Long Term Management and Monitoring Plan for Maintenance Dredging and Disposal

Port of Karumba Entrance Channel

2013-2022

8 February 2013
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Approved by DSEWPaC

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1. INTRODUCTION

This document describes the long-term environmental management arrangements for maintenance dredging of the Port of Karumba entrance channel and placement at sea by Far North Queensland Ports Corporation (FNQPC), trading as Ports North, for the period 2013 to 2022.

This Long Term Management and Monitoring Plan (LTMMP) for Dredging and Disposal supports the application to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) for a long-term Sea Dumping Permit for maintenance dredging under the Environment Protection (Sea Dumping) Act 1981 (Sea Dumping Act) for the same period.

The Sea Dumping Act implements Australia’s obligations under the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping Wastes and other Matter, 1972 (the London Protocol). The Australian Government developed the National Assessment Guidelines for Dredging (NAGD; Commonwealth of Australia, 2009) to set out the framework for the environmental impact assessment and permitting of the ocean disposal of dredged material. The NAGD identifies that the DSEWPaC may grant long-term permits for maintenance dredging on the following basis:

- An assessment of the applicant’s ability to meet their obligations under the Sea Dumping Act and any permit granted;
- Establishment of a Technical Advisory and Consultative Committee (TACC) for long-term management; and
- Development and implementation by the applicant of a satisfactory long term Management Plan for loading and dumping activities.

This LTMMP documents a systematic approach to implementation of best practice environmental management of the maintenance dredging aspect of the Port of Karumba operations by Port North and outlines general environmental stewardship initiatives to address requirements in the Guidelines for Long Term Permits issued by DSEWPaC and the NAGD. This document is to be subject to review and continual improvement over the life of this plan and the corresponding Sea Dumping Permit.

1.1 Port of Karumba

The Port of Karumba is located within the Norman River in the southeast corner of the Gulf of Carpentaria. The port facilities are situated approximately 6km upstream of the entrance channel at the mouth of the Norman River. The entrance channel to the port extends approximately 9.5km northwest from the mouth of the river. A general overview of the Port is provided in Figure 1-3.

Broad intertidal sand flats extend for distances of 3 km to 10km from the shoreline to shallow subtidal areas on both sides of the mouth of the Norman River, through which the entrance channel traverses. The intertidal and subtidal zones remain turbid throughout the year and sediments within these areas are highly mobile, making up the majority of the maintenance material within the entrance channel.

The Port of Karumba has been servicing the remote Gulf communities since the late 1800’s. In 1996 the current entrance channel to the port was developed to provide reliable access to the Port. This channel was developed over two capital dredging campaigns (1996 and 1998) and has been maintained on a regular basis ever since.
Ports North, which took over port management from Ports Corporation Queensland (PCQ) in July 2009, propose to continue the program of dredging the entrance channel to maintain a navigable depth of -3.4m LAT.

1.1.1 Operations

Ports North manages the around 67 ha of strategic port land (SPL) at the Port of Karumba, which includes a series of small land parcels, some undeveloped, extending from the high water of the Norman River landward to adjacent Yappar Street. Activities at the Port are dominated by MMG Century (formerly OzMinerals) who commenced exporting zinc concentrate through the Port in December 1999 (Figure 1-2). Zinc slurry is piped approximately 300 km from the mine to the Port, dewatered, and loaded onto a 5,000 tonne transfer vessel, the Wunma, for the 40 km journey to export ships roadsted in deep water in the Gulf of Carpentaria. Other facilities in the Port provide for general cargo, fuel and the export of live cattle. A graph showing throughput at the Port of Karumba between 1999/2000 and 2011/2012 is provided in Figure 1-1. An average of 60 ships visits the Port of Karumba each year, making it a relatively low throughput port.

![Port of Karumba Trade](image)

**Figure 1-1 Port of Karumba trade throughput 1999/2000 to 2012/2012**

The Port is an important component for transport logistics between the Gulf of Carpentaria, via sealed roads, to central north western Queensland via Mt Isa, Cairns and Townsville. These linkages are vitally important for the commercial fishing industries, which utilise transhipment services through Karumba for the large northern prawn fishery. It also handles key equipment and fuel for mining and other activities around the Gulf of Carpentaria, eastern Northern Territory and western Cape York.

The current key export trade through the Port of Karumba are lead and zinc concentrates. Historically, the port was of significance as an unloading point for the northern prawn fishery, cold storage and then road freight to southern customers as far as Brisbane and interstate markets.

The Port infrastructure includes a dredged entrance channel, two recreational boat ramps, the MMG Century bulk loading operation, minor wharves for handling of fishing fleet, live
cattle, and coastal supply freight barges and their associated cargo and associated loading/unloading facilities. Depths at facilities within the Norman River remain at a natural depth of between -3 and -6m LAT. Some shipping movements along the channel by the transhipment vessel “Wunma” are tidally dependant.

