposed dredge material is suitable for ocean disposal, physical and chemical analysis of the sediment to be dredged is required to demonstrate it is of low risk. Choice of the disposal site must also be guided by physical, chemical and biological parameters, so that the potential impacts of sea disposal can be identified, minimised and monitored as appropriate. Safeguards for those actions are addressed within the accompanying LTDP application and the SAP which sets out how sediment chemistry will be assessed following the end of the currency period for existing data.

It is the intention of this LTMMP to provide a framework for the development of specific monitoring and management programs to ensure environmental targets are met for the ocean disposal of maintenance dredging spoil by the Proponent over the lifetime of a (seven year) LTDP.

1.2 Environmental Management Framework

The Proponent's Port Operations at Dampier are subject to the Rio Tinto (WA) Health, Safety, Environment, Community and Quality Policy (Appendix A). The Policy is the guiding document for environmental management and provides context and specific direction for continuous improvement.

Environmental performance at the Dampier Port Operations is managed under Rio Tinto (WA)'s Environmental Management System (EMS) that addresses all activities with a potential to affect the environment. That system is consistent with ISO14001:2015 and its key elements include assessing environmental risk, managing to prevent impacts, monitoring the effectiveness of that management and improving where necessary. The risk assessment process includes undertaking detailed site investigations of the biological and physical environs. Where these investigations identify significant environmental issues, management measures are incorporated into the dredging design to avoid, where practicable, and/or minimise potential impacts. This LTMMP will fit under the Rio Tinto (WA) EMS.

In compliance with the Rio Tinto (WA) EMS and the DotEE objectives for sea dumping, the LTMMP sets out:

- Strategies for the management of waste and alternatives to sea disposal;
- Environmental performance objectives and management strategies and actions to attain them;
- Monitoring to demonstrate that strategies are effective and corrective actions to be undertaken should monitoring suggest performance objectives are not being met;
- Contingency planning to cover failure of management actions;
- Mechanisms directed at the continual improvement of performance; and
- Auditing, reporting and review requirements for the above.

1.3 Technical Advisory and Consultative Committee

In 2005, the Dampier Port Authority (now the Pilbara Ports Authority - PPA) established a TACC to assist in the management of dredging and dredged material placement activities within the Port of Dampier (the DTACC). This group has been established in line with the NAGD. Membership of the group is drawn from a variety of stakeholders including:

- PPA
- Community representative
- DotEE

- Department of Parks and Wildlife (DPaW)
- Department of Environment Regulation
- Department of Fisheries (DoF)
- Department of Indigenous Affairs
- Department of State Development
- Department of Transport
- Department of Planning
- Mermaid Marine Australia
- Rio Tinto – on behalf of the Proponent
- Water Corporation
- Woodside

The DTACC meets twice per annum or more frequently as required, such as might happen during dredging campaigns. The Terms of Reference for the DTACC are available at: www.pilbaraports.com.au. The role of the DTACC is to provide a single point of reference for dredging planning and management in the Port of Dampier, and to facilitate the flow of information from these groups/agencies to and from Port of Dampier stakeholders. The Proponent is an active member of the DTACC and uses that forum for consultation and feedback on its dredging proposals.

The DTACC is a forum:

- for information to flow to stakeholders, such as forward dredging plans and opportunities to combine resources;
- where a proponent can seek comment on a proposal, such as under the NAGD, with comments collated by the DTACC chair, conflicts resolved and provided back to the proponent for submission to the DotEE;
- where members can have input to the forward planning of dredging issues within the port such as spoil ground utilisation; and
- where opportunities to combine resources can be captured, such as joint research.

Since the initial formation of the DTACC's predecessor group (the Dampier Spoil Ground Management Group), the consultative forums managing spoil ground in the Port of Dampier has convened 24 times (as at end 2016).

2 The Port of Dampier

2.1 Location and Uses

The Port of Dampier is located on the Pilbara coast in the northwest of Western Australia (Figure 1). The Port of Dampier has a short history of development and, unlike many other Australian ports, is not located at the terminus of a river system. The nearest townships are Dampier, located 5 km to the south west of PP, and Karratha, located 20 km to the east. The Port of Dampier is remote from any catchment influences such as agricultural and urban runoff due to its physical location on the Burrup Peninsula, distance from major river mouths and location in an area of low annual rainfall.

The Port of Dampier exported over 172 million tonnes of products (iron ore, liquefied natural gas, salt and other products) for the 2014/2015 period. It is the world's second largest port for bulk exports, with in excess of 5,000 vessel visits in 2014/2015 (PPA 2016a). Commercial prawn fishing occurs in Nickol Bay and to a lesser extent in Mermaid Sound. Wet lining for finfish also occurs in the Dampier Archipelago. The Archipelago is used for aquaculture of pearls by the *Pinctada maxima* and other pearl industries. The waters of the Dampier Archipelago are used extensively for general boating, fishing, swimming and other recreation pursuits by the people of Dampier, Karratha, and other areas of the Pilbara.

The Port of Dampier is surrounded by a proposed Western Australian marine protected area, the Dampier Archipelago Marine Park (CALM 2005). Formal declaration of that area as a marine protected area has not progressed since the indicative management plan was published in 2005. In addition, the Commonwealth has proclaimed a marine reserve (the Dampier Commonwealth Marine Reserve, or Dampier CMR) and is currently preparing a draft management plan that is scheduled to be finalised around mid-2017. Further details on the Dampier CMR are provided in Section 4.9 of the LTMMP.

2.2 Dredge Areas

During the period of the LTDP, dredging campaigns may occur in some or all of the area depicted in Figure 2.

Characteristics of the Proponent's operational dredge area are detailed in Section 3.3 and 4 of this LTMMP.

2.3 Disposal Areas

The Port of Dampier currently contains three spoil grounds which can be considered for disposal based on characteristics of specific dredging programs. These spoil grounds are named East Lewis Island Spoil Ground, Spoil Ground A/B and Spoil Ground 2B, as shown in Figure 1.

The East Lewis Island Spoil Ground was used as a spoil ground for much of the original dredging of the Proponent's port infrastructure (DPA 2010). Spoil Ground A/B was established in 1986 to accommodate Woodside's LNG shipping channel capital dredging program. Spoil Ground 2B was established for Woodside's Pluto LNG Development and first used for spoil disposal in 2007.

Under the present PPA Spoil Ground Management Plan (DPA 2012), the East Lewis Island Spoil Ground and Spoil Ground A/B are no longer used for disposal of large capital dredging programs. These spoil grounds do have capacity to store volumes of spoil from smaller dredging programs (such as maintenance dredging), especially where dredging plant (such as hopper barges) cannot safely use the offshore grounds. Material from larger capital dredging programs is to be placed at Spoil Ground 2B.

The capacity within Spoil Ground A/B is also retained for future emergency dredging campaigns. This ground is suitable for this use due to its proximity to Port infrastructure, facilitating short cycle times and rapid clearance.

Spoil disposal is proposed to occur at Spoil Ground A/B or Spoil Ground 2B (see Table 1 for spoil ground coordinates). All spoil disposal is subject to prior agreement from the PPA and following consultation with the DTACC. The East Lewis Island Spoil Ground has not been considered for use as a spoil disposal site under the current LTMMP/LTDP application.

Characteristics of the disposal sites are detailed in Section 3.3 and 4 of this LTMMP.

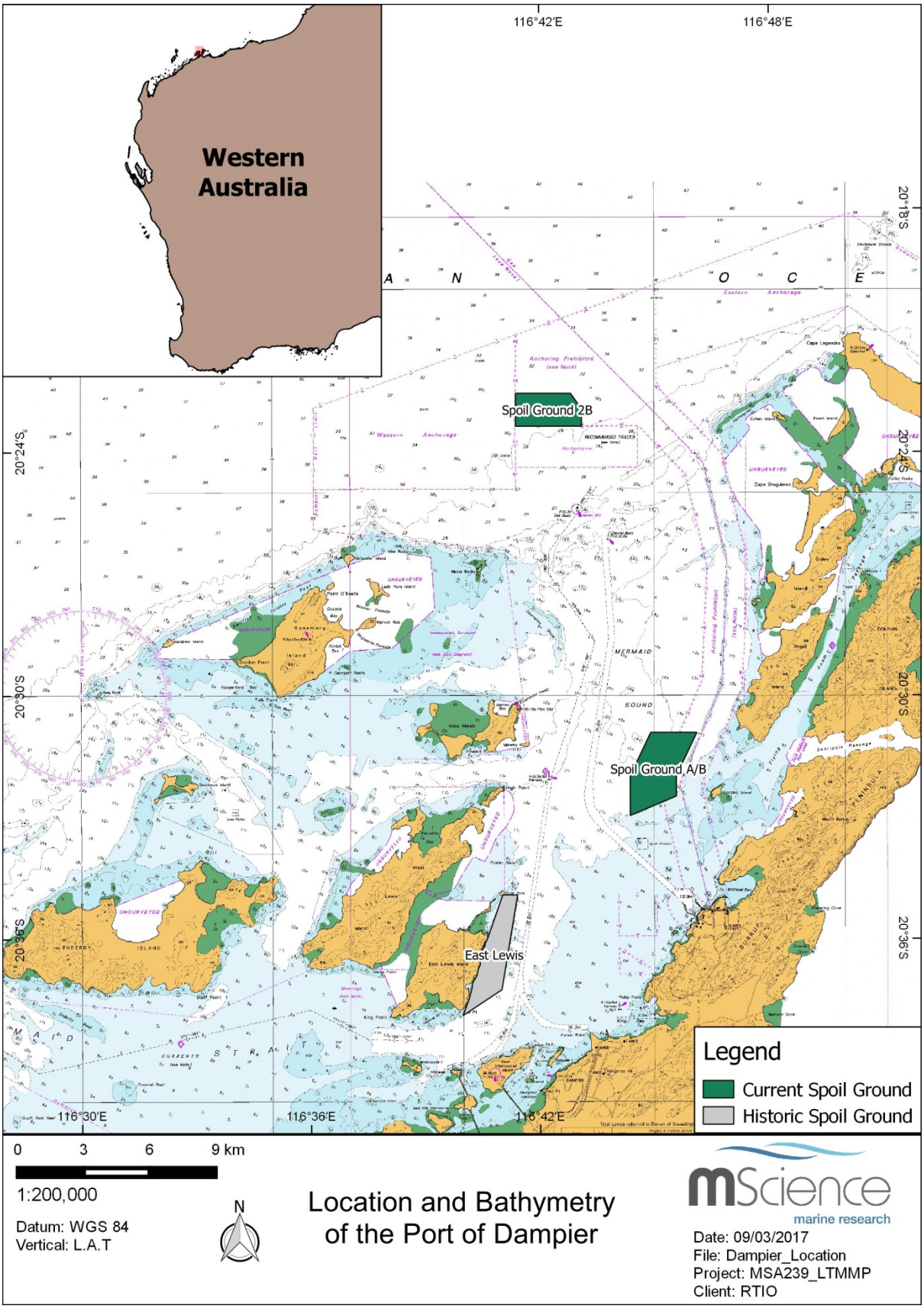
Table 1 Spoil ground coordinates

Spoil Ground	Longitude	Latitude
Spoil Ground A/B (Site code AU0088A)	116° 44' 53.880" E	20° 30' 54.720" S
	116° 46' 6.240" E	20° 30' 54.720" S
	116° 45' 34.560" E	20° 31' 59.880" S
	116° 44' 21.480" E	20° 31' 59.880" S
	116° 45' 34.389" E	20° 32' 29.433" S
	116° 44' 22.055" E	20° 32' 57.766" S
Spoil Ground 2B (Site code AU0088B)	116° 41' 22.795" E	20° 22' 33.343" S
	116° 42' 49.038" E	20° 22' 33.491" S
	116° 43' 6.245" E	20° 22' 56.290" S
	116° 43' 6.198" E	20° 23' 22.314" S
	116° 41' 22.697" E	20° 23' 22.138" S

2.4 Dredge History

The Port of Dampier was constructed in the mid 1960's to land construction materials and domestic supplies for Hamersley Iron's mine operations and to export iron ore product. Periodic maintenance and capital dredging campaigns have assisted to increase the capacity of the Dampier Port Operations to around 160 Mtpa. In the late 1980's, Woodside's North West Shelf Venture (NWSV) selected the area to establish its Karratha Gas Plant and associated port facilities for export. Further development took place in 2007 when Woodside were granted approval for the Pluto LNG Development, including a new port facility. Table 2 details the dredge history of the area.

Figure 1 Location and bathymetry of the Port of Dampier and spoil grounds



* East Lewis Spoil Ground not proposed for use in the LTDP

Figure 2 Potential dredging area within the Proponent's lease area within the Port of Dampier

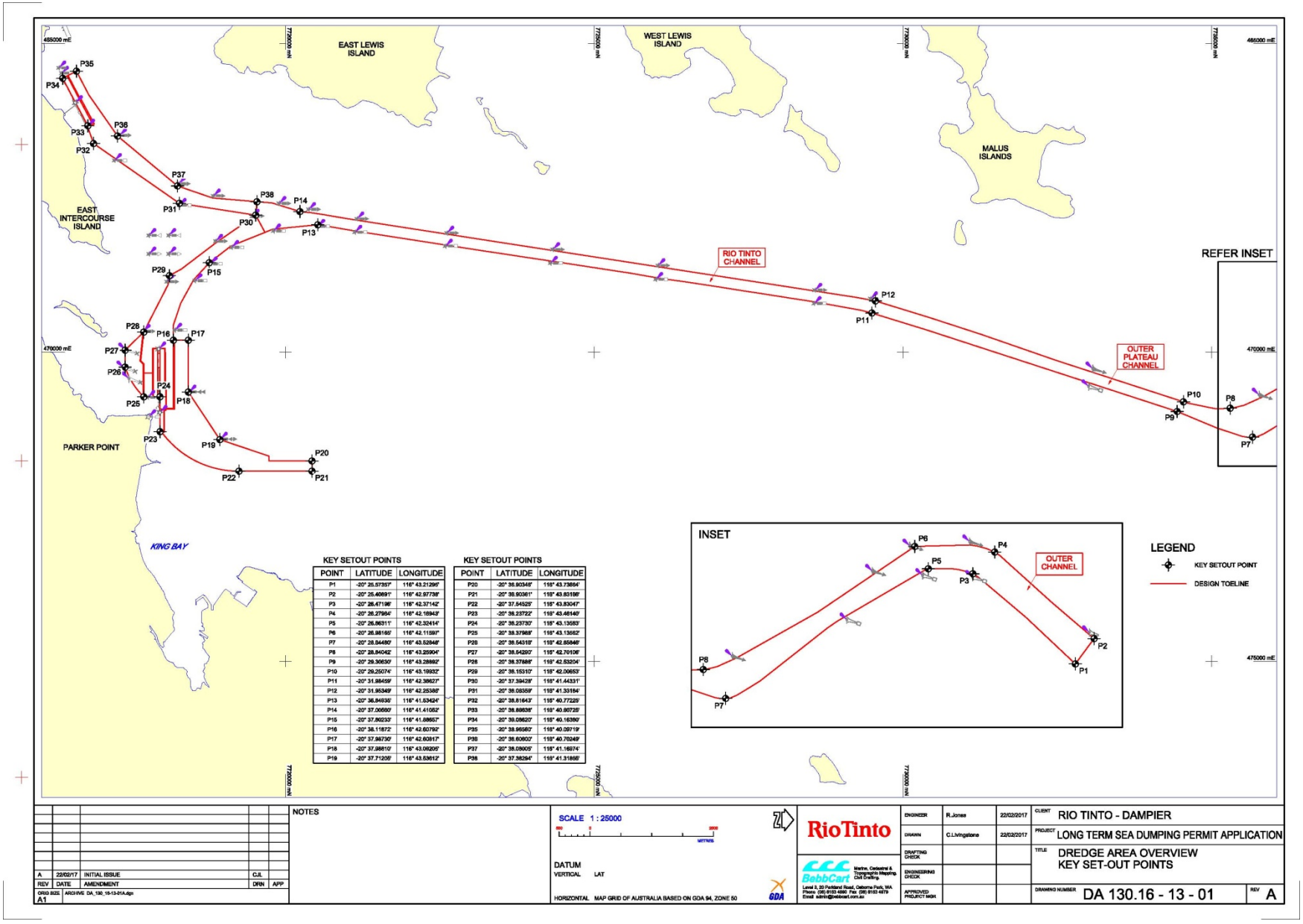


Table 2 Dampier dredging history

Date	Proponent	Dredging program	Dredge Material Volume (m^3)	Spoil Ground
2016*	Pilbara Iron	Maintenance dredging of PP and EII and shipping channels (SD2015/3122)	650,000	A/B and 2B
2010 – 2012	Pilbara Iron	Maintenance dredging of PP and EII and shipping channels (SD2009/1122)	600,000	A/B
2007 - 2010	Woodside	Capital dredging for the Pluto LNG Development	14,100,000	A/B and 2B
2006 - 2007	Pilbara Iron	Capital (SD2006/0036) and maintenance (SD2005/0031) dredging for PP berths	~3,000,000	East Lewis Island and A/B
2005 - 2006	Woodside	Capital dredging for the LNG Phase V Development	3,300,000	A/B
2004	Hamersley Iron	Capital dredging for PP berths and maintenance dredging of the shipping channel	1,830,000 (capital) 70,000 (maintenance)	East Lewis Island and A/B
2004	DPA	Capital dredging for the Bulk Liquid Berth Facility	4,609,000	A/B
2003	Woodside	Capital dredging for the Trunkline Systems Expansion	1,060,000	A/B
1998	Hamersley Iron	Capital dredging for shipping channel and maintenance dredging around PP and EII berths	2,000,000 (capital) 800,000 (maintenance)	A/B

Date	Proponent	Dredging program	Dredge Material Volume (m^3)	Spoil Ground
1994	Woodside	Capital dredging for the berth pocket for LNG ships	700,000	A/B
1989	Woodside	Maintenance dredging of the LNG shipping channel	149,700	A/B
1986 - 1987	Woodside	Capital dredging for the LNG shipping channel	6,600,000	A/B
1970 - 1971	Hamersley Iron	Capital dredging to widen main shipping channel and extend EII	760,000	East Lewis
1968	Hamersley Iron	Capital dredging of main shipping channel	1,500,000	East Lewis
1965	Hamersley Iron	Capital dredging of main shipping channel and PP	2,500,000	East Lewis

*Not started at the date of this LTMMP

Hamersley Iron and Pilbara Iron are wholly owned companies of Rio Tinto Limited (Rio Tinto) within the Rio Tinto Iron Ore product group

2.4.1 History of Sediment Contaminants

Testing of sediments for previous dredging programs within the Port of Dampier has been undertaken on many occasions by a range of proponents. Table 3 details the previous sediment testing campaigns (for maintenance and capital dredging programs) over the past 10-15 years and includes any noteworthy contaminants detected.

On the basis of past investigations of sediment chemistry from the Port of Dampier, the contaminants of concern depend mainly on the sediment type and the proximity to existing berths, load out facilities and shipping routes. This is summarised below:

- Organotins and some metals above screening guidelines have been found, primarily within or around existing berth-load out areas, but organotin levels have reduced significantly since being banned on large vessels;
- The distribution of contaminants has been confined largely to the fine sediments in the upper strata (0.5 m);
- The detection of contaminants has been more likely to occur in the sediments of high vessel traffic areas, berths, loading facilities and previously dredged areas such as channels that accumulate sediments;
- Consolidated sediments underlying upper soft strata have been very unlikely to contain contaminants above screening levels;
- Consolidated sediments and calcarenite have tended to be effectively impermeable to contamination by particulate matter and to migration of dissolved contaminants in pore waters;
- Naturally occurring high levels of Arsenic and Nickel are present within the Port of Dampier, Dampier Archipelago and the Pilbara Region;
- The presence of Total Recoverable Hydrocarbons (TRHs) has usually been low. The only exception to this is when Polycyclic Aromatic Hydrocarbons (PAHs) were found around existing berth-load out areas during a study conducted by SKM (2009). Recent testing in the area in 2015 found no trace of TRH’s (MScience 2015); and
- All surveys conducted have confirmed that the sediment quality meets the applicable guidelines for safe ocean disposal at that time.