As well as major trade items, the Port provides access to surrounding Gulf waters via two recreational boat ramps for public access. Other services provided by private operators include ship supplies, minor maintenance. A former slipway site is located on the Norman River adjacent to Strategic Port Land, and is no longer in use to reduction in demand from the fishing industry. Government agencies that undertake port related activities include Queensland Transport / Maritime Safety Queensland (MSQ), the Australian Maritime Safety Authority, and the Australian Quarantine and Inspection Service.

![View of the MMG facility on the Norman River](image)

**Figure 1-2 View of the MMG facility on the Norman River**
Figure 1-3 Port limits, entrance channel and spoil ground location
1.2 LTMMP Development Process

A comprehensive long term management plan for dredging has not been previously developed for the Port of Karumba. However; many of the elements required of an LTMMP have been completed or implemented, largely as conditions of approval for previous Sea Dumping Permits.

Implementation of a LTMMP allows a structured approach to environmental management of the dredging and disposal aspect of port operations, and summarises initiatives Ports North implements to manage and monitor the actions it takes to ensure environmental stewardship of the port area.

The Guidelines for Long Term Permits issued by DSEWPaC and the NAGD identifies that (long term) management plans should generally include the following information:

- overall management framework – describe how the plan integrates with the overall management framework
- context – put the proposal in the context of the local environment, including history of dredging and dredge material disposal at the site
- description of the project – provide information on dredging and disposal for the term of the plan or permit, including the location, staging, and timing of activities
- information on approvals – provide details of any approvals, relevant conditions and any other statutory requirements
- description of the existing environment – characterise the dredging and disposal sites and adjacent areas, including its water column, sediments, biota, resources and other uses (existing and potential) of the area
- description of the material for disposal – provide a summary of sediment types, their status relevant to the values in these Guidelines
- description of potential impacts – address both potential short-term and long-term impacts and any uncertainties regarding the predicted impacts
- management strategies and actions – describe strategies and actions to mitigate impacts – including specific and auditable measures; performance indicators; monitoring requirements; corrective actions; and responsibilities and timing for management and monitoring activities
- contingency arrangements – identify corrective actions and contingency plans should undesirable or unforseen impacts occur
- continuous improvement – identify opportunities for continuous improvement to prevent, minimise or mitigate environmental impacts in the longer term
- auditing requirements and reporting – outline reporting and documentation standards, timing and responsibility of any auditing or reporting; and
- review of management plan – make provisions for a review of the management plan, including consultation with the TACC, to ensure it remains current.

These information requirements form the framework for this LTMMP document. The relationship of this document and its key components is demonstrated in Figure 1-4.

In order to ensure transparency and stakeholder understanding and acceptance of the environmental management of the dredging and disposal, both the LTMMP and final reports on monitoring programs derived from it are to be available through the Ports North website located at [www.portsnorth.com.au](http://www.portsnorth.com.au), and any approved revisions updated accordingly.
Figure 1-4 Document relationships and management framework

Long Term Management & Monitoring Plan

Management Actions

Monitoring Programs

- Flora - Seagrass
- Benthic In-Fauna
- Marine Pests
- Sediment Analysis Plan
- Water Quality

New Scientific Knowledge

Survey Reports

Periodic Reporting

SAP Report

EMC Close Out Report

Soundings & Charts

Annual Compliance Reporting
1.3 Objectives of the LTMMMP

The primary objectives of this LTMMMP for maintenance dredging and disposal at the Port of Karumba are:

- To establish an agreed framework for the long term environmental management of dredging and spoil disposal activities;
- To provide greater financial, operational and scientific planning certainty to Ports North in relation to maintenance dredging and disposal activities;
- To facilitate long-term Port development and associated management plans; and,
- Facilitating a transparent process of monitoring and compliance to environmental responsibilities;
- To maintain predictability for Ports North maintenance dredging and sea dumping arrangements.
- Provide transparency to stakeholders regarding dredging and disposal management via operation of the Technical Advisory and Consultative Committee (TACC).
2. MANAGEMENT FRAMEWORK

The NAGD recognises the strong association between dredging and the economic viability of many of Australia’s port developments and on-going trade opportunities. The coordinated and timely approach to environmental investigations, permitting, management and approvals is considered important to maximising economic opportunity, whilst maintaining sustainability of our coastal resources.

While the NAGD provides for the continued case-by-case assessment of individual dredging proposals, it also considers the long term management of on-going dredge and disposal requirements as a jointly valuable outcome for Port operators and the environment.

2.1 Port of Karumba Management Responsibilities

Under the Queensland *Transport Infrastructure Act 1994*, Ports North is required to establish, manage and operate effective and efficient port facilities and services. The legislative responsibility extends to the provision of safe navigational access to marine facilities under the Ports North jurisdiction.