Table 3 Dampier sediment characterisation history

Dredging Program (Reference)	Proponent	Noteworthy Contaminants Detected in which the 95%UCLof the Mean Exceeded Screening Levels (dashes indicate 95%UCL below screening guideline)			Safe for Ocean Disposal[#]
		TBT*	Metals	Organics	
ChEMMS* (1992 survey) (LDM 1995)	Woodside	95% UCL above screening levels, lower concentrations of 5-7 µg Sn/kg found in oysters	-	-	N/A
Trunkline Systems Expansion (1998 survey) (LDM 1998)	Woodside	-	-	-	Yes
Dampier Port Upgrade – PP Extension (MScience 2004a)	Hamersley Iron	-	Elevated levels of aluminium and iron, remaining metals below screening levels	-	Yes
Contaminant assessment in selected Pilbara marine coastal sediments (DoE 2006)	DoE (WA)	-	Arsenic above screening level in inner harbour	-	N/A
Dampier Port Upgrade (MScience 2006a)	Pilbara Iron	Above screening level (5 µg Sn/kg) at: - PP (185 µg Sn/kg) - EII (96 µg Sn/kg) - Area E-P (32 – 62 µg Sn/kg)	Nickel samples above screening levels (21 mg/kg) at East Lewis Spoil Ground (26.5 mg/kg)	-	Yes
Pluto LNG Development (SKM 2006)	Woodside	-	Some arsenic, chromium, nickel and silver samples above guidelines, however, 95% UCL for all metals were below guidelines	-	Yes
Spoil Ground 2B (SKM 2008)	Rio Tinto	-	-	-	N/A
Maintenance Dredging (SKM 2009)	Pilbara Iron	Above screening levels (5 µg Sn/kg) in PP departure channel (8.8 µg Sn/kg) and uppermost (50 cm) of EII sediments (26.9 µg Sn/kg). Above maximum level (70 µg Sn/kg) in 50-100 cm of EII sediments (11,617 µg Sn/kg)	Chromium above screening levels (80 mg/kg) at: - PP (97 mg/kg) - PP departure channel (94 mg/kg) - EII (167.7 mg/kg) - EII departure channel (86 mg/kg) - Reference site (80.3 mg/kg)	Total PAH above screening level (4,000 µg/kg) at EII	Yes

Dredging Program (Reference)	Proponent	Noteworthy Contaminants Detected in which the 95%UCLof the Mean Exceeded Screening Levels (dashes indicate 95%UCL below screening guideline)			Safe for Ocean Disposal[#]
		TBT*	Metals	Organics	
			Nickel detected above screening levels (21 mg/kg) at: - PP (34 mg/kg) - PP departure channel (37 mg/kg) - EII departure channel (35.3 mg/kg) - Main channel (30 mg/kg) - Reference site (27 mg/kg) Nickel above maximum level (52 mg/kg) at EII (60 mg/kg) Copper above maximum level (270 mg/kg) at EII (837 mg/kg) Zinc above screening level (200 mg/kg) at EII (257 mg/kg)		
Dampier Marine Service Facility Upgrade (Worley Parsons 2009)	Dampier Port Authority	-	-	-	Yes
Pluto Train 3 Expansion (MScience 2010a)	Woodside	-	Arsenic detected at 25.24 mg/kg in the Nearshore Outer trunkline zone (above screening level of 20 mg/kg)	-	Yes
Heavy Load Out Facility (ERM 2011)	Chevron	-	-	-	Yes
Heavy Load Out Facility (Worley Parsons 2012)	Dampier Port Authority	-	-	-	Yes
Maintenance Dredging (MScience 2015)	Pilbara Iron	-	Chromium above screening levels (80 mg/kg) at EII berths (94.3 mg/kg) Nickel above screening levels (21 mg/kg) at: - EII berths (39.7 mg/kg) - PP berths (23.7 mg/kg)	-	Yes
Sediment Assessment (Jacobs 2015)	Pilbara Ports Authority		Nickel above screening level (21 mg/kg) at: - 3A (Spoil Ground A/B) (22.4 mg/kg) - 5A (EII) (26.2 mg/kg) - 6A (EII) (28 mg/kg) - 9A (General Port) (24.7 mg/kg) - 11A (EII) (24.2 mg/kg)	-	N/A

Dredging Program (Reference)	Proponent	Noteworthy Contaminants Detected in which the 95%UCLof the Mean Exceeded Screening Levels (dashes indicate 95%UCL below screening guideline)			Safe for Ocean Disposal#
		TBT*	Metals	Organics	
Sediment Assessment (GHD 2016a)	Pilbara Ports Authority	-	Nickel above screening level (21 mg/kg) at SP1 (EII departure channel) (27.2 mg/kg) Arsenic above screening level (20 mg/kg) at: - SP4 (General Port) (25.8 mg/kg) - SP16 (General Port) (29.3 mg/kg)	-	N/A

N/A - not applicable since survey was designed for sediment characterisation only and no application for ocean disposal was required or sought
Hamersley Iron and Pilbara Iron are wholly owned companies of Rio Tinto Limited (Rio Tinto) within the Rio Tinto Iron Ore product group
*TBT screening levels increased from 5 µg/kg to 9 µg/kg when NODGDM was superseded by the NAGD (Commonwealth of Australia 2009) in early 2009

2.4.2 Contaminant Classification of Proponent's Dredge Area

The potential sources of contamination within the area to be dredged are detailed in full in the SAP which accompanies this LTMMP (see Appendix C).

As stated in Section 3.1 and the accompanying SAP (Appendix C), it is anticipated that up to approximately 350,000 m^3 of dredge material is to be disposed on a biennial basis as a result of maintenance dredging activities over the seven year life of the permit (a maximum total of 1,225,000 m^3).

The NAGD classifies maintenance dredging projects with a proposed dredge volume between 50,000 - 500,000 m^3 as a 'medium-sized project' and suggests that the dredge area is divided into distinct sites based on their suspected contaminant status. Table 4 details the sediment risk classifications of the proposed dredge zones based on information gathered from past studies (2.4.1). As per Appendix D of the NAGD, dredge zones should be classified as 'probably contaminated', 'suspect' or 'probably clean'. For the purposes of the SAP associated with this LTMMP, 'probably contaminated' and 'suspect' have been grouped under a single classification 'potential contamination'.

Table 4 Dredge area risk classification

Zone	Depth (m)	Classification
Berths and Swing Basins	12.0 – 21.5	Potential Contamination
Departure Channels	15.5 - 15.6	Probably Clean

The classification of port/dredge zones (see Table 4) into potentially contaminated and probably clean is based on the historic distribution and nature of contaminants (Section 2.4.1) and current knowledge of the background environment of previously dredged areas (Table 3 and Section 4). Review of those sections suggests that areas in and around berths and the inner departure channels should fall into a 'potentially contaminated' category while areas of the distal departure channel are very unlikely to differ from native sediment chemistry and should be categorised as 'probably clean'.

2.5 Applicable Legislation and Approvals

Maintenance dredging within the Port of Dampier must comply with the following Commonwealth and Western Australian environmental legislative and policy requirements for the duration of the LTMMP/LTDP. Where an act is listed, that includes reference to any regulations under the act:

Commonwealth:

- *Biosecurity Act 2015*
- *Environment Protection (Sea Dumping) Act 1981*
- *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act)
- *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*

State (WA):

- *Environmental Protection Act 1986*
- *Pollution of Waters by Oil and Noxious Substances Act 1987*
- *Biodiversity Conservation Act 2016*
- *Port Authorities Act 1999*

International Conventions:

- *International Convention for the Prevention of Pollution from Ships 1973/1978 (MARPOL 73/78)*
- *International Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1972 (London Protocol)*
- *International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004*

Table 5 provides information on current and previous approvals granted to the Proponent or its related companies (e.g. Hamersley Iron, Pilbara Iron).

The current SDP held by the Proponent (SD2015/3122) for the Port of Dampier extends until 7 April 2019. It permits disposal of 650,000 m^3 of dredged material derived from maintenance dredging for access within the berths, swing basins and

departure channels associated with the PP and EII facilities. Disposal is permitted in either Spoil Ground A/B or Spoil Ground 2B.

Table 5 Current and historic sea dumping approvals

Permit number	Volume approved for disposal (cubic metres)	Year Permit Granted	Purpose
SD2015/3122	650,000	2016	Maintenance dredging at PP, EII and departure channels
SD2009/1122	600,000	2009	Maintenance dredging at PP and EII
SD2005/0031 (maintenance) SD2006/0036 (capital)	~3,000,000	2006	Capital dredging for additional berths at PP (DPU-B)
No permit number issued	70,000	2004	Maintenance dredging of the main shipping channel
No permit number issued	1,830,000	2004	Capital dredging for additional berths at PP (DPU-A)
No permit number issued	5,000	2000	Maintenance dredging of berth pockets at PP
No permit number issued	800,000	1998	Maintenance dredging at PP and EII berths
No permit number issued	2,000,000	1998	Capital dredging of shipping channel

3 Maintenance Dredging and Sea Disposal Requirements

3.1 Dredge Volume

It is anticipated that up to 1,225,000 m^3 of dredge material will require disposal over the life of the LTMMP/LTDP (seven years). This volume has been calculated based on a biennial disposal volume of up to 350,000 m^3, which has been estimated using best available survey information and historic accumulation rates.

Maintenance dredging may be conducted as frequently as biennially. Actual dredged volumes per campaign will vary, depending on the amount of accumulated material within the proposed dredge areas. The actual volumes will be determined from pre and post dredge surveys, but the combination of all dredge campaigns will not exceed the total volume sought in the LTDP application.

3.1.1 Contingency Dredging

The Pilbara coast experiences more cyclones than any other part of Australia, with 48 cyclones of over 90 km/hour occurring between 1910 and 2006 (BOM 2016). The tropical cyclone season extends between December and April, with a peak in February and March.

Pilbara ports have historically experienced varying degrees of infill of berth pockets and channel areas as a result of sediment movement caused by cyclonic events. Following high intensity cyclones, maintenance dredging and offshore disposal has been required to remove sediment from areas critical to the effective functioning of the ports. However, over the last 50 years, the Proponent has never been required to undertake immediate emergency dredging as a consequence of a cyclonic event.

It is anticipated that the permitted dredge volume of the LTDP will cover all maintenance dredging requirements, regardless of origin or cause of accretion within the dredged areas (e.g. whether it arises from a gradual accretion or a more rapid deposition arising from cyclonic event/s).

3.1.2 Planned Capital Dredging

There are no current plans by the Proponent for capital dredging programs within the proposed seven year LTDP period. In addition, there are no known capital dredging programs being proposed by other port users; however, another port user (or new port user) may at some time undertake a capital dredging program within the life of the LTMMP/LTDP.

3.2 Dredge Campaign Methodology

3.2.1 Dredging

Dredging may be conducted biennially over the period of the LTDP (seven years, starting 2018), and may occur in some or all of the area described in Section 2.2. Maintenance dredging campaigns are likely to use either a medium or large Trailer Suction Hopper Dredge (TSHD). In addition, a back-hoe dredge (BHD) may be used in shallow or confined areas close to infrastructure.

A TSHD is a self-propelled vessel equipped with one or two drag arms (each with an attached drag head), powerful pumps and a hopper to store the dredged material. The drag arms are lowered so the drag heads can be trailed across the seabed where material is to be dredged. Suction induced by the dredge pumps generates a strong flow field about the drag head intakes. This flow field entrains particles of bed material. A solids-water mixture is formed, drawn in through the drag heads, up suction pipes in the drag arms and is pumped into the hopper. The coarser-sized solids deposit more rapidly inside the hopper to form a material bed, while some finer-sized particles remain suspended in water overlying the hopper bed. As dredging continues the surface level of the water in the hopper rises till it reaches the (adjustable) level of a weir. Excess water then leaves the hopper by overflowing the weir and is conveyed through an overflow pipe to a discharge point at the base of the vessel. The overflow discharge carries with it suspended solids (predominantly finer, more slowly settling fractions of the dredged material) that have not been retained in the hopper.

A BHD is a variety of mechanical dredger consisting of a hydraulic excavator mounted on a pontoon that operates a bucket to dig up the seabed. BHD's are anchored in position, and moved forward, by spud poles. Once removed from the seabed, material is discharged into a hopper barge.

3.2.2 Disposal

On completion of loading, the TSHD or hopper barge will sail to the nominated spoil ground where its contents are discharged by opening the doors or valves in the hopper bottom. Release of the dredged material will typically be managed so as to preferentially fill deeper sections of the disposal site, although vessel safety and navigational constraints will dictate the exact location of any individual dump. Rate and duration of discharge will depend on the dredging plant selected. Vessel speed during release will vary as a function of the water depth at the site and the type (gradation and cohesiveness) of material being released. Release of the dredged material will be managed to ensure that the spoil ground is filled in an organised and consistent manner. Once empty, the dredge/barge returns to the dredge area where the cycle is repeated. The position of the dredge/barge will at all times be controlled by a vessel positioning system, which will allow the actual track of the vessel to be plotted and the location of individual dump operations to be recorded.

The duration of each disposal event (including positioning and hopper rinsing) may be up to 30 minutes, however, the active disposal phase (when the majority of material is discharged through the bottom doors) is typically less than 10 minutes.

3.3 Existing Dredge and Disposal Sites

Proposed disposal sites are all existing approved spoil disposal grounds as described in Section 2.3. The dredge area is shown in Figure 2 (refer Section 2.2). The following sections discuss their sediment characteristics. Additional physical and chemical environmental characteristics of the dredge and disposal sites are detailed in Section 4.

3.3.1 Physical Characteristics

The following sediment characteristics of the spoil grounds have been inferred from samples collected within and around the spoil grounds during recent surveys of the area (GHD 2016b; Jacobs 2015). Jacobs (2015) identified sediments from sites around Spoil Ground A/B to be largely comprised of silt/clay (~62 % at <0.063 mm), with the next largest fraction being sands (~38% at 0.063-4 mm). No gravel fraction (4-64 mm) was recorded from samples taken during the survey. There are some differences between the spoil grounds with Spoil Ground 2B showing more sands (~67%) and less silt/clay (~33%) than Spoil Ground A/B. The survey found less than 1% gravel in samples from Spoil Ground 2B. Similarly, GHD (2016b) recorded comparable percentage ratios of sands to silts/clays with distance from the port. Samples increased in proportions of sand further from the port. Sites closest to shore, including those within Spoil Ground A/B, were largely comprised of silts/clays (~70%) with smaller proportions of sands (~30%). Further from the port, including within Spoil Ground 2B, sites had higher proportions of sands (~72%) and less silts/clays (~28%).

Most of the material to be dredged is comprised of marine sediments (calcareous sand, silt, clay and gravel shells) and coastal limestone (accreted calcarenite, siliceous calcarenite and calcirudite); however, some material close to shore may include broken down dolerite and granite. It is estimated that the surface marine sediments are up to 5 m thick and the coastal limestone extends below -14.5 m (chart datum). The particle size distribution of material to be dredged has been derived from samples collected for two sediment surveys conducted in 2015 (Jacobs 2015; MScience 2015). In general, material in the channel is approximately 40% fines (<62 µm) and 50% sand (62 – 500 µm) with small amounts of coarser material (~10%), while closer to shore (in berths and swing basins) there is slightly more fines (60%) and less sand (20 - 35%) with the remainder comprised of coarse material.

3.3.2 Chemical Characteristics

Recent analyses of sediment samples taken from within the bounds of Spoil Ground A/B have returned levels below NAGD screening levels for metal concentrations (GHD 2016a). However, samples taken from the outer edge and immediate surrounds of the same disposal site has recorded elevated levels of arsenic (25.8 mg/kg) and nickel

(22.4 mg/kg) (GHD 2016a; Jacobs 2015). Similarly, samples taken from within the bounds of Spoil Ground 2B have returned levels below NAGD screening levels, but samples taken from the outer edge of its southwest corner of that disposal site have recorded elevated levels of arsenic (29.3 mg/kg) (GHD 2016a; Jacobs 2015), suggesting that some areas may be subject to high levels of naturally occurring arsenic.

No recent survey has found detectable levels of organotins, such as TBT, or hydrocarbons within samples taken from within or around the spoil grounds (GHD 2016a; Jacobs 2015).

The most recent chemical characterisation of sediment within the areas to be dredged occurred in 2015 as part of SDP SD2015/3122 (MScience 2015). A survey conducted for PPA in the same year included two sites around the Proponent's facilities, one each at PP and EII (Jacobs 2015). The survey by MScience (2015) found all metals, other than nickel and chromium, to be below screening levels. These exceedances were confined to areas close to the PP and EII berths. Similarly, both these sites, sampled for the PPA study, reported nickel levels above screening levels (Jacobs 2015). However, the occurrence of high concentrations of nickel at inshore sites in the Port of Dampier and throughout the Pilbara is known to be widespread and naturally occurring.

TBT and hydrocarbon levels in sediments within the areas to be dredged were found to be below screening guidelines in both surveys (MScience 2015; Jacobs 2015)

3.3.3 Sediment Flux

A recent sediment stability study of Spoil Ground A/B and Spoil Ground 2B shows that under ambient conditions sediment mobility within the spoil grounds is low, and would quickly return to low levels following a cyclonic event (RPS APASA 2016). In all instances the loss of material is greater at Spoil Ground 2B when compared to Spoil Ground A/B (RPS APASA 2016). No dredging-related impacts were recorded at sensitive coral habitats nearest to Spoil Ground A/B during the intensively monitored three year Pluto dredging/disposal program which used Spoil Ground A/B for part of its spoil disposal, despite the occurrence of several major cyclones over that period.

A study of sediment grain sizes on Spoil Ground 2B suggested that little of the very fine component of sediment dumped on this spoil ground during the Pluto LNG Development remained in the surface sediments (MScience 2008a). The same study also showed a gradient of particle size and chemical composition for sediments between this spoil ground and Hamersley Shoal (nearest sensitive benthic habitat), although sediments at Hamersley Shoal itself were not altered in response to spoil. This suggests that while Spoil Ground 2B is dispersive for fine sediments, dispersion of these sediments is not likely to impact surrounding habitats.

Under the present PPA Spoil Ground Management Plan (DPA 2012), Spoil Ground A/B is no longer used for disposal of large capital dredging programs. However, it currently has capacity to store minor volumes of spoil from smaller dredging programs (such as maintenance dredging), especially where the dredging plant cannot safely

use Spoil Ground 2B such as split hopper barges. Surveys to date suggest Spoil Ground A/B is largely retentive (RPS APASA 2016).

At a DTACC meeting on 16 October 2015, the PPA noted that it would be undertaking a review of all managed spoil grounds within the Port of Dampier (including Spoil Ground A/B). As part of this work, the PPA was to review current/historical assumptions and existing ceilings/limits (e.g. current allowance set aside for emergency dredging and current height/depth restrictions). The outcomes of this review may result in some increased capacity being generated. If the current assumptions/limitations are eased (conservatism reduced), this will result in increased available capacity at Spoil Ground A/B. This spoil ground review will be presented and discussed using the existing DTACC process. Use of Spoil Ground A/B for this current dredging program will be subject to prior agreement from the PPA and following consultation with the DTACC.

Spoil Ground 2B was developed for the capital dredging activities associated with Woodside's Pluto LNG Development (2007 – 2010). That capital dredging program has been the only use of Spoil Ground 2B to date. The site is largely retentive, however as discussed, studies have shown that very little of the fine component of sediment dumped on the spoil ground remains in the surface sediments (MScience 2008a).

Estimates of the theoretical capacity remaining on these grounds provided by PPA in December 2015 were 11 Mm^3 for Spoil Ground A/B and 23 Mm^3 for Spoil Ground 2B, which is deemed sufficient to contain the maintenance dredge material proposed over the life of the LTDP (Section 3.1). The actual volumes that could be placed on these two spoil grounds are considered to be less than the estimated theoretical capacity, but still readily sufficient to contain substantially more than the maintenance dredging volumes being sought through this LTDP application.

3.4 Sampling and Analysis Plan

A Sampling and Analysis Plan (SAP) and SAP implementation report were approved by the DotEE as part of SD2015/3122 granted for maintenance dredging at PP, EII and the departure channels; these are the same areas proposed for the LTDP. These sediment quality data maintain currency until August 2020. In order to maintain currency of valid data over the duration of the LTMMP/LTDP and to ensure that spoil remains suitable for ocean disposal in accordance with the NAGD, a further SAP will be implemented (and submitted) before August 2020.

The SAP to be implemented prior to August 2020 forms part of the LTDP application and allows for volumes based on biennial campaigns. Should the maintenance dredge volumes for campaigns after August 2020 exceed the volumes in the SAP, an amendment for increasing the number of sample sites in accordance with the NAGD will be sought for approval from the DotEE. Based on the implementation of the SAP (scheduled before August 2020), the sediment data would be current for the remaining duration of the LTDP. If another LTDP was required beyond January 2025, then a further SAP would be required to be implemented.

4 Existing Environment

This section characterises the Dampier Archipelago, including the Proponent's dredging areas, the disposal sites and adjacent areas.

4.1 Local and Regional Environment

The Port of Dampier is bounded by the western coastline of the Burrup Peninsula to the east and Dampier Archipelago to the west. The marine waters between both boundaries are relatively shallow with water depths ranging typically between -5 and -20 m Lowest Astronomical Tide (LAT). Waters between these two boundaries are known as Mermaid Sound (Semeniuk et al. 1982). The area is described as a drowned coastal environment of plains interspersed with a number of small islands often fringed by limestone rock formations.

Subtidal substrates generally consist of soft silt/sand sediments of terrestrial origin with occasional limestone rocky reef (Stoddart and Anstee 2005). Fringing and subtidal reef systems provide habitat for a range of species including diverse coral, fish and invertebrate communities mixed with macroalgae. The marine environments of the area are described in Semeniuk et al. (1982) and Wells and Walker (2003a) and the following sections are based on those references, unless cited otherwise.

Rocky Shores

Rocky shores are the most common habitat in the Port of Dampier and the Dampier Archipelago. The coastline is largely Precambrian igneous rock, but in some areas, there is an overlay of Pleistocene limestone. The fauna of the upper shores is sparse, dominated by littorinid snails and grapsid crabs. The intertidal region has a diverse fauna dominated by oysters and associated species such as limpets, chitons, crabs, and barnacles. The biota becomes increasingly diverse in the lower intertidal, with a variety of sessile and motile invertebrates and benthic algae. Corals reach into the lowest portions of the intertidal zone, and then dominate most subtidal rocks in areas of lower turbidity.

Sandy and Muddy Shores

Sedimentary shorelines dominate in the bays and inlets of the Port of Dampier and Archipelago. There are few sandy beaches in the area. The exception is Hearson's Cove on the north-eastern Burrup Peninsula and a few coarse sand beaches and sand flats in the outer areas of the Dampier Archipelago. The sedimentary upper intertidal areas are dominated by extensive mudflats, which generally have mangroves. Seaward of the mangroves, the mudflats extend into subtidal areas. The seabed is mostly mud and fine sand. In many areas both the intertidal and subtidal areas have a rich and diverse benthos; however, the biota is impoverished in the vicinity of the port, including the proposed dredge area and disposal sites, where there is a very fine mud on the bottom. Both seagrasses and algae are also relatively sparse in the intertidal, increasing in the shallow subtidal, but still reduced in biomass compared to temperate regions.

Mangroves

The geographical distribution of mangrove habitat is typically restricted to sheltered areas such as estuaries, tidal creeks and sheltered bays. Mangroves are recognised as being important habitats for feeding grounds and fish nurseries, as well as protecting coastal areas from erosion by stabilising sediments. The Pilbara region supports a small number of mangrove species: *Avicennia marina*, *Aegialitis annulata*, *Aegiceras corniculatum*, *Bruguiera exaristata*, *Ceriops tagal*, and *Rhizophora stylosa*. *Avicennia marina* is the most abundant and ubiquitous of those species.

Coral Reefs

Coral reefs are widely distributed throughout the Dampier Archipelago. Those of the inner and mid zones of the Archipelago, particularly on the western side of the Burrup Peninsula within the Port of Dampier, are often limited to narrow bands adjacent to rocky shorelines. Although live coral cover can be reasonably high, the reefs themselves are generally only a veneer over rock rather than being of entirely biogenic origin.

More consistent and extensive areas of coral occur in the outer Archipelago, particularly at Sailfish Reef, Hamersley Shoal, Legendre Island, the Malus Islands, Flying Foam Passage and the northern end of West Lewis Island. These reefs are up to several hundred metres wide and generally exhibit well-developed reef flats, reef crests and reef slopes. The deeper reef slopes of Sailfish Reef, Hamersley Shoal and Legendre Island are dominated by soft corals (MScience 2007a).

Coral reefs have also been recorded in the vicinity of King Bay, and between Phillip Point and the Dampier Public Wharf. The majority of coral habitat identified within the Port of Dampier occurs in the immediate subtidal area; between approximately Spring Low Water and -4 m LAT (MScience 2005). The majority of corals in the Archipelago occur at depths between 0-10 m (Jones 2004a). A total of 120 scleractinian coral species from 43 genera have been recorded in the Dampier Archipelago (Blakeway and Radford 2005). Coral reef communities fringe the islands and coastline of Mermaid Sound.

No reefs are present in the proposed dredge area. No reefs are present in Spoil Ground A/B, coral communities exist approximately 3 km east of the disposal site at Conzinc and Angel Islands. Equally, no reefs are present within Spoil Ground 2B and the nearest reefs are approximately 7 km to the southeast.

Turf Algae, Macroalgae and Seagrass Communities

Nine species of seagrasses occur in the Dampier Archipelago; *Cymodocea angustata, Enhalus acoroides, Halophila decipiens, Halophila minor, Halophila ovalis, Halophila spinulosa, Halodule uninervis*, *Syringodium isoetifolium, Thalassia hemprichii*. These seagrasses tend to have reduced biomass compared to the dense seagrass meadows found in southern Western Australia (Wells and Walker 2003a). *Halophila sp*. have been observed in small patches at Tidepole Island and covering large expanses of seabed throughout the offshore islands of Dampier (IRC Environment 2003). A survey

of port waters found only *Halophila sp* which occurred ephemerally in small patches, with the largest distribution being in Withnell Bay (Bertolino 2006).

Subtidal limestone pavements within the Pilbara region are colonised by varying abundances of large communities of macroalgae including brown algae species *Sargassum sp*., *Dictyopteris sp*. and *Padina*, green algae species *Halimeda sp*. and *Caulerpa sp*. and red algal species of crustose corallines, non-corallines and algal turf (CALM 2005). Several of these species form thick canopies in summer which can compete with scleractinian corals (MScience 2010b)

4.2 Bathymetry

The bathymetry of the Port of Dampier, including the proposed dredge area and disposal sites, is shown in Figure 1. The seabed of the Dampier Archipelago tends to drop off steeply from the bedrock shoreline of the Burrup Peninsula and various islands, and then assumes a more gradual gradient, sloping to the northeast. Water depths in Mermaid Sound range from 10-12 m outside of dredged infrastructure, reaching greater depths in areas of current scour between islands. A raised limestone bank, trending northeast-southwest, stretches across the entrance of the Sound between Cohen Island and Nelson Rocks. Further offshore, the seabed continues to slope gradually onto the North West Shelf, reaching 30 m around 25 km from the shoreline (north of the Port of Dampier).

4.3 Climate

The regional climate of the Dampier Archipelago has both arid and tropical components, comprising of two dominant seasons; a hot summer with erratic, heavy rainfalls from October to April, and a mild winter with occasional rain from May to September. The average annual rainfall is 261 mm, but it can be highly variable within the Archipelago with most rainfall received typically between January and May (Pearce et al. 2003). The sporadic summer rainfall is associated with tropical cyclones and depressions which develop to the north west of Dampier. Winter rainfall events are the result of passing depressions across the south-west of Australia.

Net annual evaporation is approximately 3500 mm. Evaporation ranges between 200 mm per month during winter months to 400 mm per month during summer months (Pearce et al. 2003).

Winds during winter are predominantly offshore with moderate (5 – 10 knot) to occasionally strong (+35 knot) easterlies. Winds shift from east to south easterly in the morning to north easterly in the afternoon, easing in the evening. During summer, westerly winds are dominant in the morning, shifting to north westerly in the afternoon. Average wind speeds in summer are 5 to 15 knots, although gusts up to 35 knots have been recorded.

Tropical cyclones generally occur between November and April in the Pilbara. Winds in excess of 250 km/hr, torrential rain, storm surges, large waves and substantial movement of coastal sediments can be experienced during cyclones.

4.4 Hydrology

4.4.1 Currents

Water circulation and currents in the Dampier Archipelago are determined by a combination of large scale ocean circulation, tides, local winds (including tropical cyclones) and non-tidal long period waves (continental shelf waves and meteorological effects) (Pearce et al. 2003). Close to the coast, flows are mainly parallel to the shore with speeds ranging from about 5 cm/s (neap tides) to 25 cm/s (spring tides).The magnitude of currents in the Archipelago are firstly influenced by localised bathymetry and secondly by the location of islands (Pearce et al. 2003). Consequently, strong currents flow along the axis of Mermaid Sound and in the channels between the islands due to the narrow passages and the shallow bathymetry.

4.4.2 Tides

Tides within the Dampier Archipelago are semi-diurnal, with mean low water neap and mean high water spring tides ranging from 0.8 m to 4.5 m; however, astronomical tides can be much higher (up to 5.1 m) (Pearce et al. 2003). Tidal current flow in the Burrup Peninsula region is locally influenced by the surrounding islands and channels that form the Dampier Archipelago. Mills (1985) demonstrated that the strongest tidal currents generally occur near the outer extremities of the Archipelago, particularly in the channels immediately adjacent to the south-west end of Enderby Island (75 cm/s). It was also shown that tidal currents diminished towards the north-west of Mermaid Sound (45 cm/s) and are generally weakest in the innermost reaches of the Dampier Archipelago, except in some of the inter-island passages.

4.4.3 Waves and Wind

Wave height and direction within port limits are heavily influenced by the sheltering effect of the Archipelago itself and is determined by oceanography, refraction and bottom friction (Pearce et al. 2003). Long period swell waves which approach from the westerly and north-westerly sectors, are refracted by the complex bathymetry and islands of the Dampier Archipelago and move down Mermaid Sound in a southerly direction. Significant wave heights decrease as the swell progresses from the open ocean waters into the protected waters of Mermaid Sound. Within the southern part of Mermaid Sound, waves are predominately wind generated and are generally small (0.5 m), except under cyclonic conditions when wave height can exceed 1.3 m.

4.5 Water Quality

4.5.1 Physical

Waters of the North West Shelf are usually temperature stratified, with sea surface temperatures (SST) attaining a mean temperature of 29.3°C in March, dropping to 24°C in August. Nearshore, in the semi-enclosed waters of the Dampier Archipelago, temperature means vary from 22.5°C in July/August to 30.4°C in February (Pearce et al. 2003).

Salinity remains relatively constant (34.6-35.6 ppt) temporally, however it can vary spatially. Within the Dampier Archipelago, surface salinity increases from inshore (about 36.7 ppt west of King Bay in March) to further offshore (about 35.5 ppt, around 35 km north of EII in March). Mermaid Sound displays a 'winter hydrographic regime' whereby denser (cooler and more saline) water forms within the Archipelago, and wedges seaward beneath open North West Shelf waters. During summer, a 'summer hydrographic regime' is characterised by vertical stratification on the open continental shelf and elevated salinity in shallower coastal waters (Pearce et al. 2003).

4.5.2 Turbidity and TSS

Water quality investigations have been undertaken throughout the Dampier Archipelago, often as part of compliance monitoring in association with dredging and construction activities.

The offshore reefs of the Dampier Archipelago are characterised by a relatively clear water column; conversely, waters of the inner Archipelago experience naturally higher levels of turbidity as a result of shallow bathymetry, tropical cyclone events and local re-suspension of fine sediments caused by wind and tidal mixing (Stoddart and Anstee 2005).

Past studies have shown that local variation in exposure to wind and wave conditions may cause areas of the Dampier Archipelago to react differently from adjacent areas within a kilometre away. Stoddart and Anstee (2005) found there was a weak but significant relationship between TSS and turbidity, with ranges of 0 to 75 mg/L and 0 to 50 NTU found, respectively, over 19 sites within the Dampier Archipelago. MScience (2010c) established 33 sites to monitor turbidity between November 2007 and August 2010 for the Pluto dredging project. The mean turbidity, outside of dredging periods, at all sites ranged from 0.4 to 3.6 NTU over the 30 month study. Comparison of turbidity during dredging and non-dredging periods indicated that dredging appeared to increase turbidity by <0.5 NTU. Recent maintenance dredge monitoring at three sensitive coral sites around Spoil Ground A/B found mean turbidity readings ranged from 1.4 to 1.9 NTU between the 29 September and 16 November 2016 (MScience 2016). Therefore, the background level of turbidity or TSS is highly site dependent.

4.6 Marine Fauna

A search of the EPBC Protected Matters Database was conducted on 7 February 2017. It identified 14 threatened marine faunal species (Table 6) and 26 migratory marine faunal species (Table 7) that may potentially occur within and /or within the vicinity of the dredging and disposal activities. These include marine reptiles, mammals and birds that potentially occur in or migrate through the area.

Table 6 and Table 7 also provide an indication of the type and likelihood of impact dredging and disposal operations will have on each species. Potential impacts to marine fauna and their management measures are detailed further in Section 5.3.

Table 6 Threatened species listed on the EPBC protected matters database

Species	EPBC Status	Type of Presence	Likelihood of being impacted by dredging/disposal operations	Significant impact?
Blue Whale Balaenoptera musculus	Endangered	Species or species habitat likely to occur within area	Unlikely	N/A
Humpback Whale *Megaptera novaeangliae*	Vulnerable	Species or species habitat known to occur within area	Unlikely	N/A
Short-nosed Seasnake *Aipysurus apraefrontalis*	Critically Endangered	Species or species habitat likely to occur within area	Possible	No
Loggerhead Turtle *Caretta*	Endangered	Breeding known to occur within area	Unlikely	N/A
Green Turtle *Chelonia mydas*	Vulnerable	Breeding known to occur within area	Possible	No
Leatherback Turtle *Dermochelys coriacea*	Endangered	Breeding likely to occur within area	Unlikely	N/A
Hawksbill Turtle *Eretmochelys imbricata*	Vulnerable	Breeding known to occur within area	Possible	No
Flatback Turtle *Natator depressus*	Vulnerable	Breeding known to occur within area	Unlikely	N/A
Grey Nurse Shark (west coast population) *Carcharias taurus*	Vulnerable	Species or species habitat likely to occur within area	Unlikely	N/A
White Shark *Carcharodon carcharias*	Vulnerable	Species or species habitat may occur within area	Unlikely	N/A
Dwarf Sawfish *Pristis clavata*	Vulnerable	Species or species	Unlikely	N/A

		habitat known to occur within area		
Green Sawfish *Pristis zijsron*	Vulnerable	Species or species habitat known to occur within area	Unlikely	N/A
Whale Shark *Rhincodon typus*	Vulnerable	Species or species habitat may occur within area	Unlikely	N/A
Southern Giant-Petrel *Macronectes giganteus*	Endangered	Species or species habitat may occur within area	Unlikely	N/A

Table 7 Migratory species listed on the EPBC protected matters database

Species	EPBC Status	Type of Presence	Likelihood of being impacted by dredging/disposal operations	Significant impact?
Bryde's Whale *Balaenoptera edeni*		Species or species habitat may occur within area	Unlikely	N/A
Blue Whale Balaenoptera musculus	Endangered	Species or species habitat likely to occur within area	Unlikely	N/A
Humpback Whale *Megaptera novaeangliae*	Vulnerable	Species or species habitat known to occur within area	Unlikely	N/A
Dugong *Dugong dugon*		Species or species habitat known to occur within area	Unlikely	N/A
Loggerhead Turtle *Caretta*	Endangered	Breeding known to	Unlikely	N/A

		occur within area		
Green Turtle *Chelonia mydas*	Vulnerable	Breeding known to occur within area	Possible	No
Leatherback Turtle *Dermochelys coriacea*	Endangered	Breeding likely to occur within area	Unlikely	N/A
Hawksbill Turtle *Eretmochelys imbricata*	Vulnerable	Breeding known to occur within area	Possible	No
Flatback Turtle *Natator depressus*	Vulnerable	Breeding known to occur within area	Unlikely	N/A
Reef Manta Ray *Manta alfredi*		Species or species habitat known to occur within area	Possible	No
Giant Manta Ray *Manta birostris*		Species or species habitat likely to occur within area	Possible	No
White Shark *Carcharodon carcharias*	Vulnerable	Species or species habitat may occur within area	Unlikely	N/A
Dwarf Sawfish *Pristis clavata*	Vulnerable	Species or species habitat known to occur within area	Unlikely	N/A
Green Sawfish *Pristis zijsron*	Vulnerable	Species or species habitat known to occur within area	Unlikely	N/A
Whale Shark *Rhincodon typus*	Vulnerable	Species or species habitat may occur within area	Unlikely	N/A
Killer Whale *Orcinus orca*		Species or species habitat may	Unlikely	N/A

		occur within area		
Indo-Pacific Humpback Dolphin *Sousa chinensis*		Species or species habitat known to occur within area	Possible	No
Spotted Bottlenose Dolphin *Tursiops aduncus*		Species or species habitat likely to occur within area	Possible	No
Common Noddy *Anous stolidus*		Species or species habitat may occur within area	Unlikely	N/A
Fork-tailed Swift *Apus pacificus*		Species or species habitat likely to occur within area	Unlikely	N/A
Lesser Frigatebird *Fregata ariel*		Species or species habitat known to occur within area	Unlikely	N/A
Southern Giant-Petrel *Macronectes giganteus*	Endangered	Species or species habitat may occur within area	Unlikely	N/A
Wedge-tailed Shearwater *Puffinus Pacificus*		Breeding known to occur within area	Unlikely	N/A
Bridled Tern *Sterna anaethetus*		Breeding known to occur within area	Unlikely	N/A
Caspian Tern *Sterna caspia*		Breeding known to occur within area	Unlikely	N/A
Roseate Tern *Sterna dougallii*		Breeding likely to occur within area	Unlikely	N/A

Marine Mammals

The waters of the Dampier Archipelago contain a diverse range of vertebrate species. A total of eight species of toothed whale (including five species of dolphin), and four species of baleen whale have been recorded from the proposed Dampier Archipelago Marine Park (DAMP) (CALM 2005). These include the humpback whale (*Megaptera novaeangliae*), killer whale (*Orcinus orca*), Bryde's whale (*Balaenoptera edeni*), the spotted bottle nose dolphin (*Tursiops aduncus*) and the Indo-Pacific hump backed dolphin (*Sousa chinensis*). Blue whales and the other species of whales listed in Table 6 and Table 7 are unlikely to frequent the nearshore waters off Dampier, tending to remain in deep water (>30 m), and are therefore unlikely to be affected. However, compared with all the other species in the Dampier area, the occurrence of the humpback whale (*Megaptera novaeangliae*) is reasonably well documented (BMT Oceanica 2017; Jenner and Jenner 2009; Jenner and Jenner 2011; Jenner et al. 2001), and should be the focus of marine mammal management in the area.

Humpback whales migrate annually from feeding grounds in the Antarctic to breeding grounds in Camden Sound in the Kimberley region of Western Australia. The north bound migration peaks adjacent to the Port of Dampier between approximately the last week of July and the first week of August. The peak of the south bound migration occurs during the last week in August and the first week of September. Jenner et al. (2001) suggested that the majority of migrating whales are found in waters deeper than 50 m; however, some individuals come closer to shore, particularly during the southern migration.

The Dampier region is not an aggregation or calving area for this species, although there is some recent suggestion that Nickol Bay (between Dampier and Karratha, outside the Port of Dampier) may constitute some form of milling area during the southern migration (Jenner and Jenner 2009; Jenner and Jenner 2011). More recent surveys indicate that Nickol Bay is used as a single day staging post, mainly by pods with calves using the areas close to shore during the southern migration (BMT Oceanica 2017). Based on this information, humpback whales may be present in the outer Mermaid Sound during the known migrations, but are unlikely to be in large numbers where dredging and disposal is occurring. Therefore, it is anticipated populations will not be significantly impacted.