Ports North also has a key role in ensuring that services and facilities are provided for existing and potential customers that are reliable, efficient and competitive. This means that Ports North must adopt a strategic long-term approach to provide ports services, channel infrastructure, and to pursue mechanisms that provide certainty in ensuring Ports North meets it statutory responsibilities.

Ports North also needs to ensure that dredging and dredge material management of the Port of Karumba is undertaken proactively and in accordance with relevant State and Commonwealth statutory requirements, whilst ensuring certainty and sustainability in the long-term management of the Port.

Ports North has developed this LTMMP for maintenance dredging and disposal in support of an application for a ten-year Sea Dumping Permit, fulfilling the goals of the strategic resources planning for the Port, while facilitating the ongoing protection of the marine environment and recognising the requirements of associated stakeholders and interested parties.

2.2 Ports North Environment Policy

Ports North maintains an Environment Policy which reflects the organisations corporate commitment to environmental management in all aspects of business and operations. The Policy outlines environmental objectives which must be adhered to by all staff and contractors. The Policy guides actions by Ports North staff and appointed contractors, including those for dredging services, and contract documents reflect the requirement for the objectives of the Environment Policy be adhered to at all times.

2.3 Environmental Management System (EMS)

Ports North maintains an Environmental Management System (EMS) which is implemented to be consistent with ISO14001:2004, which covers the activities under Ports North direct operational control at the Port of Karumba. The EMS outlines all aspects of environmental management across Ports North’s operations at each of the nine port locations. The EMS covers Ports North’s activities and operations only, while port users, tenants or casual berth users may have their own management systems and plans in place however Ports North does not have operational control of these management actions.
This LTMMMP is one of two (the other being the Port of Cairns Long Term Management Plan for Dredging and Disposal 2010-2020), which are sub-ordinate management documents captured by the EMS and applicable to one of the Permits or Licences held by the organisation. Specific management and control process for review, reporting, auditing, monitoring and performance review is applied to each of these Plans.

2.4 Environmental Management Plan (EMP)

An Environmental Management Plan for Port of Karumba is maintained by Ports North, which identifies environmental values of the Port, and management measures to ensure that impacts of routine port operations and potential risk of contamination to the natural environmental are minimised over the long term. The EMP details port monitoring, management and mitigation strategies, and sets out the general requirement on long term or established operators on Strategic Port Land to implement individual site based operational environmental management plans, including detailed stormwater management plans to minimise pollution or contamination to the port catchment.

2.5 Ports North Roles and Responsibilities

The approvals for this maintenance dredging project include a range of conditions which must be complied with. Some of these conditions relate to operational activities while others relate to broader management issues, environmental monitoring and reporting. Contract negotiations between dredging contractors and Ports North will clarify responsibility for compliance with the various conditions applicable to dredge operation and management.

Table 2-1 provides an outline of the roles and responsibilities of the staff involved in the Karumba dredging project. Figure 2-1 provides an outline of the chain of command and links between parties involved in the project.

2.6 Management Process

As manager of the Port of Karumba, Ports North will continue to conduct maintenance dredging to ensure safe and efficient operation of the port in accordance with legislative requirements under the State Transport Infrastructure Act 1994, the conditions of various permits and consideration of TACC recommendations as per subsequent Section.

Future maintenance dredging will require ongoing compliance with the ERA 16 licence under the State Environmental Protection Act 1994, and specific conditions set out in the Commonwealth Environmental Protection (Sea Dumping Act) 1981, Sea Dumping Permit issued to Ports North by DSEWPaC.
Table 2-1 Roles and responsibilities of key positions for Port of Karumba maintenance dredging

This table is to form the template for the contacts list and is to be updated with the campaign specific details once Contractor is appointed, and names and phone numbers of all positions filled out. It is acknowledged that organisation structures, specific staff names and phone numbers will change from time to time.