Prince (2001) undertook aerial surveys of marine mammals and other large fauna of the Pilbara coast and concluded that Pilbara coastal waters support small populations of dolphins, the majority of which appear to be bottlenose. Dolphins are not protected under the EPBC Act. Dolphins do have the potential to occur in the area, but due to their intelligent and mobile nature, they are not generally considered at threat from dredging or disposal operations. Dugongs (*Dugong dugon*) are also common in the Dampier Archipelago; however their distribution is directed towards seagrass beds (Wells and Walker 2003b). Dugongs are not known to frequent the dredging or disposal areas as there is no adjacent seagrass.

Specific dredging and disposal activities that have the potential to impact marine mammals, and their management measures, are detailed in Section 5.3.

Marine Reptiles

Four species of turtle are known to nest on the islands of the Dampier Archipelago (Prince 1993); Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*), Flatback (*Natator depressus*) and Loggerhead (*Caretta caretta*). The nearest turtle nesting location to Dampier infrastructure is on the north-eastern tip of West Lewis Island (~11 km distant). This site is a minor rookery for green turtles (*C. mydas*), with nesting occurring over the same periods as at other sites in the region. Rosemary Island, to the north of West Lewis Island, has been previously identified as a critical nesting and inter-nesting habitat for hawksbill turtles (Limpus 2009). Subsequently, the Dampier Archipelago (including Rosemary and Delambre islands) has been identified by the May 2017 Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017) as critical nesting habitat for hawksbill and flatback turtles respectively.

Satellite tracking of hawksbill turtles nesting at Rosemary Island (refer: http://www.seaturtle.org/tracking/index.shtml?project_id=1136) indicates that the Proponent's operational areas in the Port of Dampier are not actively used for inter-nesting or foraging activities and so dredging within these areas is unlikely to impact these critical life stages. A flatback turtle satellite tracking program was also conducted by the Proponent at Bells Beach (Cape Lambert) and Delambre Island during the 2010/2011, 2011/2012 and 2012/2013 nesting seasons (Thums et al. in prep). This tracking was conducted concurrent with a maintenance dredging program being undertaken at Dampier and a capital dredging program being undertaken at Cape Lambert. The study broadly identified that while there was a low level of overlap (<five turtles) between flatback turtle inter-nesting areas and the Proponent's operational areas in the Port of Dampier, none of the turtles were entrained within a dredger or struck by marine vessels in that locality. The satellite tracking also showed no apparent avoidance of operational areas or modifications to inter-nesting behaviour, and no common migratory corridors were identified within these areas.

Marine turtles mainly frequent the seagrass beds, in shallow bays, and coral reefs of remote areas to the north of the Dampier Archipelago (CALM 2005), but they are known to occur within the coral communities of Angel and Conzinc Island (MScience, unpublished). Seagrass beds have not been recorded within the vicinity of the dredge or disposal sites and studies have shown the habitat of the inner Dampier Archipelago does not appear to be a key endpoint for foraging behaviour of the green or hawksbill turtles (Pendoley 2005).

Dampier is an active operational port area and as such, is subject to pre-existing levels of elevated artificial light. Lighting on dredgers is kept to a minimum to enable safe operations and, especially given the very short-term nature of dredging campaigns, is not expected to significantly change artificial light levels within the region. Given this, no significant modifications to hatchling dispersal behaviour is expected to occur in association with the maintenance dredging program.

Based on this information, marine turtles may be present but populations will not persist in operational areas for long periods of time due to the limited food source available. It is possible that small numbers of animals, particularly green turtles, will transit through dredge and disposal areas and may be impacted. However, the numbers likely to be impacted will be minimal with dredging vessels maintaining compliance with the management measures detailed in Section 5.3.3, therefore the impact will not be significant.

As many as 12 species of sea snake have been recorded in the Pilbara and may occur in the area, those known to occur in the Dampier region include; *Aipysurus laevis*; *Astrotia stokesii*; *Ephalophis greyi*; *Hydrelans darwiniensis*; *Hydrophis Fordonia leucobalia* and the critically endangered Short-nosed Seasnake (*Aipysurus apraefrontalis)* (Wells and Walker 2003b). Little is known of the size of their populations, distribution or status within the Port of Dampier; however the olive seasnake (*Aipysurus laevis)* is thought to be the most common in the Pilbara region (Guinea et al. 2004). Seasnakes inhabit a variety of environments, but commonly prefer sandy substrates with seagrass beds. Of those known to inhabit the Dampier Archipelago, the black ringed seasnake (*Hydrelans darwiniensis)* is found in mangroves and mudflats, while the olive (*Aipysurus laevis)* and short nosed seasnake (*Aipysurus apraefrontalis),* inhabit coral reefs. Similar to turtles, seasnakes may be present in the area but populations will not persist in operational areas for long periods of time due to the limited food source available. The olive and short nosed seasnake are likely to inhabit the coral reefs at Conzinc and Angel Island, but it has been reported that very few numbers of the population at Ashmore Reef move more than 50 m from the reef flat (Guinea and Whiting 2005). Therefore, it is unlikely that the seasnakes described will be significantly impacted by dredging or disposal operations.

Specific dredging and disposal activities that have the potential to impact marine reptiles, and their management measures, are detailed in Section 5.3.

Seabirds

The islands of the Dampier Archipelago provide breeding/nesting habitat for 16 species of seabirds which includes migratory species protected by international agreements, the China Australia Migratory Bird Agreement (CAMBA) and Japan Australia Migratory Bird Agreement (JAMBA). There are no large bird colonies near the dredging areas or in the vicinity of the disposal areas. The bird species that frequent the harbour area will be habituated to the port activities, so will not be significantly impacted.

Fish and Sharks

The Dampier Archipelago is known to support 736 fish species, comprised mostly of tropical species with a small number (six) of subtropical species and 31 species with uncertain distributions (Hutchins 2003). The majority of the known fish species are wide ranging (75%), whereas smaller numbers occur only in northern Australia (10%), Western Australia (5%) and the Northern Territory (2%). The EPBC Act Protected Matters Database identified five (Table 6) threatened shark species as potentially occurring within and/or in the vicinity of dredging and disposal areas, but all are considered unlikely to be impacted.

4.7 Introduced Marine Pests

Eight introduced marine species have been recorded in the literature from the Dampier Archipelago and Mermaid Sound (Jones 2004b; Wells et al. 2009). Of the species shown in Table 8, three are well known, widely-distributed foulers in Australian waters. No studies or anecdotal data are available showing evidence that introduced barnacles in the Dampier area have caused any ecological consequences, such as adverse impacts on native species.

In 2011, *Perna viridis* was discovered on a mobile platform in the Port of Dampier. The incident was formally reported and the platform cleaned under surveillance of the WA DoF. The widespread and highly invasive *Didemnum perlucidum* is listed as being found at several sites throughout the Port area (DoF 2014), although the DoF advice was that control is not recommended outside of marine protected areas.

Ongoing surveillance programs are conducted on vessels and the King Sound Supply Base as part of dredging programs (and other planned activities) mandated under the environmental management programs of approved industry proposals (e.g. Ministerial Statement conditions).

Table 8 Known IMP species of Dampier

Species	**Family**	**Method of Introduction**
Balanus Amphitrite	Crustacea (Barnacle)	Hull fouling
Balanus cirratus	Crustacea (Barnacle)	Hull fouling
Balanus trigonus	Crustacea (Barnacle)	Hull fouling
*Balanus reticulatus**	Crustacea (Barnacle)	Hull fouling
*Megabalanus rosa**	Crustacea (Barnacle)	Hull fouling
*Megabalanus tintinnabulum**	Crustacea (Barnacle)	Hull fouling
Botrylloides leachi	Ascideacae (Sea squirt)	Unknown
Perna viridis	Bivalvia (Mussels)	Hull fouling
*Didemnum perlucidum**	Didemnidae (Tunicates)	Unknown

*Widely distributed foulers

4.8 Recent Surveys

A summary of key environmental studies and monitoring programs associated with the dredging and disposal area is provided inTable 9.

4.9 Marine Protected areas

While there are no marine protected areas within the Port of Dampier, an area of approximately 122,170 ha has been proposed as a marine reserve for the Dampier Archipelago based on the marine and coastal environment of the region. The combination of offshore islands, intertidal and subtidal reefs, mangroves, macroalgal communities and coral reefs, was identified by the Marine Parks and Reserves Selection Working Group report as having very significant conservation values (Buxton and Cochrane 2015; MPRSWG 1994).

The proposed reserve area (Figure 3) is divided into three discrete areas intersected by the Port of Dampier. The eastern portion of the proposed marine park extends from the boundary of the Port of Dampier to include Delambre Island and waters adjacent to the eastern most limit of the proposed reserve (CALM 2005). The proposed marine park boundary in this area then extends along the coastline of Nickol Bay to Dixon Island. The deeper waters of Nickol Bay are excluded from the proposed reserve. The western portion of the proposed marine park extends from Rosemary Island in the north to Enderby Island and also includes West Lewis, East Lewis, and Malus Islands. The proposed marine management area extends from Eaglehawk Island to the Fortescue River mouth in the south-west, and includes all waters up to approximately 20 km from the coast (CALM 2005).

Despite the issue of a draft interim management plan for the area in 2005, the marine protected area remains only ‘proposed’ at this stage.

In addition to these State proposed marine parks, the Commonwealth has proclaimed a 1,251 ha marine reserve (the Dampier CMR) that forms part of the North-west Commonwealth Marine Reserves Network. The location and current zoning of the Dampier CMR are shown in Figure 3. The Dampier CMR consists of three zones: a Special Purpose Zone (Ports) (IUCN VI) covering 1,054 ha (~84% of the Dampier CMR), a Marine National Park Zone (IUCN II) covering 104 ha (~8%), and a Habitat Protection Zone (IUCN IV) covering 93 ha (~7%). A draft management plan is currently being prepared by the DotEE; the management plan is scheduled to be finalised around mid-2017.

Table 9 Recent environmental surveys conducted in the Port of Dampier

Program	Summary of Results	Reference
Marine Health and Impact studies	Specialist marine studies undertaken to determine ecosystem health within and surrounding port operations. Highly disturbed sites identified as occurring along the mainland shore, within the range of the port operations. The construction of the causeway at EII was found to reduce current flow, but water quality was being maintained by tidal flushing. Sites around Tidepole Island were found to be moderately disturbed, while outer islands within the Archipelago classified as unmodified.	(IRC Environment 2001) (IRC Environment 2003) (MScience 2004b)
Coral Habitat Monitoring	Baseline data of coral distribution (>10%) determined. Predictions of past (pre-European) coral distributions estimate that 25 to 35% of coral has been lost since 1957. Corals surveyed between 2006 and 2010 for impacts from dredging and disposal during the Proponent's Dampier Port Upgrade. While coral was found to be declining in several areas, this was not associated with dredging effects.	(MScience 2006c) (MScience 2008b) (MScience 2010b)
Dampier Marine Monitoring Program	A monitoring program to examine the effects of the Proponent's port operations on water, sediment, seafood quality, and biodiversity adjacent to the PP facilities was conducted between 2006 and 2010. Elevated nutrient levels were recorded near a wastewater outfall over a number of monitoring events. Fish were found to have naturally elevated levels of arsenic. Suspended sediment concentrations were predominantly influenced by tidal action.	(MScience 2006a) (MScience 2008b) (MScience 2009a) (MScience 2010d)
Artificial Reef, Fish, Coral Recruit and Spawning Monitoring	Monitoring of the King Bay Artificial Reef and reference locations has been undertaken since 2006. Studies determined that recruitment of sediment tolerant corals was seen to be occurring on the artificial reef and coral cover was increasing. Fish density had increased in the artificial reef area but was lower than at control sites.	(MScience 2006b) (MScience 2007b) (MScience 2008b) (MScience 2009b)
Sediment Quality	Numerous surveys with results summarised in Section 2.4.1	

4.10 Sensitive Sites

In the absence of established seagrass beds, corals are identified as the most sensitive biological receptor in the Port of Dampier. Coral community composition and distribution is presented in Section 4.1.

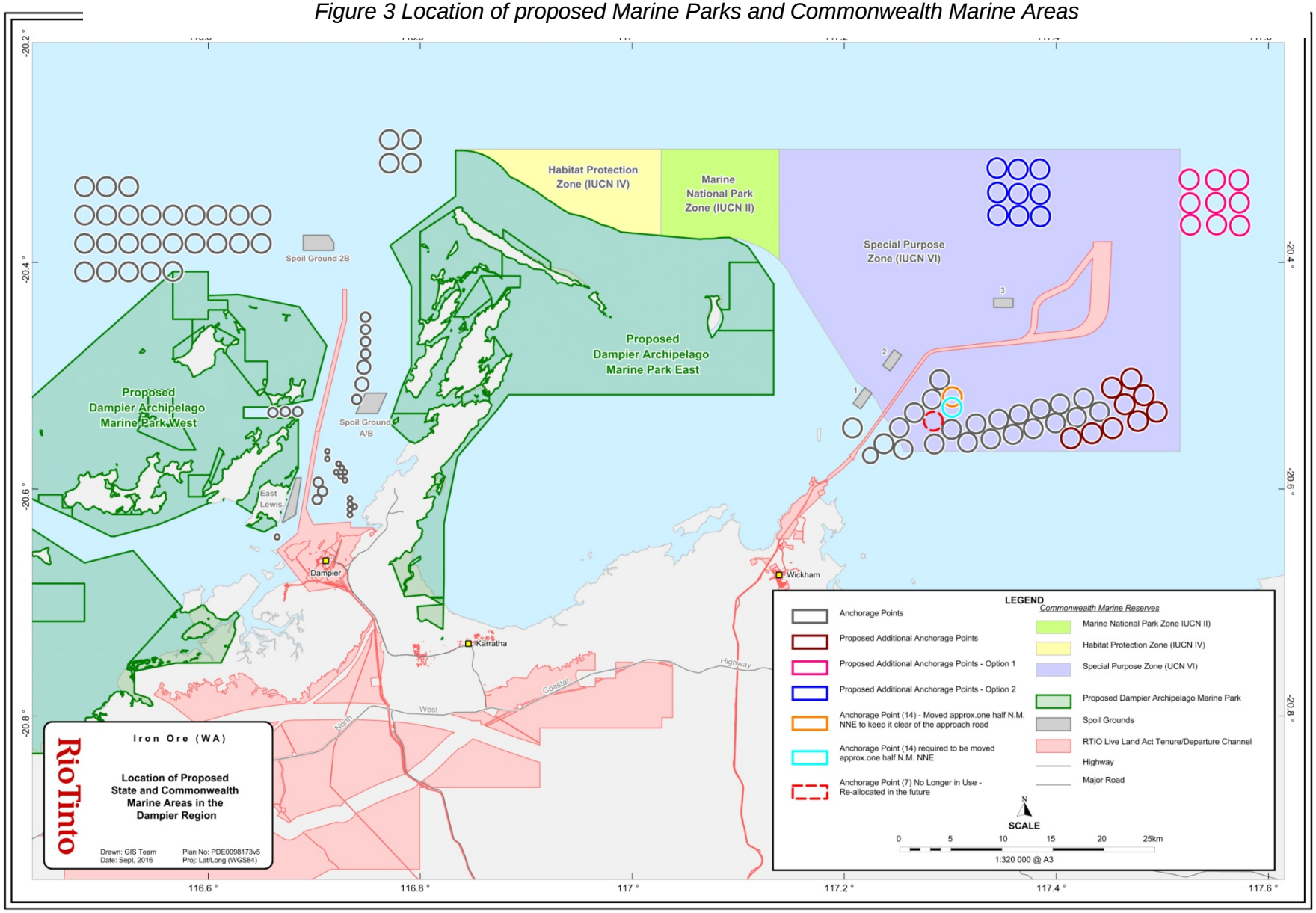
4.11 Other Users

The Dampier region has a history of Aboriginal habitation dating back ~20,000 years (CALM 2005). There are numerous sites where shell middens, artefacts and rock art remain, especially on the Burrup Peninsula. There is still a strong Aboriginal identity in the region today and the area is culturally and recreationally significant to Indigenous people.

The Proponent maintains an active program of Aboriginal heritage consultation and management. Despite this and previous investigations into Aboriginal heritage values undertaken during capital dredging and other port developments at Dampier, no instances of marine heritage sites have been identified. The Proponent currently has an agreement with the Australian Government in relation to the National Heritage Listing of the Burrup Peninsula, including a management plan for this area's protection. This agreement and the associated management plan covers the terrestrial portion of the Burrup Peninsula, not the marine area.

Maintenance dredging operations in Dampier will be entirely in areas that have been previously disturbed during capital and port development works, avoiding the chance of disturbing heritage sites.

Figure 3 Location of proposed Marine Parks and Commonwealth Marine Areas



5 Management and Monitoring of Impacts

5.1 Water Quality

5.1.1 Potential Impacts

Dredging and spoil disposal activities may result in increased suspended sediment levels within the water column and an associated increase in sedimentation rates to benthic environments. These events have the potential to affect marine flora and fauna in the water column and on the sea bed (as further discussed in Section 5.2)

During dredging by TSHD, the primary sources of sediment suspension will be the drag head, overflow and, depending on depth, the propeller of the dredge vessel. If a BHD is used, short pulses of sediment suspension occur as the bucket is hauled through the water. Mechanical dredgers are considered to cause only a minor disturbance to benthic sediments compared to TSHD's (PIANC 2010). During disposal, plumes of turbid water are generated as the material from the hopper barge or TSHD is released and settles to the seafloor, interacting with the seabed sediments. Finer sediments can be entrained in the water column by prevailing surface currents while heavier material will settle directly to the seafloor. Some loss of sediments from the hopper barge or dredge can also occur between the dredge area and the disposal area, creating a small plume of turbid water along the travel route.

The increase in suspended sediments caused by dredging and disposal is expected to be limited temporally and spatially as:

- The duration of each dredging campaign is anticipated to be short (three to six weeks);
- Previous maintenance dredging campaigns of a similar size in the Port of Dampier have demonstrated turbidity returns to background level within one tidal cycle and the spatial extent of the plume is limited to one kilometre from the dredge footprint and disposal area (MScience 2016); and
- Benthic Primary Producer Habitats (BPPH) within one kilometre of the dredge footprint have been shown to be tolerant of elevated turbidity levels, as demonstrated by monitoring associated with previous dredging in the area (MScience 2010c).

Based on previous monitoring results of dredging in this area (MScience 2010c; MScience 2016), a single TSHD is likely to result in very high Suspended Sediment Concentrations (SSC) for short periods in areas immediately around the dredge; indicatively, SSC of 50-200 mg/L could be expected for periods of less than 1 hr within 50-100 m of the dredge. As shown in Figure 4 and discussed further in Section 5.2, only a small, highly resilient coral community located at the end of Mistaken Island to

the east of the Dampier Salt loadout is present within the 250 m buffer zone. Outside of the 250 m buffer, the intensity-duration events would be within the background 80th percentile.

As well as the elevation of suspended sediments, dredging campaigns involve a number of vessels and operations with the potential to generate hazardous wastes and spillages. If not handled correctly, solid wastes, waste water and discharges generated during dredging activities such as packaging materials, hazardous/contaminated materials (e.g. batteries, rags etc.), sewage, chemicals, hydrocarbons and food scraps, has the potential to impact:

- Ecosystem health;
- Aesthetic values; and
- Recreational values.

In the present case, environmental management routinely applied under the Rio Tinto (WA) EMS has been sufficient to prevent any occurrence of environmental impacts during a number of large dredging programs undertaken in the Port of Dampier over the past 15 years. Thus, wastes are not seen as a risk requiring management beyond that routinely applied by the Proponent for previous dredging programs.

5.1.2 Management Strategies and Indicators

Objectives

- Maintain the structure and function of marine ecosystems;
- Ensure water quality is safe for recreational activities; and
- Ensure there is no deterioration in local marine water quality as a result of hydrocarbon use or generation of wastes (solid, hazardous and sewage) associated with the dredging activities.

Key Performance Indicators

KPI's for minimising pollution and mitigating potential impacts shall include that there will be no residual water quality impacts at sensitive benthic communities within the local area. Water quality impacts and the development of the management trigger have been described in Section 7.1. Specific KPIs relating to water quality shall include:

- the management trigger not be exceeded more than five times during a campaign; where the investigation of the exceedance concludes that it was directly attributable to dredging; and

- there are no exceedances of the management trigger in the fortnight after disposal operations cease; where the investigation of the exceedance concludes that it was directly attributable to dredging.

Note that the management trigger period of three days shall be defined as a rolling interval over the duration of the campaign and fortnight post dredging, however the campaign and post dredging period will be evaluated separately (i.e. the plume will need to be detected for at least three days during the post-dredging period with no daily contributions from the campaign period).

Specific KPIs relating to hydrocarbon spills will be:

- all hydrocarbon spills to the environment will be recorded and investigated; and
- zero hydrocarbon spills which result in a measurable impact to significant species and/or habitat.

5.1.3 Management Measures

- All practicable attempts to reduce turbidity generation during dredging and disposal will be employed, including reducing draft, limiting overflow dredging and using below-keel discharges;
- Sailing routes will be planned to remain in existing maintained channels, where possible and to minimise the generation of propeller wash; and
- Well maintained dredging vessels will be used.

Waste and hydrocarbons will be managed in accordance with the PPA Port of Dampier Handbook (PPA 2016) and Marine Oil Pollution Plan (PPA 2015a), respectively. Measures extracted from these sources include:

- All waste from the dredging vessel will be managed as per the requirements of the International Convention for the Prevention of Pollution from Ships, 1973 and PPA local requirements;
- Refuelling activities will be conducted by a licensed bunkering operation within the Port of Dampier;
- Oily wastes will be segregated from general wastes and removed from the site in an appropriate manner;
- General waste materials will be segregated and disposed of appropriately;

- Spill kits will be readily available where hydrocarbons or chemicals are used, and all work groups will be trained in their use; and
- Wastes will be removed from vessels by an appropriate licensed operator.

5.1.4 Monitoring

Water quality monitoring will be conducted as described in Section 7.1.

5.1.5 Management Triggers and Corrective Actions

Corrective actions will be conducted following exceedance of management triggers as described in Section 7.1.1.

5.1.6 Contingency Measures

The Proponent will notify the PPA in the event of an oil spill occurring as a result of activities associated with any maintenance dredging campaign. The PPA will coordinate the oil spill response process as described in the Port of Dampier Marine Oil Pollution Plan (PPA 2015a). The Proponent's internal procedures for oil spill response, documented in the Ports First Strike Oil Spill Response Plan, will also be followed. The basic components of the first strike plan are:

- Predictions of oil trajectory, impact areas and weathering processes;
- Response protection priorities;
- Response strategies (e.g. contain and recover with booms and skimmers);
- OH&S requirements, including hazards & control measures;
- Waste Management, recovery and disposal;
- Personnel requirements;
- Equipment, ancillaries and logistics requirements;
- Duration for the response operation; and
- Clear communications and medivac (if needed) requirements.

5.2 Benthic Primary Producer Habitats

The combined benthic habitat and impact hypothesis map, presented in Figure 4, identifies the benthic habitats which occur within the Port of Dampier.

5.2.1 Direct Impacts

The direct impact zones associated with the proposed dredging are defined as the dredge footprint and associated spoil grounds. Maintenance dredging operations will result in the removal of sediments from previously disturbed habitat; similarly, disposal will occur within areas previously used to accept dredge spoil.

Figure 4 shows that there is no established BPPH which will be directly removed from within the proposed dredge footprint.

The benthic habitats at Spoil Ground A/B and Spoil Ground 2B are likely to have been smothered during approved dredge disposal activities associated with previous dredging programs. As such, the BPPH within the spoil ground footprints will be limited to resilient species which have managed to colonise the area since the last dredging program conducted within the Port of Dampier.

5.2.2 Indirect Impacts

Indirect impacts are those caused by the migration of sediments away from dredging and spoil disposal which leads to elevated suspended sediments and sedimentation in surrounding areas. As the present program is comprised of maintenance dredging only, no direct removal to undisturbed seabed will occur and thus indirect impacts will be the predominant risk.

For the current LTMMP/LTDP, it is estimated the direct disturbance footprint and nominated spoil grounds would be surrounded by a 250 m zone of indirect impact; the size of this disturbance/impact footprint is considered conservative (that is, larger than likely). Within the 250 m zone of impact, it is likely that sedimentation and light loss will occur at frequency-intensity-duration (FID) combinations which could cause mortality of some Benthic Primary Producers (BPP). There is a small coral community at the end of Mistaken Island east of the Dampier Salt loadout, which despite the results of past disturbance contains a moderate cover of live coral. That community has survived capital dredging works in 1998 and maintenance dredging works in 2006-7 (MScience 2008c) with a similar footprint planned under the current LTMMP/LTDP Application.

Outside of that 250 m area, FID patterns of suspended sediment and sedimentation derived from dredging and disposal operations are unlikely to breach thresholds causing mortality. As discussed below:

TSS and Light Attenuation

The Port of Dampier is subject to naturally variable and sometimes high turbidity, in addition to sediment pulses associated with cyclones (Stoddart and Anstee 2005) and

periodic dredging programs. The main BPP communities found within the Port of Dampier consist of algae, corals and mixed communities (Section 4.1, Figure 4), with corals identified as the most sensitive biological receptor in the absence of established seagrass beds. Increased TSS from dredging activities have the potential to reduce light attenuation at the seabed which may cause impacts to coral and other benthic communities. As discussed in Section 4.5.2, background levels of turbidity or TSS is highly site dependent within the Dampier Archipelago, and can range from 0.4 to 3.6 NTU. The light levels and TSS that Dampier corals have experienced during previous dredging programs has been investigated (MScience 2010c; MScience 2016; Stoddart and Stoddart 2005). During the worst case scenario i.e. extended periods of capital dredging, short term elevations in turbidity were seen at sites within 1200 m of dredging; however, it was determined that there was no significant long term effect of dredging noted between impact sites outside the zone of high impact and the reference sites. During the 2016 maintenance dredging campaign, monitoring at three sensitive coral sites around Spoil Ground A/B found mean turbidity readings ranged from 1.4 to 1.9 NTU. Intensity-duration-frequency analyses showed that for durations of 6 or 24 hours, the frequency of intensity events above the 95th percentile of the reference site was low (MScience 2016). That intensity value (2.5 NTU) was less than one third of the level commonly quoted as having the potential to cause impacts to coral communities (Erftemeijer et al. 2012; Stoddart and Stoddart 2005).

Sedimentation

The indirect impacts from sedimentation/water quality from dredging and disposal activities are outlined in Section 5.1.1.

Reported tolerance limits of coral reef systems for chronic SSC range from <10 mg/L in pristine offshore reef areas to >100 mg/L in marginal nearshore reefs. Some individual coral species can tolerate short term exposure (days) to SCC as high as 1000 mg/L while others show mortality after exposure (weeks) to concentrations as low as 30 mg/L (Erftemeijer et al. 2012; Jones et al. 2015).The common coral species found in areas likely to be affected by the proposed maintenance dredging campaigns (Blakeway 2005; Blakeway and Radford 2005) are regarded as highly resilient to the impacts of elevated SSC (Gilmour et al. 2006). The coral communities nearest to areas of elevated suspended sediments are those adjacent to Spoil Ground A/B, surrounding Conzinc Island, Angel Island and within Conzinc Bay. These communities have been shown to experience repeated elevated sedimentation as a result of sediment plumes emanating from disposal of spoil at Spoil Ground A/B. Historically, these elevations have not resulted in detectable coral mortality (MScience 2008c) and turbidity measured at these sites during the last maintenance campaign was well below the concentrations expected to cause coral mortality.

Ecologically Sensitive Windows

Assessment of the potential for indirect impacts above is based on effects on adult benthos. Reproductive stages of benthos (gametes, embryos, larvae) may be more sensitive to suspended sediments or sedimentation and periods when the reproductive products of large components of benthic communities are susceptible to such impacts are known as ‘ecologically sensitive windows’. Spawning of corals in and around

Dampier is the key ecologically sensitive window (Baird et al. 2011; Gilmour et al. 2016). Two windows can be predicted with confidence:

- Autumn spawning of many of the common coral species occurs predictably 8-9 days after the full moon in March (Baird et al. 2011); and

- spawning of the majority of individuals of the common and widespread *Porites lutea* species occurs 3-4 days after the full moon in December (Stoddart et al. 2012).

5.2.3 Management Strategies and Indicators

Objectives:

- Limit the direct and indirect loss of BPPH associated with dredging and offshore spoil disposal activities.

Key Performance Indicators:

- No long term impacts (10% net loss of coral cover, if impacts sites have >5% cover) to BPPH outside of the 250 m impact zone.

5.2.4 Management Measures

Direct Impacts:

- The design and layout of proposed dredging campaigns will be planned to avoid additional direct disturbance. To mitigate any additional direct impacts outside of the proposed disturbance footprint, accurate positioning systems will be used on all dredgers during maintenance operations.

Indirect Impacts:

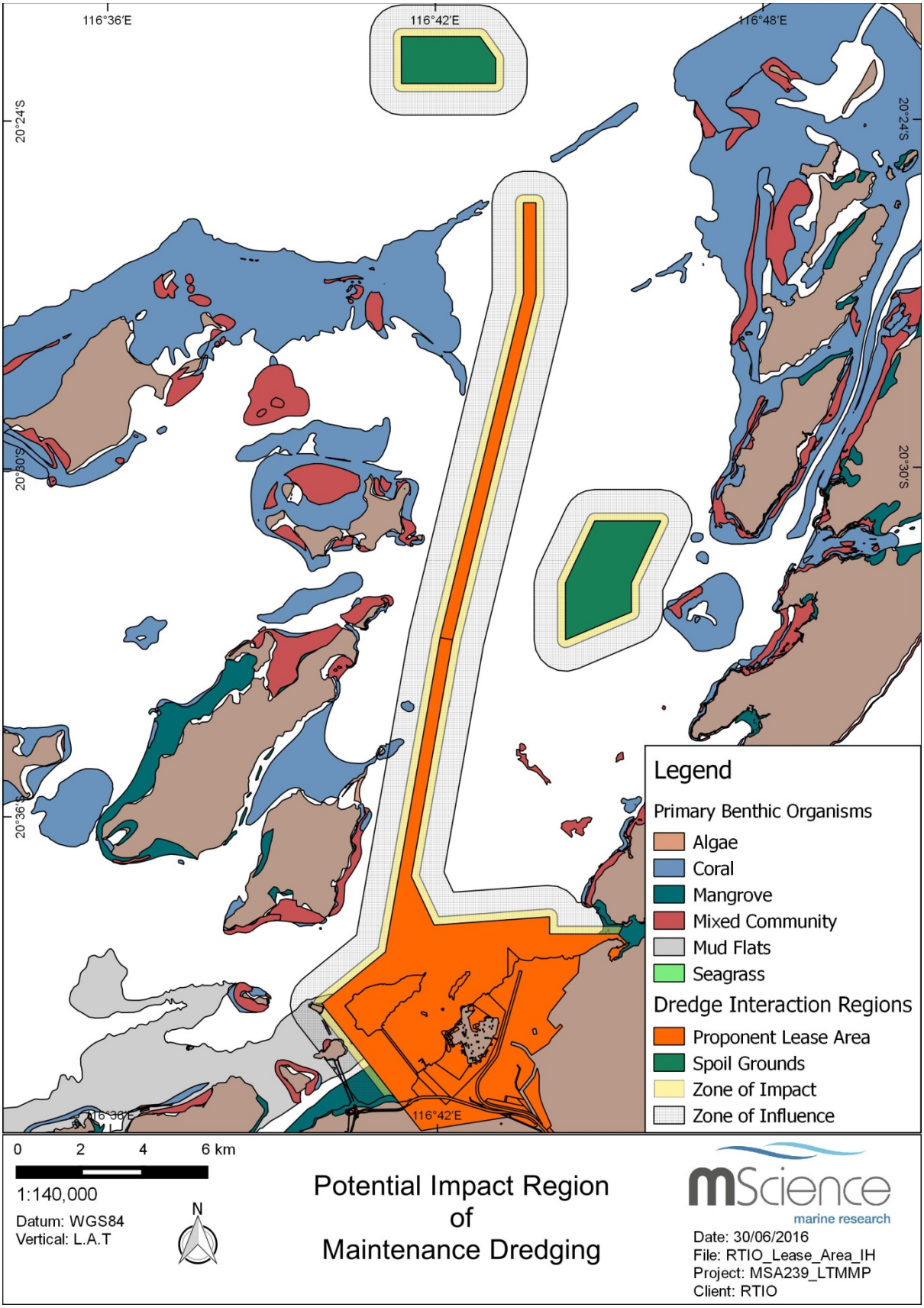
- Potential indirect impacts to BPPH as a result of increased sedimentation and/or TSS levels will be managed via the water quality management measures and corrective actions described in Section 5.1.

- BPPH will be assessed at impact and reference sites before and after (only if coral cover at impact sites is found to be >5%) the first major dredge campaign, as discussed in Section 7.

- The Proponent will plan to schedule dredging operations to avoid sensitive ecological windows occurring around the predicted peak of mass spawning times for corals in Dampier (i.e. stoppage to occur 3 days before the predicted night of spawning and 7 days after the predicted spawning event). If it is not

practical to avoid dredging in those periods, the Proponent commits to review potential impacts on coral spawning and implement management measures (as may be agreed with DotEE) to minimise the potential for impacts on coral reproductive success.

Figure 4 Benthic habitat map and potential impact zones



5.2.5 Monitoring

- Water quality monitoring will be conducted as described in Section 7.1.
- BPPH monitoring will be conducted as described in Section 7.2.

5.2.6 Management Triggers and Corrective Actions

Corrective actions will be conducted following exceedance of management triggers as described in Section 7.2.1.

5.2.7 Contingency Measures

Contingency measures will be conducted as described in Section 7.2.2.

5.3 Marine Fauna

5.3.1 Potential Impacts

Marine fauna may be affected by dredging and disposal activities through:

- direct strike by vessels;
- physical interaction with the dredge head and discharged dredge material; and
- underwater noise during dredge and disposal activities.

The potential exists for marine fauna to be impacted if they approach or are present near the disposal sites during disposal of dredged material. It is anticipated that mobile marine fauna would move away from the area where dredging is being undertaken and thus negligible direct impacts to marine fauna are expected to result from dredging.

The activities being undertaken are for maintenance dredging only, in areas previously dredged and used on an ongoing basis by large fully loaded ore carriers (and other vessels). Thus there is low likelihood of turtles and other marine fauna being present on the seabed. Monitoring programs from the Proponent's previous dredging programs in the Port of Dampier since 2003 have not recorded any incidents of injury or death to marine turtles. Maintenance dredging only occurs in previously dredged area and will not result in the direct loss of foraging habitat or inter-nesting areas.

The marine fauna which occur within the Port of Dampier and greater Dampier Archipelago have been identified in Section 4.6.

5.3.2 Management Strategies and Indicators

Objectives

- Ensure dredging and offshore disposal activities do not significantly impact marine fauna within the Port of Dampier.

Key Performance Indicators

- Zero injury/mortality of marine mammals or marine turtles attributable to dredging activities.

5.3.3 Management Measures and Monitoring

- All vessels associated with dredging activities will adhere to the marine fauna interaction management zones stated by the most recent Australian National Guidelines for Whale and Dolphin Interactions, as per industry best practice.

- Prior to dumping activities at the disposal site, vessel crew will check for marine fauna within a 300 m radius of the vessel using binoculars.

- If any marine fauna are sighted within a 300 m radius of the vessel, disposal activities will not commence and/or be suspended until 20 minutes after the last marine species is observed to leave the 300 m monitoring zone, or the vessel will move to a different area maintaining a 300 m distance to the marine fauna.

- Lighting will be limited to lights required for the safe and efficient operation of the dredging vessel.

- Turtle deflector devices and/or tickler chains will be installed on the drag head of the dredge vessel wherever safety and logistical constraints permit.

- Suction from the drag head will substantially commence only when it has engaged the seabed i.e. soft start, to minimise the risk of marine turtle entrainment.

- Suction from the drag head will be stopped as soon as practically possible for operational safety after the completion of dredging and wherever possible prior to raising of the drag head to minimise the risk of turtle entrainment.

5.3.4 Corrective Actions and Contingency Measures

Management measures will be reviewed to identify alternative or additional practical measures in the event that one or more marine turtles or mammals suffer injury or mortality as a result of the dredging and disposal activities, and/or after release of relevant revised government guidance documents (e.g. turtle conservation plan).

In the event of an oil spill impacting on marine fauna, occurring as a result of activities covered under the LTMMP/LTDP, contingency measures described in Section 5.1.6 will be activated to minimise the effect of oil pollution on marine fauna in the area of the spill.

5.4 Introduced Marine Pests

5.4.1 Potential Impacts

There are two key vectors for introduced marine pests entering a port: biofouling of the vessel hull, or the release of pests into the marine environment via ballast waters.

The following could occur as a result of the introduction of marine pests which do not already occur in the Dampier Archipelago:

- Establishment of non-indigenous marine pest species;
- Competition for food and space with native species;
- Removal of native species;
- Predation of native species; and
- Introduction of associated pests and disease.

All species of introduced marine organisms previously reported in the Dampier region (see Section 4.7) are associated with hard substrates. The sediments to be dredged (for maintenance dredging) are essentially soft seabed sediment in areas that have been repeatedly dredged and not suited to support marine organisms which require hard substrate.

5.4.2 Management Strategies and Indicators

Objectives

- Minimise the risk of marine pest species introduction, establishment and spread into and within WA waters as a result of dredging and disposal activities.

Key Performance Indicators

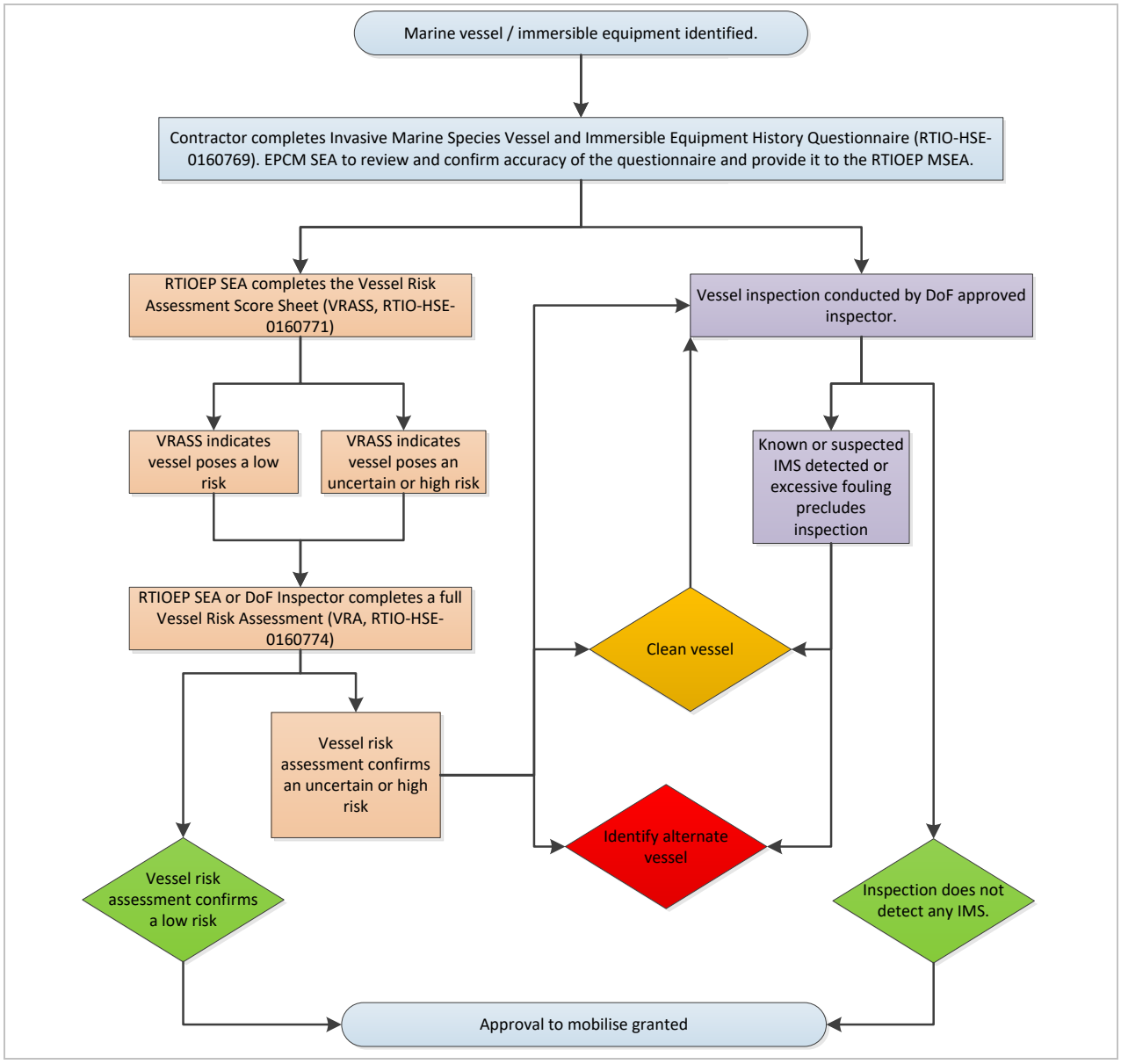
Zero introduced marine pest incursions attributable to dredge and disposal operations.