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<tr>
<th>Position</th>
<th>Responsibility</th>
<th>Reporting To</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ports North</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ports North</strong></td>
<td>Operational support</td>
<td></td>
</tr>
<tr>
<td><strong>Chief Executive Officer</strong></td>
<td>Ultimate responsibility for ensuring Ports North staff and the organisation meet permit conditions and legal compliance requirements</td>
<td>Ports North Board</td>
</tr>
<tr>
<td><strong>General Manager Corporate Services</strong></td>
<td>Community – complaints and engagement</td>
<td></td>
</tr>
<tr>
<td><strong>General Manager Projects and Planning</strong></td>
<td>Dredge contract</td>
<td></td>
</tr>
<tr>
<td><strong>Port Supervisor</strong></td>
<td>Contact for local port information and coordination of emergency situations</td>
<td></td>
</tr>
<tr>
<td><strong>Security, Emergency and Compliance Coordinator</strong></td>
<td>Implementation and coordination of emergency response plans, port contingency plans and advice on situations</td>
<td></td>
</tr>
<tr>
<td><strong>Surveyor and Survey Assistant/Draftsperson</strong></td>
<td>Conduct of hydrographic surveys (channel and spoil ground)</td>
<td></td>
</tr>
<tr>
<td><strong>Environment Manager</strong></td>
<td>Implement awareness training in respect of Permit conditions and LTMMP deliverables</td>
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<tr>
<td><strong>Project Superintendent</strong> (may be an external role appointed by Ports North)</td>
<td>Contract supervision Environmental Monitoring (e.g. water quality, if delegated task by Ports North)</td>
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<tr>
<td><strong>Maritime Safety Queensland (MSQ) Contacts</strong></td>
<td>Hotline – General contact point for Safety or Pollution events – access to state wide resources</td>
<td>MSQ Regional Harbour Master</td>
</tr>
<tr>
<td><strong>Manager Remote Area Services Karumba</strong></td>
<td>Contact for Marine Pollution, hazardous spills and shipping safety issues</td>
<td>MSQ Regional Harbour Master</td>
</tr>
<tr>
<td><strong>Staff On-board TSHD</strong></td>
<td>Vessel Master</td>
<td></td>
</tr>
<tr>
<td><strong>Chief Engineer</strong></td>
<td>Responsible for operation and maintenance of onboard machinery</td>
<td>Vessel Master</td>
</tr>
<tr>
<td><strong>Crew</strong></td>
<td>Implementation of specific EMP components i.e. spill response, waste, general duty</td>
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<td><strong>Contractors Staff On-Shore</strong></td>
<td>Site Manager</td>
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<tr>
<td><strong>Manager Dredging Operations</strong></td>
<td>Management of overall operations of dredger</td>
<td>Senior Management</td>
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<tr>
<td><strong>Environmental Coordinator</strong></td>
<td>Responsible for undertaking monitoring of EMP implementation</td>
<td>Senior Management</td>
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<tr>
<td><strong>Senior Management</strong></td>
<td>Responsible for overall management of the Contractors dredging activities</td>
<td>CEO/General Manager</td>
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<td><strong>Department of Environment and Heritage Protection (DEHP)</strong></td>
<td>Marine Animal-Wildlife Hotline</td>
<td>DEHP Regional Office</td>
</tr>
<tr>
<td><strong>Pollution Hotline</strong></td>
<td>Land based/source spills, Environmental Harm, environmental complaints</td>
<td>DEHP Regional Office</td>
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**Ports North**

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<tr>
<th>Position</th>
<th>Reporting To</th>
<th>Contact Numbers</th>
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<tr>
<td><strong>Ports North</strong></td>
<td></td>
<td>(07) 4051 2558 Ph:</td>
</tr>
<tr>
<td><strong>Port Operations 24 hr Contact</strong></td>
<td></td>
<td>(07) 4052 3811 Mobile:</td>
</tr>
<tr>
<td><strong>Chief Executive Officer</strong></td>
<td>Ports North Board</td>
<td>(07) 4031 2551 Fax:</td>
</tr>
<tr>
<td><strong>General Manager Corporate Services</strong></td>
<td>Chief Executive Officer</td>
<td>(07) 4052 3804</td>
</tr>
<tr>
<td><strong>General Manager Projects and Planning</strong></td>
<td>Chief Executive Officer</td>
<td>(07) 4052 3851</td>
</tr>
<tr>
<td><strong>Port Supervisor</strong></td>
<td>General Manager Commercial</td>
<td>(07) 4745 9544</td>
</tr>
<tr>
<td><strong>Security, Emergency and Compliance Coordinator</strong></td>
<td>Manager Port Services</td>
<td>(07) 4052 3851</td>
</tr>
<tr>
<td><strong>Surveyor and Survey Assistant/Draftsperson</strong></td>
<td>General Manager Projects and Planning</td>
<td>(07) 4052 3885</td>
</tr>
<tr>
<td><strong>Environment Manager</strong></td>
<td>General Manager Projects and Planning</td>
<td>(07) 4052 3820</td>
</tr>
<tr>
<td><strong>Project Superintendent</strong> (may be an external role appointed by Ports North)</td>
<td>General Manager Projects and Planning or Surveyor</td>
<td></td>
</tr>
<tr>
<td><strong>Maritime Safety Queensland (MSQ) Contacts</strong></td>
<td>MSQ Regional Harbour Master</td>
<td>1300 551 899</td>
</tr>
<tr>
<td><strong>Manager Remote Area Services Karumba</strong></td>
<td>MSQ Regional Harbour Master</td>
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</tr>
<tr>
<td><strong>Vessel Master</strong></td>
<td>Manager Dredging Operations</td>
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<tr>
<td><strong>Chief Engineer</strong></td>
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<td><strong>Crew</strong></td>
<td>Vessel Master</td>
<td></td>
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<tr>
<td><strong>Site Manager</strong></td>
<td>Manager Dredging Operations</td>
<td></td>
</tr>
<tr>
<td><strong>Manager Dredging Operations</strong></td>
<td>Senior Management</td>
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<td><strong>Environmental Coordinator</strong></td>
<td>Senior Management</td>
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<tr>
<td><strong>Senior Management</strong></td>
<td>CEO/General Manager</td>
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<tr>
<td><strong>Department of Environment and Heritage Protection (DEHP)</strong></td>
<td>DEHP Regional Office</td>
<td>1300 130 372</td>
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<td><strong>Marine Animal-Wildlife Hotline</strong></td>
<td>DEHP Regional Office</td>
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<td>DEHP Regional Office</td>
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</table>
Figure 2-1 Ports North - Organisational Structure - Karumba Dredging

Shading identifies applicable positions with management responsibilities for dredging and disposal activity at Port of Karumba as outlined in text section above.

- **Chief Executive Officer**
- **General Manager - Planning & Projects**
  - Secretary
  - Senior Projects Engineer
  - Surveyor
  - Survey Assistant / Draftsperson
  - Environment Manager
  - Marine Services Supervisor
  - Administration
  - Administration Officer
  - Marina Coordinator
  - Security, Emergency and Compliance
  - Seaport Operations Officers x 7
- **Manager Port Services**
  - Area Officer x 2
  - Port Supervisor - Mourilyan
  - Port Supervisor - Karumba
- **General Manager - Commercial**
  - P/T Administration Officer
  - Commercial Coordinator
  - Business Development
  - Port Supervisor – Thursday Island
- **Manager Assets**
  - Plant & Maintenance Manager
  - Area Officer x 2
  - Port Supervisor - Mourilyan
- **General Manager – Corporate Services**
  - Financial Officer
  - Manager Finance
  - Accountant
  - Finance Clerk
  - Graduate Trainee
  - Technical Officer (Electrical)
  - Plant & Mtc Team Leader
  - Plant & Maintenance team x12
  - Technical Officer Building & Services
  - Asset Engineer
  - ICT Manager
  - ICT Officer
  - Payroll Purchasing Officer
  - Administration
2.7 Dredging and Disposal Legislative Framework

The Port of Karumba and its offshore spoil ground lie within Queensland State coastal waters (within 3nm of the territorial baseline) and Commonwealth waters (essentially from the territorial baseline at high-water mark, to 200nm offshore). Dredging and the subsequent disposal of dredged material are therefore controlled under both Queensland and Commonwealth legislation. The following sections outline the legislative framework for dredging and sea disposal of dredged material at the Port of Karumba.

2.7.1 Commonwealth Responsibilities

Environment Protection (Sea Dumping) Act 1981

The loading for the purposes of dumping of material at sea in Australian waters is regulated by the Commonwealth under the *Environment Protection (Sea Dumping) Act 1981* (Sea Dumping Act). Australian waters extend from the low water mark to the outer edge of the Exclusive Economic Zone (EEZ), to those parts of the continental shelf that are beyond the limit of the EEZ and waters above the Australian continental shelf beyond the limit of the EEZ.


The Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), administers the *Sea Dumping Act* and issues permits for all sea dumping activities from vessels, aircraft and platforms in Australian waters, and all dumping activities from Australian vessels and aircraft anywhere at sea, with the exception of the Great Barrier Reef Marine Park, where the Great Barrier Reef Marine Park Authority has delegated responsibility. Since the *Sea Dumping Act* has jurisdiction to the low water mark, a permit from the DSEWPaC is required for sea dumping.

As described in Section 2.8, between 1996 and 2011, nine Sea Dumping Permits were granted for dredging and disposal at the Port of Karumba. These were granted to Ports Corporation of Queensland, who managed port operations until 30 June 2009, when management was divested to Far North Queensland Ports Corporation Ltd, (trading as Ports North).

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

For all sea dumping activities that are the subject of a permit application under the *Sea Dumping Act*, DSEWPaC will make a determination (in accordance with Section 160 of the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*) whether approval is also required under the *EPBC Act*. The Minister will consider whether the action will have significant impact on the environment. The *EPBC Act* promotes the conservation of biodiversity by providing strong protection for:

- Listed species and communities (this includes listed threatened species and ecological communities, listed migratory species and listed marine species);
- Cetaceans (all whales, dolphins and porpoises) in Commonwealth waters and outside Australian waters;
• Protected areas (World Heritage properties; RAMSAR wetlands; Biosphere reserves; Commonwealth reserves; and conservation zones); and

• Commonwealth marine waters

Review of published mapping indicates the site is within the North Marine Bio-Region, however there are no specific Marine Protected Areas (MPAs) within the southern gulf region, including the area subject of this management plan.

Ports North considers that maintenance dredging activities within the Port of Karumba do not trigger consideration under the EPBC Act. This follows a consideration of potential environmental impacts, particularly protected matters under the Act and evaluation of the action against criteria within the EPBC Act Significant Impact Guidelines 1.1 (Commonwealth of Australia, 2009) which states that:

“Dredging to maintain existing navigational channels would not normally be expected to have a significant impact on the environment where the activity is undertaken as part of normal operations and the disposal of spoil does not have a significant impact.”