5.4.3 Management Measures and Monitoring

In accordance with the PPA's Environment Management Plan (PPA 2015b) and the Proponent's Marine Vessel Mobilisation Procedure (Appendix B) (as has been applied to recent capital dredging projects at Dampier and Cape Lambert) all vessels mobilising to and operating within the Port of Dampier will assessed under the National System for the Prevention and Management of Marine Pest Incursions (currently under review) which is administered by the Commonwealth Department of Agriculture and Fisheries (DAF) (under Chapter 5 ballast water and sediment) of the *Biosecurity Act 2015*.

Figure 5 details the Proponent's existing vessel mobilisation process to manage introduced marine pests.

Figure 5 Vessel mobilisation procedure



Vessel masters will have all relevant documentation ready for inspection by DAF, customs and PPA on arrival at the Port of Dampier. This will include:

- Hull anti-fouling and cleaning records;
- Vessel inspection report;
- Ballast tank records;
- Voyage history; and
- Other documentation required to enter WA or Commonwealth waters.

5.4.4 Corrective Actions

If a known or suspected marine pest species is identified within sediment or within the niches of a vessel during a pest inspection, in accordance with the Marine Vessel Mobilisation Procedure, the actions below will be implemented:

- If found during pre-mobilisation inspections, the vessel will undergo full cleaning and be re-inspected before being considered approved for mobilisation, or another vessel will be sought.
- If found within WA waters during arrival or operations, the vessel will be moved offshore as soon as practicable (if possible within waters 200 m deep).
- Photographic or video image of the contamination will be taken and a sample of the material obtained and sent for expert taxonomic identification. In conjunction with the identification process, a monitoring and control plan (if required) will be developed and implemented in consultation with the DoF and the PPA to determine if the marine pest has become established and measures to eradicate and/or control are required.
- The vessel will undergo full cleaning and re-inspection before re-entry into the Port of Dampier harbour. Treatment, cleaning and inspection will be undertaken to the satisfaction of the DoF and a Proponent representative.

5.4.5 Contingency Measures

In the event that a new/unknown introduced marine pest is recorded on port infrastructure or in the surrounding marine environment as a result of activities covered under the LTMMP, the Proponent will:

- Report the introduced marine pest to the DoF (and the PPA);
- Seek advice from the DoF as to how the introduced marine pest should be managed, or what further survey might be needed; and
- If advised by the DoF that further survey or action is needed, consult with the PPA to implement the action.

6 Spoil Ground and Dredge Spoil Management

6.1 Alternatives to Sea Disposal

For each maintenance dredging campaign that arises within the life of the LTMMP, the Proponent will review the potential for non-dredging options to avoid the generation of spoil requiring sea disposal via a comparative assessment of the risks of various options to dredging campaign cost, human health and the environment. This approach has been used for recent dredging programs in Dampier and Cape Lambert and the template developed for those assessments has been adopted.

That assessment uses a semi-quantitative ranking of the risks (consequence x probability) where 1 represents a “minimal risk”, 2 a “moderate risk” and 3 an “extreme risk”. As a guide, a ranking of 3 would generally rule out an option. An example of the assessment is presented in Table 10.

The spoil to be removed is generally fine unconsolidated sediments with a high proportion of fines and water. Disposal of fine unconsolidated sediments with high water content is not viable to be used as land fill (land reclamation) or for use in construction purposes around the margins of the Port of Dampier.

Much of the area around the margins of the Port of Dampier is either of high conservation value (e.g. mangroves, anthropological or archaeological sites) or of high value for industrial or port usage. Effective disposal of this material would require a large surface area for dewatering and return of dewatering with attendant high suspended sediment load to sensitive nearshore environments. Furthermore, the disposal of fine unconsolidated sediments on land risks the generation of dust over the town of Dampier (upon completion of the decanting/drying process) causing nuisance/complaints from residents and the spread of salinity.

6.2 Waste Prevention

Waste prevention relates more to controllable issues such as the contamination of sediment rather than the return of sediments to channels and berths that causes a requirement for maintenance dredging.

Recent analysis of sediments from the proposed dredge footprint found that the sediments were safe for unconfined ocean disposal (MScience 2015). It is likely that these sediment results will remain current for the life of the LTMMP, and sediment contamination issues will not be relevant to this LTMMP.

The Proponent manages the potential contamination of sediments from any loss of product or discharge of wastes to the marine environment under its normal operating procedures. These procedures include applying water onto product (and scraping conveyors to remove sticky product) to reduce dust emissions, regular clean-down of wharf structures and water retention basins to trap sediments. Thus, no specific additional waste prevention options are described here.

6.3 Management, Monitoring and Contingency Measures

Key Performance Indicators

- All spoil is disposed only within the approved spoil grounds.

Management

- Vessel tracked by GPS during disposal operations.
- Distribute spoil over disposal ground in accordance with PPA dredge management plan for Dampier (DPA 2012) or direct PPA instructions to minimise mounding of spoil within the disposal area.

Monitoring

The following bathymetric surveys are to be conducted at the disposal site identified for each specified dredging and disposal campaign:

- Prior to commencement of dumping activities for a specified dredge and disposal campaign, to confirm effective capacity of the spoil ground; and
- Within one month of the conclusion of dumping activities for the specified dredge and disposal campaign, to evaluate changes in seafloor bathymetry.

During each dredging campaign, the Project Manager for dredging will have daily oversight of dredging operations and receive daily reports from the dredging contractor. Should any non-compliance issues with the LTMMP/LTDP be identified, the Project Manager will take immediate measures to stop/mitigate/redress such non compliances. Any non-compliance will be reported to the DotEE.

Simultaneous Dredging Contingency Planning

Prior to any dredging campaign, the Proponent will consult with the PPA and the DTACC to determine whether other port users are proposing to undertake dredging/dumping which would have cumulative impacts to the planned campaign. As has been common practice at the Port of Dampier, port users sometimes commission the same dredge previously commissioned by another port user to undertake maintenance dredging (to defray mobilisation costs), thereby assisting minimise the risk of simultaneous dredging programs.

Table 10 Spoil disposal options template

Option	Description	Commentary	Cost Risk	Human Health Risk	Environmental Risk
1	Do nothing (not dredging)	The "do nothing" option is included here for reference. The dredging works are required in order for safe and effective export of iron ore from the Proponent's Dampier facilities to continue. Not carrying out dredging would jeopardise the safety and effectiveness of these operations	Rating **3**. Considerations include: The cost of not dredging will ultimately have an extreme impact on the Proponent's Dampier operations, with shallowing of the channels progressively limiting the loaded departure drafts of bulk carriers. Without dredging, these operations may become non-viable over time. Estimated cost premium: extreme	Rating **1**: Considerations include: Nil impact	Rating **1**: Considerations include: Nil impact
2	Dredging with ocean disposal	This option involves a trailing suction hopper dredge (TSHD) transporting dredged material to an approved offshore disposal site.	Rating **1** Considerations include: The cheapest / baseline option Estimated cost premium: nil	Rating **1**: Considerations include: None likely: Material is not toxic and dredging is not in recreational use area	Rating **1**: Considerations include: Turbidity impacts will occur around the sites of dredging and disposal but will not be at a level causing mortality of benthos in areas of high conservation value
3	Disposal to land	This option involves creating a bunded disposal site on land, which would be filled with dredged material by the TSHD via a pipeline. A suitably sized onshore disposal site would need to be located close (<~500m) to deep water, to allow access by the TSHD. Beneficial reuse could be achieved by building up the elevation of low-lying land thus making it more valuable or useable.	Rating **2**: Considerations include: • Large additional cost of secondary handling of material from dredge hopper to land (discharge time of ~1hr compared to 30mins for ocean disposal): ~$2M • Costs of constructing bund and decant filters: ~$5M • Potential dredging delays while waiting for disposal area to drain: ~$2M	Rating **1**: Considerations include: • Material is not toxic; • Windblown dust would require management • Low lying coastal areas are often natural drainage areas, stormwater would need to be managed to avoid stagnant water pools etc.	Rating **3**: Considerations include: • Holding ponds would be extensive in size (estimated ~28ha) to allow drying; Coastal land not used for industry around the Dampier Harbour is of high conservation value. Clearing of native vegetation is likely to be required.

Option	Description	Commentary	Cost Risk	Human Health Risk	Environmental Risk
		Overall, ~28ha of land would be required for this disposal site (assuming an average fill height of 5 m), however this area could be built up progressively over time. The Proponent has assessed this option, however no suitable locations have been identified. The Proponent does not have current requirements for additional land areas. The material to be disposed consists predominantly of fine sand, silts and clays and is thus relatively unsuitable for use as construction fill. Additional ground improvement is likely to be required before the area could be used commercially.	• Ongoing costs managing this site (e.g. dust management, stormwater drainage etc.): ~$2M • Additional ground improvement before use: ~$20M Estimate cost premium: $31M		• Disposal at the onshore site may impact on the underlying groundwater via infiltration of salt water from the disposed material • Decant water with high sediment load would return to the sensitive nearshore environment
4	Reclamation of seabed	This option involves creating a rock armoured disposal site on an area of relatively shallow seabed, which would be filled with dredged material by the TSHD via a pipeline. A suitably sized reclamation area would need to be located close (<~500m) to	Rating **3**: Considerations include: • Large additional cost of secondary handling of material from dredge hopper to land (discharge time of ~1hr vs 30mins for ocean disposal): ~$2M	Rating **1**: Considerations include: • Material is not toxic; • Windblown dust would require management	Rating **3**: Considerations include: • Reclamation area would be extensive in size (estimated ~20ha); nearshore benthic habitat is of high conservation value.

Option	Description	Commentary	Cost Risk	Human Health Risk	Environmental Risk
		deep water, to allow access by the TSHD. Beneficial reuse could be achieved by creating new land. Overall, ~20ha of seabed would be required for this disposal site (assuming an average fill height of 10 m), however this area could be built up progressively over time. The Proponent has assessed this option; however, no suitable locations have been identified. The Proponent does not have current requirements for additional land areas. The material to be disposed consists predominantly of fine sand, silts and clays and is thus relatively unsuitable for use as construction fill. Additional ground improvement is likely to be required before the area could be used commercially.	• Costs of constructing ~1.5km of rock armoured seawall and decant filters: ~$70M • Potential dredging delays while waiting for disposal area to drain: ~$2M • Ongoing costs managing this site (e.g. dust management, stormwater drainage etc.): ~$2M • Additional ground improvement before use: ~$20M Estimate cost premium: $96M		• Disposal at the onshore site may impact on the underlying groundwater via infiltration of salt water from the disposed material • Decant water with high sediment load would return to the sensitive nearshore environment • Turbidity would be generated during the rock wall construction • Potential impact/modification of hydrodynamic/current patterns adjacent to reclaimed area unknown.
5	Beach renourishment	This option involves using dredge material to renourish coastal areas that have experience coastal erosion. Dredged material	Rating **1**: Cost considerations include: • Large additional cost of secondary handling of	Rating **1**: Considerations include: • Material is not toxic;	Rating **3**: Considerations include: • Renourishment area would be extensive in

Option	Description	Commentary	Cost Risk	Human Health Risk	Environmental Risk
		would be pumped to beach by the TSHD via a pipeline. Large beach area(s) would need to be located close (<~500m) to deep water, to allow access by the TSHD. Beneficial reuse could be achieved by renourishing these eroded areas. Suitable beach areas of ~3.5ha per year would be required. The Proponent has assessed this option, however no suitable locations have been identified. The Proponent has not identified any nearby eroded areas that meet the access and dimension requirements. The material to be disposed consists predominantly of fine sand, silts and clays, and the water concentration in each hopper load is likely to be relatively high (80 – 90%), plus additional water will be required to mobilise and discharge each hopper load. This material is relatively unsuitable for use as beach renourishment, and the large water concentration pose a significant risk of eroding	material from dredge hopper to land (discharge time of ~1hr compared to 30mins for ocean disposal): ~$2M Estimate cost premium: $2M	• Windblown dust may require management • Require large area on the beach to contain all of the dredged material, which could affect beach access and aesthetics during disposal	size (estimated ~3.5ha per year); likely that some smothering of nearshore benthic habitat would occur. • Return water with high sediment load would return to the sensitive nearshore environment • Significant potential for process to be erosive instead of renourishing the area, due to fine dredged material and large water concentrations. • Potential for impacts on shore species, including birds

Option	Description	Commentary	Cost Risk	Human Health Risk	Environmental Risk
		the beach further rather than renourishing it.			
6	Offsite disposal/ reuse	This option involves temporary stockpiling of material on land within a bunded disposal site, which would be filled with dredged material by the TSHD via a pipeline, and progressively excavated and trucked away for disposal or reuse at an external site. A suitably sized temporary onshore stockpile site would need to be located close (<~500m) to deep water, to allow access by the TSHD. Beneficial reuse could be achieved by reusing the dredged material in some way. A stockpile site of ~3ha would be required, assuming an average fill height of 5m (with capacity for ~1 week of dredging). This temporary site would need to be constructed before and removed after each dredging session. The Proponent has assessed this option, however no suitable reuse options/locations have	Rating **2**: Cost considerations include:: • Large additional cost of secondary handling of material from dredge hopper to land (discharge time of ~1hr vs 30mins for ocean disposal): ~$2M • Costs of constructing bund and decant filters: ~$5M • Dredging delays while waiting for this small disposal area to drain are very likely: ~$2M • Excavation and trucking costs to remove material (assumed final destination 20km from temporary stockpile, truck cycle time of ~2hr): ~$20M • Additional treatment to beneficiate material to make it suitable for reuse and/or dust management if used for landfill $2.5M Estimate cost premium: $31.5M	Rating **2**: Considerations include: • Material is not toxic; • Significant trucking operation on public roads would be required, over 500 truck movements per day. Related public safety and noise implications are significant.	Rating **3**: Considerations include: • Temporary stockpile area would be significant in size (estimated ~2ha); Coastal land not used for industry around the Dampier Harbour is of high conservation value. Clearing of native vegetation may be required. • Disposal at the onshore site may impact on the underlying groundwater via infiltration of salt water from the disposed material • Decant water with high sediment load would return to the sensitive nearshore environment. Compared to the onshore disposal and reclamation options, the relative turbidity

Option	Description	Commentary	Cost Risk	Human Health Risk	Environmental Risk
		been identified. As the material to be disposed consists predominantly of fine sand, silts and clays it is not a particularly useful product for reuse purposes. It is likely that in this scenario, the material would be taken to a landfill site, and thus does not equate to beneficial reuse of the dredged material.			will be significantly higher due to the smaller disposal site volume.

7 Monitoring Programs

7.1 Water Quality

The water quality monitoring program is based on the assumption that biota of the area have survived water quality impacts of previous dredging and disposal campaigns over time frames of several months, compared to the three to six week period anticipated for the dredge campaigns covered under this LTMMP. It is not anticipated that SSC will be an issue at the dredge uplift location, particularly in light of the plumes generated by vessel movements in the area, but it is important to determine if sedimentation and light loss as a result of plumes could occur at FID combinations which would cause mortality of nearby coral communities. Therefore, FID patterns of suspended sediment at the nominated disposal site will be monitored by remote sensing.

Water quality monitoring will be conducted as per Table 11, and follow the process shown in Figure 6.

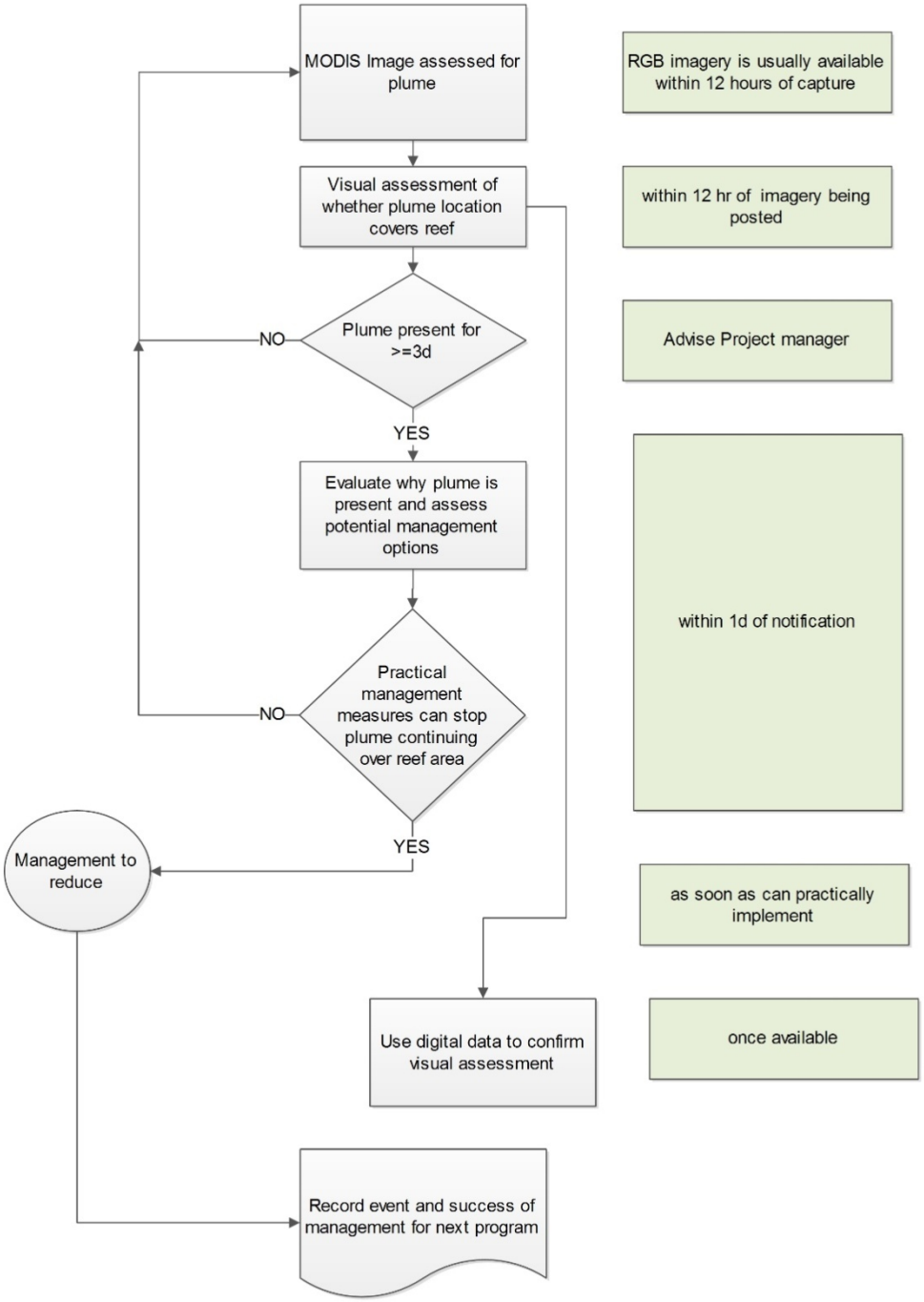
Satellite imagery techniques will be similar to those developed and reported during the Proponent's most recent maintenance dredge monitoring program under SD2015/3122 (MScience 2016). The technique is capable of detecting elevations of ~6 mg L^{-1} of suspended sediment above pre-dredging levels assessed from MODIS images collected during periods of no dredging, and metocean conditions similar to those anticipated during dredging. Plumes are defined as including every pixel where the incremental trigger is exceeded. Three days of >6 mg L^{-1} SSC above pre-dredge background (i.e. total SSC of 12 mg L^{-1}) would be well below most commonly accepted triggers of harm for corals in the nearshore Dampier area (30 to 100 mg L^{-1}, see discussion in Section 5.2.2 and (Erftemeijer et al. 2012; Hanley 2011; Jones et al. 2015)).