Given that the aim of the dredging operations is to maintain existing navigation channels, the most probable impacts would be related to dredge disposal rather than the dredging itself. Therefore, the focus of this assessment relates primarily to considering potential impacts relating to dredge spoil disposal at the spoil ground, as well as consideration of the impact of dredging and disposal on inshore coastal areas.

A search of the on-line EPBC Act Protected Matters Search Tool was conducted incorporating the port area and spoil ground to determine potential matters of national environmental significance to be addressed. Results of this are discussed in Section 7.2 and a copy of the EPBC Act Protected Matters Report is provided in Appendix 1.

### 2.7.2 State Responsibilities

**COASTAL PROTECTION AND MANAGEMENT ACT 1995 AND STATE COASTAL MANAGEMENT PLAN**

The Queensland State Coastal Management Plan, (the State Plan) has been developed under the Coastal Protection and Management Act 1995 (the Coastal Act). The State Plan describes how the coastal zone and its resources are to be managed. The ‘Coastal Zone’ is defined as: coastal waters - Qld waters to the limit of the Highest Astronomical Tide - HAT), and all areas to the landward side of coastal waters in which there are physical features, ecological or natural process that affect, or potentially affect, the coast or coastal resources.

The area affected by the loading and dumping of dredged material at the Port of Karumba is covered under the State Plan as it is partially located within 3 nm (approx. 5.5 kms) of the territorial baseline. The State Plan outlines management policies for Extractive Industry/Dredging (2.1.6/2.1.8 State Plan) and aims to achieve the best environmental outcome for the dumping of dredge spoil.

Regional Coastal Management Plans (Regional Plans) are also required as part of the Coordinated Management objective of the State Plan. Four regional plans have been prepared and there is no plan for the Gulf of Carpentaria, or part thereof.

The Queensland Coastal Protection and Management Act 1995 (Coastal Act) require that coastal development applications be assessed under the Integrated Development Assessment System (IDAS) within the Sustainable Planning Act 2009. These amendments overcome the previous requirements for approvals under the Harbours Act 1955 (Section 86
approvals). The Queensland Department of Environment and Heritage Protection (DEHP) administer the Coastal Act.

Review of the State Coastal Plan during 2008-2011 resulted in the release by the then DERM, of the new Queensland Coastal Plan (QCP) and State Policy-Coastal Management, and State Planning Policy 3/11: Coastal Protection (SPP). The Coastal Plan recognises existing port infrastructure and areas of operation, including Strategic Port Land at Karumba. The QCP includes greater protection of the coastal zone, planning to mitigate against effects of climate change and sea level rise.

**Environmental Protection Act 1994**

Port authorities are required to obtain an environmental licence for the environmentally relevant activity for extractive industry and screening (ERA 16) under the Environmental Protection Act 1994 (Qld) (EP Act). Previously under the EP Act, dredging activities undertaken by a Port Authority were exempt under the Transport Infrastructure Act 1994 from requiring an environmental licence for dredging under ERA 19 (Dredging). However, with the update of the Environmental Protection Regulation in 2008, ERA 19 was removed and dredging was included in ERA 16 for extractive and screening activities. This removed any exemption afforded to Port Authorities under the Transport Infrastructure Act 1994.

Development Approval SPDE00100610 for ERA 16 was granted by DERM on 21 April 2010. A copy of the approval is provided in Appendix 3. This approval is ongoing and applicable to the site to which the approval conditions continue to apply. With the Land Owner's Consent, a Registration Certificate may be issued to any operator to operate at the site; however the conditions of the Development Approval continue to apply.

**Fisheries Act 1994**

If dredging or spoil placement activities involve the removal or disturbance of marine plants or works within a declared fish habitat area, approvals under the provisions of the Fisheries Act 1994 are required. The Act provides for the protection, management and conservation of Queensland’s recreational and commercial fishery resources. Activities which involve disturbance to marine plant or declared fish habitat areas require an application to be assessed under the IDAS within the Sustainable Planning Act 2009. The presence of marine flora in surveys conducted during the EIS phase, and subsequent benthic surveys have not confirmed a presence of marine plants within the areas subject to dredging or spoil placement activities, and hence the requirement for an approval for removal or disturbance of marine plants under the Fisheries Act 1994 is not applicable.

**Transport Infrastructure Act 1994**

This Act establishes a regime under which a port system is provided and can be managed (amongst other things). Functions and powers of Port Authorities are defined, including power to maintain port infrastructure, including dredging of channels, to remove shoals and requires the Port Authority to dispose spoil to an approved location.

The Transport Infrastructure Act also establishes the structure for management of Strategic Port Land (SPL), Land Use Plans, and the role as land manager for activities on SPL, as well as offence provisions via Port Notices.
2.8 Existing Approvals and Conditions

**SEA DUMPING PERMIT**

The history of approved Sea Dumping Permits at the Port of Karumba is provided below and includes a mix of long-term and annual permits for capital and maintenance dredging. Note that FNQPC took over management of the Port of Karumba in 2009 and so does not have detail of Sea Dumping Permit numbers prior to 2008.

- The first permit was granted on 25 June 1996, which was for the first stage of capital dredging of the channel. The permit expired on 25 September 1998.
- The second permit was granted on 24 June 1997 for 1,200,000 m$^3$, which was for the secondary stage of capital dredging of the channel. The permit expired on 30 September 2000.
- The third permit was granted for 2,250,000 m$^3$ on 11 May 2000 for maintenance dredging of the channel. This permit expired on 30 September 2005. Dredging under this permit was completed in 2000, 2002 and 2004.
- SD2006/0034 - the fourth permit was granted on 31 July 2006 for 650,000 m$^3$ maintenance dredging of the channel for a period of one (1) year.
- SD2007-0662 - the fifth permit was granted on 1 May 2008 for 700,000 m$^3$ maintenance dredging of the channel for a period of one (1) year.
- SD2010/1482 - the sixth permit was issued on 29 April 2010 for 450,000 m$^3$ maintenance dredging for a period of one (1) year.
- SD2010/1482 was varied on 28 April 2011 for a one year extension for the 2011 campaign of up to 550,000 m$^3$.

The one year Sea Dumping Permit issued for the 2010 campaign for maintenance dredging in Karumba was varied for one year to allow for the 2011 campaign and subsequently expired on 28 April 2012. Bed-Levelling works were implemented in place of the 2012 dredging campaign, and hence a Sea Dumping Permit for 2012 was not required.

This LTMMP should be applied in conjunction with conditions of approval as outlined within the Sea Dumping permit issued under the *Commonwealth Environment Protection (Sea Dumping) Act 1981*.

**OPERATIONAL WORKS APPROVAL UNDER THE COASTAL ACT**

An approval under *Section 86* of the repealed Queensland *Harbours Act 1955* exists for the Karumba channel, which was issued by the State on 24 June 1996 and amended on 30 September 1996. This approval is a deemed approval under the *Coastal Act*. The spoil ground is also included within this approval which permits the dumping of spoil at the existing spoil ground and sets a number of conditions, which were addressed and implemented by PCQ during dredging campaigns (including contingency events). A copy of the approval can be found at Appendix 3.

**ENVIRONMENTAL LICENCE UNDER THE ENVIRONMENTAL PROTECTION ACT**

Amendments to the *Environmental Protection Act 1994* and *Environmental Protection Regulation 2008* require that maintenance dredging conducted by Queensland Port Authorities is subject to an approval for Environmentally Relevant Activity (ERA) 16 Extractive or Screening Activities.
Approval and licence condition requirements for the Port of Karumba were completed on 21 April 2010. Permit conditions for maintenance dredging include the set of standard conditions and one specific condition for the 2010 campaign. A requirement is also included for Ports North to develop an ‘Integrated Environmental Management System’ (IEMS) as defined under the EP Act as:

“A system for the management of the environmental impacts of the carrying out of the activity or activities.”

This LTMMP is developed and implemented to address the IEMS requirement, and contains a monitoring plan which outlines the environmental monitoring requirements under the permit. The former DERM (now DEHP) confirmed that monitoring requirements will be based on existing environmental monitoring programs in place by Ports North.

State approvals for Environmentally Relevant Activities (ERAs) require that a Development Approval is in place for the site (Lot/Plan) of the activity, and that a Registration Certificate is held by the operator conducting the action. Due to the nature of maintenance dredging activities for Queensland ports, and the length of this permit term, the appointed dredging contractor may change due to commercial arrangements. Therefore, a requirement of that dredging contract will be for a Registration Certificate to be obtained and be valid for the period of proposed dredging. An example of the Registration Certificate for the 2010 campaign, issued by the former DERM to Port of Brisbane Pty Ltd is included at Appendix 3.

2.9 Summary of Approvals

Ports North maintains the following approvals (refer Appendix 3) for the maintenance dredging at Port of Karumba:

<table>
<thead>
<tr>
<th>Port of Karumba Maintenance Dredging - Current Approvals</th>
</tr>
</thead>
<tbody>
<tr>
<td>- S86 Harbours Act Approval No. NR25001 dated 24 June 1996 and amended on 30 September 1996 – Approval for the channel design and sea dumping location.</td>
</tr>
<tr>
<td>- ERA 16 Extractive and Screening Activities Permit No. SPDE00100610 dated 21 April 2010.</td>
</tr>
<tr>
<td>- Applicable Sea Dumping Permit No. issued by DSEWPaC.</td>
</tr>
</tbody>
</table>

2.10 Technical Advisory and Consultative Committee

Under the NAGD the development of a Technical Advisory and Consultative Committee (TACC) is required to assist in the consultation process for a long-term Sea Dumping Permit application and the implementation of a Long Term Management and Monitoring Plan for dredging and offshore spoil disposal. Appendix C of the NAGD states that “A TACC is intended to assist ports and other proponents and the Determining Authority to access local knowledge and reconcile various stakeholder interests”.