Table 11 Monitoring program 1 - water quality

Monitoring Program 1 – Remote Sensing of Dredge Plumes	
Timing	Daily one month prior, during and one month post completion of each dredge campaign.
Parameters	Raw satellite images interpreted for reflectance as a proxy for plumes of suspended solids.
Where	Management area (Figure 8)
Management Trigger	Plume (>6 mg L^{-1} above pre dredge level) sustained within the same coral management zone for three days.

Digital data from MODIS images is often not available for up to seven days after image capture. This would not allow monitoring to be completed in time for reactive management. Thus the assessment of plumes for use in testing the three day criterion would be based on assessment of daily RGB data (Composite images), which is then confirmed by analysis of the digital data for MODIS images once it is available. Qualified observers, those experienced and already trained to identify plumes of >6 mg L^{-1} from composite RGB images, will detect colour changes indicative of the presence of plumes of >6 mg L^{-1}. Observers will have been trained by assessing composite images previously confirmed by digital MODIS data to contain plumes of >6 mg L^{-1}. Note that the management triggers, as defined in the subsequent spectral analysis, will be used for management audits and management of future campaigns.

Figure 6 Water Quality Monitoring Flow Chart



**If the management trigger (plume present for >=3 days) is exceeded more than five times during a campaign, then it will be considered that a water quality KPI has not been met and the campaign activities will be subject to further review.*

7.1.1 Management Trigger and Corrective Action

SSC data recorded from satellite images will be interpreted twice daily during each dredging campaign and assessed against the management trigger described in Table 11 and the management process shown in Figure 6.

Where review of monitoring data during a dredging campaign identifies an exceedance of a water quality trigger has occurred, data will be:

- examined to determine if equipment or user error was the cause; and
- compared against the location and characteristics of the dredging and disposal activities to determine whether the conditions which caused the exceedance are likely to occur during the next dredge campaign.

In the event of an exceedance, an investigation will be held to determine why the exceedance occurred. Management measures will then be reviewed to identify alternative or additional practical measures to make sure an exceedance does not occur again. Where practicable, the revised management measures will be implemented during the same campaign. If not practicable, the revised changes will be implemented for the subsequent maintenance dredge campaign within the life of the LTMMP/LTDP.

7.2 BPPH Monitoring

7.2.1 Remote Sensing

Corals are the most sensitive biological receptor within the Port of Dampier. Water quality monitoring via remote sensing will determine the FID patterns of suspended sediment and impact on coral communities in proximity to the utilised spoil ground.

7.2.2 Coral Communities

Guidance from the Western Australian Marine Science Institution (WAMSI) indicates that coral mortality may occur when water quality impacts are present for a period greater than fourteen days. For the purposes of maintenance dredging at Dampier, a conservative approach has been taken and this threshold has been reduced to 7 days; such an event is defined as a “major” dredging event herein.

Monitoring of coral communities will be undertaken for the first major dredge campaign to:

- Confirm that compliance with water quality targets is protecting corals;
- Check whether any exceedance of targets has impacted corals; and

- Confirm the status of coral communities adjacent to dredging to determine what responses are appropriate to protecting them.

Benthic habitat monitoring will be conducted as per Table 12, and follow the process shown in Figure 7

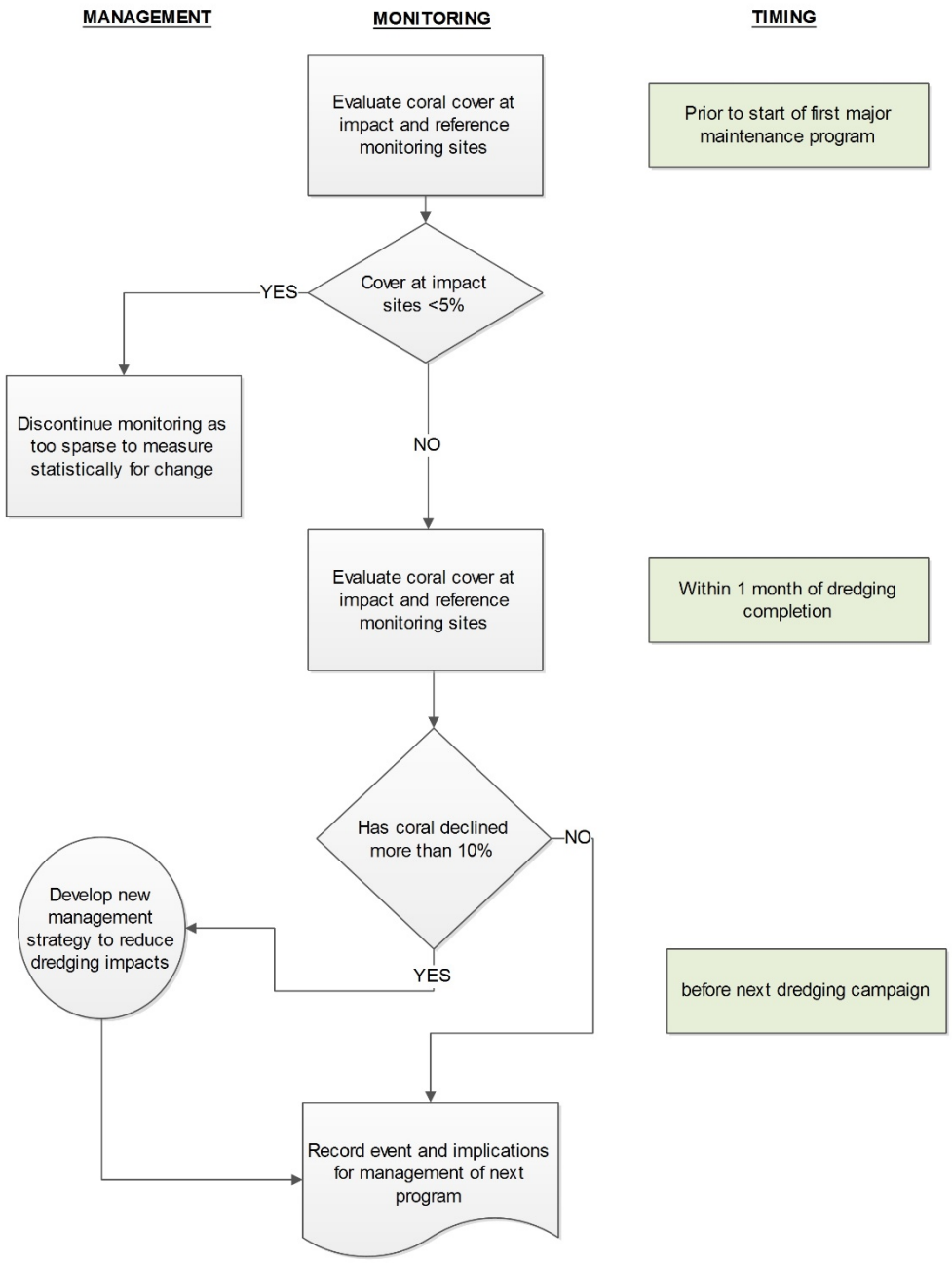
Table 12 Monitoring program 2 - benthic habitats

Monitoring Program 2 – Benthic Habitat Survey	
Timing	Once during the life of the LTDP – Before and after the first major dredge campaign.
Parameters	Spatial extent and density of coral communities.
Where	Coral community sites within the management trigger zones, as shown in Figure 8, and at external reference sites.
Management Triggers	>10% loss in coral cover.
Review	Review requirement for further surveys based on results of first post dredge survey.

The baseline condition of corals within the Port of Dampier is already well known, therefore one pre and one post dredge survey is proposed for the first major dredging campaign for the life of the LTMMP/LTDP. Coral surveys have been undertaken previously as part of works associated with the monitoring of dredging around the Port of Dampier or in investigating potential environmental impacts. Reports containing information on coral distribution and condition are shown in Table 9.

Coral density and other health indicators will be estimated at sites near to disposal and reference sites to provide a baseline condition for the LTMMP, prior to the commencement of the first major dredging campaign under the LTMMP/LTDP. The baseline condition will be compared against the results of monitoring conducted at the end of the first major dredging campaign.

Figure 7 BPPH monitoring flow chart



7.2.3 Management Triggers and Corrective Action

Management will follow the process shown in Figure 7.

Analysis of percent cover using photo imagery for five belt transects at 10 sites, where coral communities occur around the Port of Dampier (Stoddart et al 2005), was shown to be capable of detecting a 10% decline in cover at sites with >80% power where the initial coral cover was 40% or more and 30 to 70% power at sites with lesser cover (Stoddart et al. 2005). Surveys conducted over the period 2005 to 2010 provide a comprehensive understanding of background variability in coral cover at these sites (MScience 2010c). Coral monitoring to be conducted before and after the first substantive dredging campaign under this LTDP would follow those methods and sites.

Where review of pre dredge survey data after the first major dredging campaign identifies coral cover at impact sites to be <5%, monitoring will be discontinued as it will be too sparse to measure statistically for change.

If coral cover is >5% at impact sites and review of post dredge monitoring data after the first major dredging campaign identifies a >10% loss of coral cover has occurred, the following actions will be implemented:

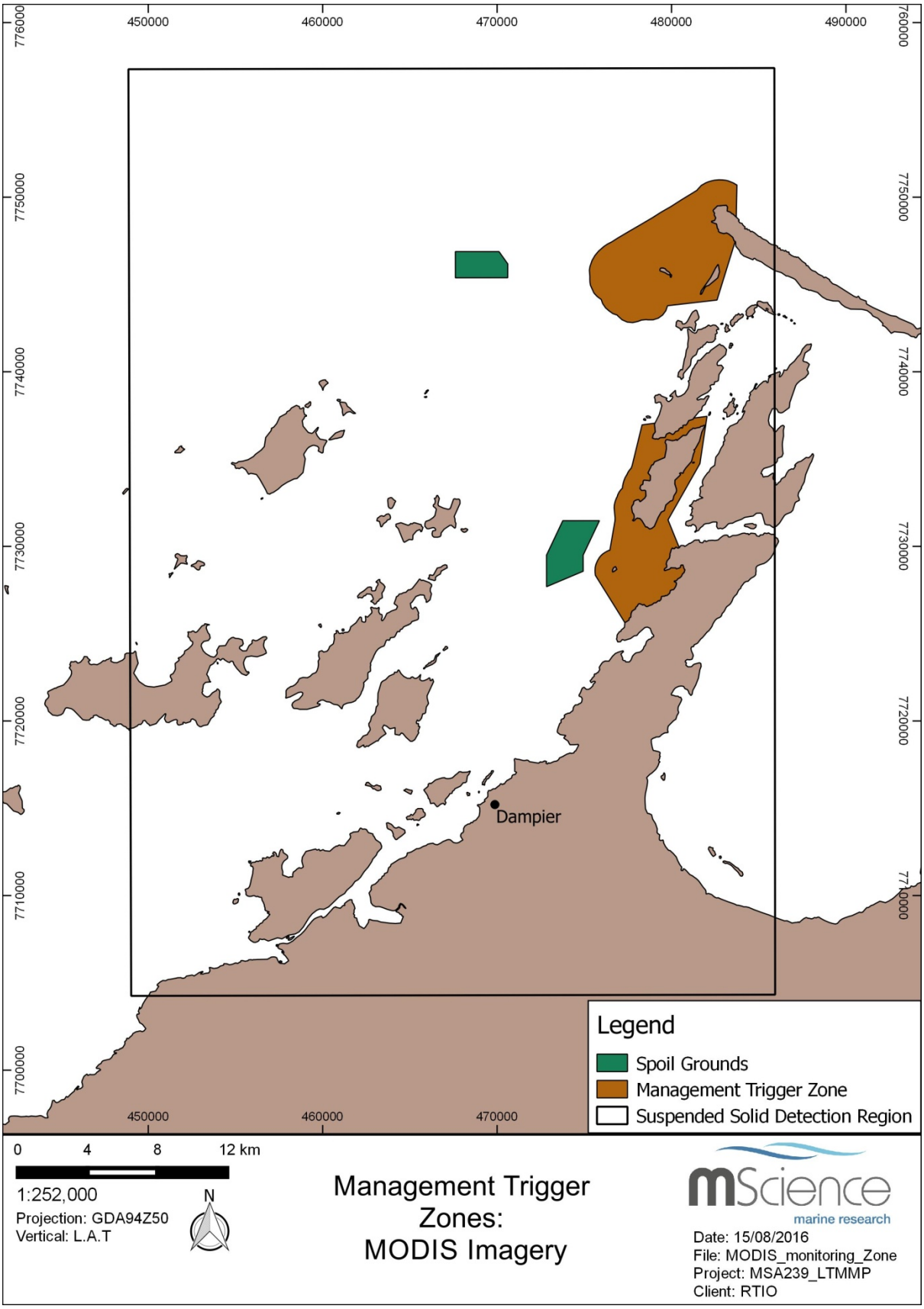
- Assess whether decline in coral cover was caused by dredging and disposal activities – if so management measures will be reviewed to identify alternative or additional practical measures to make sure a >10% loss does not occur again. Where practicable, the revised management measures will be implemented during the same campaign. If not practicable, the revised changes will be implemented for the subsequent maintenance dredge campaign; and

- Consider additional pre and post dredge surveys for subsequent dredging campaigns within the life of the LTMMP/LTDP.

7.2.4 Contingency Measures

The Proponent may choose to conduct a precautionary benthic habitat survey if there is a major thermal event identified over any summer or a major cyclone impacts the Port of Dampier area, or for some other reason.

Figure 8 Monitoring area and management trigger zones



8 Roles and Responsibilities

The Proponent is ultimately responsible for the implementation of the LTMMP. The positions and responsibilities of key roles are presented below.

Table 13 Roles and Responsibilities

Position	Responsibilities
Project Manager	• Overall responsibility of the LTMMP • Overall responsibility for compliance with statutory obligations • Ensure dredging and disposal is conducted safely and in accordance with the LTMMP
Dredge Contractor	• Prepares and implements an Environment Management Plan (EMP) in accordance with this LTMMP and the PPA'S EMP • Implements management actions • Ensures staff have the correct training • Ensures equipment is maintained
Environmental Superintendent/Advisor	• Complies with the requirements of this LTMMP • Oversees implementation of environmental controls, monitoring programs, inspections and audits • Oversees monitoring and compliance reporting • Provides advice on environmental issues as required
Environmental Approvals Principal/Advisor	• Liaises with the DotEE on matters pertaining to the LTDP/LTMMP • Obtains approvals from the DotEE for any necessary variations or amendments of the LTDP/LTMMP
All personnel involved in maintenance dredging campaigns	• Complies with this LTMMP and other legal requirements • Exercise a Duty of Care to the environment • Report all environmental incidents

9 Reporting, Auditing and Review

Table 14 summarises the reporting requirements pre, post and during dredging works under the LTMMP/LTDP.

Table 14 Summary of reporting

Report	Details	Frequency/ schedule	Prepared by	Submitted to
Marine Water Quality				
Water Quality Monitoring Report	Results of monitoring and management actions taken. Including trigger exceedances	• Final report within three months after completion of each dredging campaign • Exceedance reporting is reactive	Environmental contractor	DotEE (and the PPA)
Hydrocarbon Spill Report	Incident report on hydrocarbon spill to marine waters including response measure implemented	Per occasion	Proponent	DER (under Dampier Environmental Licence requirements) PPA (immediately) DotEE
Benthic Primary Producer Habitats				
BPPH Report	Field report following completion of the BPPH survey	Final report three months after completion of the first major dredging campaign under the LTDP	Environmental contractor	DotEE (and the PPA)
Spoil Grounds				
International Maritime Organisation Report	Sea Dumping Permit International Reporting Requirements	• Annual • On expiry of LTDP	Proponent	DotEE
Bathymetric Survey Report	Results of pre and post bathymetric surveys of spoil grounds	Report within two months of completing the post dredging hydrographic survey	Hydrographic surveyor	PPA DotEE

Report	Details	Frequency/ schedule	Prepared by	Submitted to
Plotting Sheets	Time/date and GPS position of each dumping run	On completion of the project or on request	Dredge contractor	PPA
Marine Fauna				
Marine Fauna Incident Report	Details of incident	Within 48 hours of incident	Dredge contractor	DotEE DPaW
Marine Fauna sighting Reports	Record of marine fauna observations	Updated for every observation	Dredge contractor	Internal
Introduced Marine Pests				
Introduced Marine Pest Reports	Vessel Inspections reports and identification notifications	Notification: within 24 hr Vessel Inspection Checklist: 72 hour Inspection Report: within 3 weeks	Dredge contractor	DoF (and the PPA)

Audit

A compliance audit schedule will be developed based on the conditions/obligations contained within the LTMMP/LTDP and any other relevant approval documents. It is envisaged that the management and mitigation actions detailed in the LTMMP will form the basis of the audit criteria.

Any independent audits of compliance will be performed by an approved independent auditor, in accordance with any relevant LTDP condition.

Review

The LTMMP may be reviewed in response to any potential significant alteration of the environment in which dredging occurs (e.g. as a result of a major oil spill, or if other port users impact on the area). A review and amendment of the LTMMP may also be undertaken following identification of aspects of the LTMMP that are found not to be functional/efficient; any such review will be preceded by consultation with the DotEE. Any review will be led by the Proponent and will include consultation with the DTACC and the PPA, depending on the significance of the amendment/s being contemplated.

Primary consideration for the review will include:

- Volume and locations of material dredged to date;

- Assessment of whether the volume to be dredged within the time remaining on the LTDP is likely to exceed the permitted amount;
- Effectiveness of waste prevention strategies;
- Continual improvement of port operations relevant to the LTMMP;
- Currency of sediment sampling results and need to implement the SAP;
- Non-conformances as identified during audits; and
- Any other issues that arise during the course of dredging campaigns under this LTMMP/LTDP.

The findings of the review and any proposed amendments to the LTMMP will be provided to DotEE. The reviewed or revised LTMMP will require approval by DotEE prior to being implemented.

Publication

The LTMMP will be made available for public viewing via the Proponent's website for a period of two months after its initial approval and for a similar period after any approved major revision to the document.

Deliverable Actions

Action	Reference section of LTMMP	Where	Who	When
Pre-dredging				
Sediment SAP Implementation	3.4 Appendix C	SAP	Environmental contractor	Once during the life of the LTMMP/LTDP, prior to August 2020
Bathymetric Survey	6.3	Spoil ground proposed for dredging campaign	Hydrographic surveyor	Complete prior to commencement of each dredging campaign
Vessel Inspections	5.4	Port of departure before arrival in Port of Dampier	Dredge contractor	Complete prior to vessel arrival within Port of Dampier limits

Action	Reference section of LTMMP	Where	Who	When
Water Quality Monitoring Program	7.1	Dampier remote sensing monitoring cell	Environmental contractor	One month prior to start of each dredging campaign
Benthic Habitat Monitoring Program	7.2	Zones indicated in Figure 8	Environmental contractor	Once during life of the LTMMP/LTDP. Prior to start of first major dredge campaign
Dredging				
Marine Fauna Monitoring	5.3.3	At spoil ground proposed for campaign	Dredge contractor	During disposal activities
Water Quality Monitoring Program	7.1	Dampier remote sensing monitoring cell	Environmental contractor	Throughout each dredging campaign
Post-dredging				
Bathymetric Survey	6.3	Spoil ground proposed for campaign	Hydrographic surveyor	One month post dredging
Water Quality Monitoring Program	7.1	Dampier remote sensing monitoring cell	Environmental contractor	Continue one month post dredging for each campaign
Benthic Habitat Monitoring Program	7.2	Zones indicated in Figure 8	Environmental contractor	Once during life of the LTMMP/LTDP. On completion of first major dredge campaign

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APPENDIX A – RTIO HSEC&Q POLICY

Policy

Health, Safety, Environment and Communities

Our commitment to health, safety, environment and communities is fundamental to how we do business at Rio Tinto. It applies wherever and whenever we operate, from exploration, to closure.

RESPECT
We recognise and consider the views of others and treat them as we would want to be treated.

INTEGRITY
We act fairly, honestly and consistently in what we say and do and we speak out when necessary.

TEAMWORK
We work together and learn from each other to achieve our goals.

ACCOUNTABILITY
We take responsibility for our actions and hold others to account for theirs.

Delivering world class health, safety, environment and communities performance is essential to our business success. Meeting our commitments in these areas contributes to sustainable development and underpins our continued access to resources, capital and engaged people. Our focus on continuous improvement ensures regular renewal and relevance of our policies, procedures and activities.

Our goals include for everyone to go home safe and healthy every day. We believe all fatalities, injuries and occupational illnesses are preventable and aim to build and optimise wellbeing. We have committed leaders, employees and contractors creating this culture to drive great performance.

Equally critical, is maintaining stakeholder confidence through accountable and effective management of our risks and our impacts.

We approach each social, environmental or economic challenge as an opportunity to create safer, more valuable and more responsible ways to run our business. Wherever possible we prevent, or otherwise minimise, mitigate and remediate the effects of our business' operations. We assess the impact of our activities and products in advance, and we work with local communities and agencies to manage and monitor these impacts.

Our approach starts with compliance with relevant laws and regulations. We support and encourage further action by helping to identify, develop and implement world class practices through the application of our Group wide standards.

We actively monitor and ensure the security and resilience of our operations and collaborate when confronted with unwanted events or interruptions to minimise the impact on our people, stakeholders and operations.

We promote active partnerships at international, national, regional, and local levels, based on mutual commitment and trust. We engage with our joint venture partners to share our practices and insights. We acknowledge and respect Indigenous and local communities' connections to lands, waters and the environment and seek to develop mutually beneficial agreements with land connected peoples. We respect human rights and work with communities to create mutual value throughout and beyond the life of our operations.

Importantly, it is a shared responsibility, requiring the active commitment and participation of all our leaders, employees and contractors. Our business standards, systems and processes, support responsible operations, as well as contributions and innovations that make a positive and sustainable difference in every region we are part of.

RioTinto

APPENDIX B – RTIO VESSEL MOBILISATION PROCEDURE

Iron Ore (WA)

RTIOEP Marine Vessel Mobilisation Procedure

Table of contents

1 Context

The RTIOEP Marine Vessel Mobilisation Procedure provides the minimum environmental management processes required to mobilise a marine vessel to RTIO port waters during an expansion project.

2 Objective

To provide a standardised process for all marine vessel mobilisations to RTIO ports during expansion works to minimise the potential for the translocation of an invasive marine species.

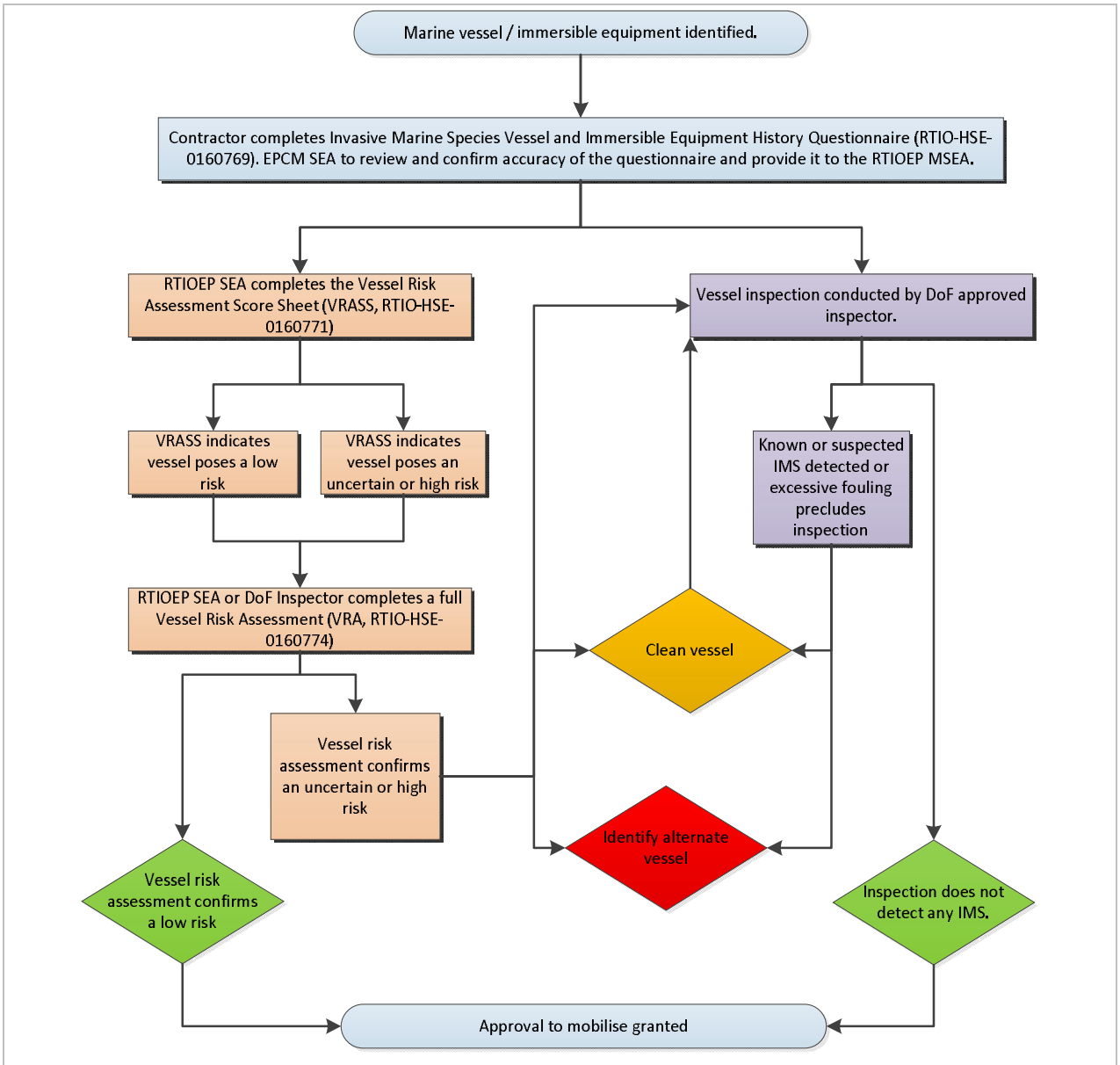
3 Definitions

Term	Meaning
ANZECC	Australian and New Zealand Environment and Conservation Council
DoF	Western Australian Department of Fisheries
EPCM	Engineering, Procurement, and Construction Management
ERASS	Equipment Risk Assessment Score Sheet
Invasive Marine Species	A species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health
Immersible equipment	Equipment that can be submerged and operated underwater e.g.

	anchors, dredging equipment, remotely operated vehicles etc.
RTIO	Rio Tinto Iron Ore
RTIOEP	Rio Tinto Iron Ore Expansion Projects
SEA	Specialist Environmental Advisor
Senior Project Representative	The senior onsite EPCM representative – usually the Construction Manager or their delegate.
VRA	Vessel Risk Assessment
VRASS	Vessel Risk Assessment Score Sheet

4 Work Practice

Flowchart



Flowchart 1: Marine Vessel Mobilisation and Associated Immersible Equipment Process

Minimum Requirements

Requirement / Step	Accountable Role
4.1 Implementation	**Project Manager**
The RTIOEP Marine Vessel Mobilisation Procedure shall be implemented by all Expansion Projects, where applicable.	
4.2 Overview	

This procedure outlines the minimum mitigation measures required to mobilise a marine vessel and associated immersible equipment to a RTIO port during an Expansion Project. Ultimately, the purpose of this procedure is to reduce the potential for the translocation of an Invasive Marine Species (IMS) to a previously unaffected RTIO port.

The procedure applies to the following non-trading vessels and associated immersible equipment, as defined within the National Biofouling Management Guidance for Non-trading Vessels (Commonwealth of Australia 2008):

General	Transport Service Vessels
• Barges; • Cable ships; • Dredgers; • Lighters (including oil recovery vessels); • Research vessels; • Tall ships; • Trailered vessels; and • Super yachts.	• Charter boats; • Pilot boats; • Ferries; • Tugs and line handling boats; and • Water taxis.

Heavy lift vessels are considered Trading Vessels under the *Navigation Act 1912* and consequently, are exempt to the requirements of this procedure.

All steps outlined in this procedure are mandatory and variations to this procedure must be supported by a risk based approach and approved by the RTIOEP Environmental Manager. Marine vessel and immersible equipment mobilisation procedures that are developed by RTIOEP Contractors must meet the requirements of this procedure and be approved by the RTIOEP Environment Manager.

4.3 Training and Competency	**Role**
All personnel involved in Expansion Projects that require the mobilisation of marine vessels and associated immersible equipment are required to undertake training detailing the intrinsicalities of this procedure.	**All Relevant Project Personnel**

Requirement / Step	Accountable Role
4.4 Marine Vessel Mobilisation Process	
4.4.1 Vessel History Questionnaire	**Contractor Representative**
The Contractor proposing to mobilise a marine vessel and associated immersible equipment is initially required to complete a Vessel History Questionnaire (RTIO-HSE-0160769). The questionnaire must be submitted to the EPCM SEA at least four weeks prior to the planned mobilisation date. The EPCM SEA is responsible for reviewing the questionnaire and ensuring that it is complete and accurate.	
4.4.2 Vessel Risk Assessment Score Sheet	**EPCM SEA**
Once the validity of the Vessel History Questionnaire has been confirmed, the EPCM SEA is to complete a Vessel Risk Assessment Score Sheet (VRASS) and / or Equipment Risk Assessment Score Sheet (ERASS) (RTIO-HSE-0160771). Once complete, the VRASS and Vessel and Immersible Equipment History Questionnaire (Refer to Section 4.4.1 of this document) must be submitted to the RTIOEP SEA for review and lodgement within RTIO's document management system. The VRASS and Summary Report must be submitted to the RTIOEP SEA four weeks prior to the planned mobilisation date for the marine vessel and associated immersible equipment. In the event that the VRASS indicates the vessel poses a low IMS risk, the RTIOEP SEA is to advise the Senior Project Representative who in-turn, is to advise the Contractor, that the vessel has been unconditionally approved to mobilise to site. In the event that an uncertain or high risk is calculated, a full vessel risk assessment (Refer to Section 4.4.3 of this document) must be completed.	
4.4.3 Vessel Risk Assessment	**IMS Inspector**
In the event that the VRASS and / or ERASS (refer to Section 4.4.2 of this document) indicates the proposed vessel and/or associated immersible equipment pose an uncertain to high IMS risk, it is the responsibility of the EPCM SEA to contract a Western Australian Department of Fisheries (DoF) approved IMS Inspector to conduct a full Vessel Risk Assessment (VRA). A list of DoF approved IMS inspectors is available at RTIO-HSE-0160773 however due to the transient nature of this list, it is also recommended that the DoF are consulted with prior to the works occurring. The IMS Inspector must conduct a detailed VRA based on the vessels operational history. The VRA is to critically analyse the potential for an IMS introduction, not just the potential for the vessel to support biofouling. The VRA is to analyse, where available, the IMS status of previous ports / areas in which the vessel has operated post its most recent antifouling application and internal equipment treatment only. The VRA is to be completed using a following template: RTIO-HSE-0160774. The VRA is to conclude whether the proposed marine vessel and associated immersible equipment mobilisation poses a low risk of introducing a previously absent IMS to port waters. A low risk rating may be applied unconditionally or conditionally upon the discretion of the IMS Inspector. For example, a low risk determination may be conditional to the vessel demobilising prior to a certain date (i.e. prior to a certain age of the vessel's antifouling). In the event that a low risk is determined, the RTIOEP SEA is to advise the Senior Project Representative who in-turn, is to advise the Contractor, that the vessel can mobilise to the project. In the event that an uncertain or high risk is determined, the vessel must undergo	

Requirement / Step	Accountable Role
additional mitigation such as an inspection (Section 4.4.4 of this document) or treatment / cleaning (Section 4.4.5 of this document), or an alternate vessel must be sought.	
4.4.4 Vessel Inspection	**IMS Inspector**

An inspection is required in the event that the IMS Inspector determines that a vessel poses an uncertain or high risk of introducing an IMS to port waters during the VRA process (refer to Section 4.4.3 of this document). Inspections must be conducted as detailed within the following:

Inspection Requirements

- all inspections must occur outside of RTIO port waters.
- in-water inspections must be conducted with adequate visibility (as determined by the IMS Inspector). The method for in-water inspections is at the discretion of the IMS Inspector and may include but not limited to:
    - IMS Inspector physically undertaking the inspection, or
    - IMS Inspector remotely directing divers through live audio and visual communications.
- inspection of external niche areas shall include:
    - vessel hull; and
    - all external niche areas, i.e. anodes, propellers, thrusters and sea chests intakes.
- inspection of internal niche areas shall include:
    - deck areas and associated immersible equipment;
    - bilge spaces;
    - anchor chain/cable lockers;
    - ballast tanks;
    - internal seawater cooling systems (including strainers and strainer boxes); and
    - confirmation with the vessel's Chief Engineer (to identify any reported blockages, reduced seawater pressures or elevated cooling water temperatures that may imply biofouling build-up).
- all inspections shall determine:
    - condition and area of fouling control coating (FCC) coverage (external areas);
    - presence/absence of sediment;
    - extent of biofouling;
    - presence/absence of potential IMS of concern; and
    - ballast water management will be in accordance with the AQIS ballast water requirements.
- video and/or digital still photographs shall be taken of all key areas (including external and internal niche areas) for accurate assessment and future reference.

Inspection Reporting Requirements

At the conclusion of the inspection, the IMS Inspector will complete and sign the Vessel and Immersible Equipment IMS Checklist and Inspection Summary Report (RTIO-HSE-0160770). The content of this report is to be based on the field observations made during the inspection and immediate post-inspection sample analysis.

The Contractor shall then fax or email the completed IMS Inspector's Summary Report to the EPCM SEA and RTIOEP SEA within 24 hours following the completion of the inspection.

A Final Inspection Report will be prepared by the IMS Inspector and submitted to the EPCM SEA and RTIOEP SEA within five business days following the completion of the vessel

Requirement / Step	Accountable Role

inspection.

Species confirmation may be required to confirm the inspection's field observations and the results of any additional analyses will be included in the full report, or will be provided to the EPCM SEA and RTIOEP SEA at the earliest possible opportunity.

Biofouling

In the event that a vessel or immersible equipment has excessive levels of biofouling such that detection or identification of a species of concern cannot be achieved to a satisfactory level of confidence by the Inspector; the following shall occur:

The IMS inspector shall:

i) photograph the biofouled area, with the extent of biofouling clearly visible;
ii) at the conclusion of the inspection the Contractor shall alert the EPCM SEA and RTIOEP SEA to the presence of excessive levels of biofouling;
iii) at the conclusion of the inspection, complete and sign the Summary Report detailing the findings of the inspection and recommend actions to manage the presence of excessive biofouling; and
iv) fax or email the completed Summary Report to the EPCM SEA and RTIOEP SEA within 24 hours of completion of the inspection.

The EPCM SEA will, on receipt of notification of excessive biofouling direct the Contractor to undertake treatment / cleaning activities (refer to Section 4.4.5 of this document) or seek an alternate vessel.

Detection of a Known or Suspected Invasive Marine Species of Concern

Following notification that a vessel or immersible equipment carries a known or suspected IMS the following shall occur:

The IMS Inspector shall:

i) photograph the biofouled area(s), with the IMS of concern clearly visible collect and preserve a sample of the organism to permit expert taxonomic species confirmation;
ii) at the conclusion of the inspection immediately alert the EPCM SEA, Senior Project Representative and RTIOEP SEA to the presence of a known or suspected IMS of concern;
iii) at the conclusion of the inspection, complete and sign the Summary Report (RTIO-HSE-0160770) detailing the findings of the inspection and recommended actions to manage the presence of the known or suspected IMS; and
iv) fax or email the completed Summary Report to the EPCM SEA, Senior Project Representative and RTIOEP SEA within 24 hours of completion of the inspection or as soon as possible.

The Senior Project Representative will on receipt of notification of known or suspected IMS, direct the Contractor to undertake treatment / cleaning activities (refer to Section 4.4.5 of this document) or seek an alternate vessel. .

4.4.5 Vessel Treatment / Cleaning	**IMS Inspector**

Development and Implementation of Vessel and/or Immersible Equipment Treatment/Cleaning Plans

i) The EPCM SEA shall engage a qualified IMS Inspector (RTIO-HSE-0160773) to establish a specific treatment and/or cleaning plan to address the identified risk;
ii) the RTIOEP SEA will liaise with regulators to seek advice and support for the identified treatment/cleaning plan;

Requirement / Step	Accountable Role
iii) the EPCM SEA shall engage a qualified IMS Inspector (RTIO-HSE-0160773) to observe and confirm the successful implementation of any required treatment and / or cleaning activities required and undertake a final inspection to confirm treatment / cleaning outcomes and identify the final risk status of the vessel or immersible equipment; iv) the EPCM SEA will submit all inspection report documentation to the RTIOEP SEA; and v) the RTIOEP SEA will provide final vessel clearance approval or other requirements to the EPCM SEA and Senior Project Representative who will in-turn provide these documents to the Contractor.	
Treatment / Cleaning Considerations Treatment may involve the use of chemicals or heat to remove or render any IMS non-viable. The use of these techniques is dependent on the area(s) being treated and the type of organism suspected. Cleaning generally involves the complete removal of biofouling from internal or external areas exposed to IMS establishment. There are a number of methods that may be applied, such as sand blasting, high pressure water jet and manual removal by scrapers. The utilised method is to be selected based on the area(s) required to be cleaned and the type of organism suspected (if any). Any requests for cleaning within Australia waters shall to be undertaken in accordance with the requirements of the ANZECC Code of Practice (ANZECC 1997). The requirements applying to Australian waters are applicable to all commercial vessels and are to be used alongside any State environmental protection agency requirements. Cleaning methods are generally considered more appropriate for vessels in dry dock than cleaning of vessels in water. Dry dock environments allow more thorough assessment of cleaning requirements and facilitate subsequent inspection necessary to confirm treatment and/or cleaning outcomes. It is also the view of the DoF that out-of-water cleaning is the preferred method. Treatment of internal seawater systems may be done in or out of water as long as the systems can be suitably isolated.	
4.4.6 Vessel Demobilisation	**EPCM SEA**
Prior to a marine vessel demobilisation from an Expansion Project, the Contractor shall submit an updated Vessel and/or Immersible Equipment Questionnaire (RTIO-HSE-0160769) to the EPCM SEA. Based on the information provided, the EPCM SEA shall complete and submit a VRASS and / or ERASS (refer to Section 4.4.2 of this document) to the RTIOEP SEA prior to the demobilisation of the vessel.	

5 References

ANZECC, 1997, *Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance*, Australian and New Zealand Environment and Conservation Council, Canberra.

Commonwealth of Australia, 2008, *National Biofouling Management Guidance for Non-trading Vessels*, Commonwealth of Australia, Canberra.

6 Associated Documents

RTIOEP Marine Vessel Mobilisation Procedure: Invasive Marine Species Vessel and Immersible Equipment History Questionnaire (RTIO-HSE-0160769)

RTIOEP Marine Vessel Mobilisation Procedure: Vessel and Immersible Equipment Invasive Marine Species Checklist and Inspection Summary Report (RTIO-HSE-0160770)

RTIOEP Marine Vessel Mobilisation Procedure: Vessel Risk Assessment Score Sheet (RTIO-HSE-0160771)

RTIOEP Marine Vessel Mobilisation Procedure: Approved Invasive Marine Species Inspectors (RTIO-HSE-0160773)

RTIOEP Marine Vessel Mobilisation Procedure: Vessel Risk Assessment Template (RTIO-HSE-0160774)

APPENDIX C – SAMPLING AND ANALYSIS PLAN

Attached as companion document

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