Prior to divestment of port management to Ports North in 2009, PCQ undertook considerable consultation regarding ongoing dredging at the Port of Karumba. The Karumba TACC was
established in 1996, and has been well informed of each dredging event, approvals processes and the outcomes of dredging related monitoring conducted at the Port in these past years. Minutes of the TACC meeting, held in conjunction with development of this LTMMMP are attached as Appendix 6.

It is the intention, that as the managers for the Port of Karumba, Ports North will continue to facilitate liaison with the TACC. TACC meetings will be convened at least once per year and prior to each anticipated dredging campaign, prior to the dredging being undertaken, or at any such time that a matter requiring technical guidance on matters of interest to the TACC is required.

As described in Appendix C of the NAGD (2009), function of the TACC at Karumba is intended to:

- Provide continuity of direction and effort in protecting the local environment;
- Aid communication between stakeholders and provide a forum where points of view can be discussed and conflicts resolved;
- Assist in the establishment, as appropriate, of longer term permitting arrangements, including reviewing the development and implementation of Sampling and Analysis Plans, Long Term Management Plans and research and monitoring programs;
- Review ongoing management of dredging and dumping activities in accordance with the NAGD and permitting arrangements; and
- Make recommendations to the proponent and DSEWPaC as necessary or appropriate.

The TACC may also convene subordinate advisory groups, as necessary, to address particular technical issues or to facilitate prompt resolution of a particular issue.

Key areas of involvement of the Karumba TACC will include:

- Participation in formal structure of meetings, including distribution of meeting invitations, request for agenda items, circulation of agenda, appointment of a chairperson/facilitator for each meeting, recording of minutes, circulation of final meeting minutes and action items
- development of an issues register to avoid repetition and confirm outcomes over term of LTMMMP;
- Standard committee process of issue resolution is to be followed with DSEWPaC and Ports North to negotiate resolution of conflict on any issues
- DSEWPaC ultimately has the role in resolving any conflict in advice provided by the TACC stakeholders;
- Review and comment on the updated LTMMMP;
- Liaison prior to, during and after each dredging campaign to discuss and review the proposed program, including environmental monitoring programs, protective measures and the ongoing monitoring of environmental condition indicators within the Port.
- Provision of feedback and discussion of the LTMMMP during the course of the long-term Sea Dumping Permit to ensure it remains current to regulators and the community.
- Provision of technical advice to DSEWPaC and Ports North on their given area of expertise (e.g. DAFF, CSIRO, or DEHP), into the assessment process for any request to vary the LTMMMP or Permit Conditions.

Ports North will continue to facilitate the meeting arrangements, minutes and follow up of action items to coordinate the process between the TACC, Ports North and DSEWPaC. If required, a standard committee structure may be appointed should the scale of issues warrant. Standard meeting protocols will be implemented, including circulation of draft agenda for input from stakeholders, meeting minutes and an issues log to ensure a concise record of items raised and how those have been resolved. DSEWPaC is included as a
TACC stakeholder, however has a role as an “observer” at meetings, due to the DSEWPaC having responsibility for approving actions or variations to the Sea Dumping Permit or LTMMMP. The Port of Karumba TACC is to consist of representatives;

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Representative and Contact Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ports North</td>
<td>General Manager Projects and Planning Environment Manager</td>
</tr>
<tr>
<td>PO Box 594 CAIRNS QLD 4870</td>
<td></td>
</tr>
<tr>
<td>Department of Sustainability Environment</td>
<td>Director, Ports and Marine Section Environment and Assessment Branch</td>
</tr>
<tr>
<td>Water Population and Communities [DSEWPaC]</td>
<td></td>
</tr>
<tr>
<td>GPO Box 787 CANBERRA ACT 2601</td>
<td></td>
</tr>
<tr>
<td>MMG Century</td>
<td>Environmental Supervisor</td>
</tr>
<tr>
<td>PO Box 230 KARUMBA QLD 4891</td>
<td></td>
</tr>
<tr>
<td>CSIRO Marine Research</td>
<td>Marine Ecologist</td>
</tr>
<tr>
<td>PO Box 2583, Brisbane, QLD 4001</td>
<td></td>
</tr>
<tr>
<td>Queensland Department of Environment and Heritage</td>
<td>Principal Environment Officer - Cairns</td>
</tr>
<tr>
<td>Protection [DEHP]</td>
<td></td>
</tr>
<tr>
<td>PO Box 2066 CAIRNS QLD 4870</td>
<td></td>
</tr>
<tr>
<td>Carpentaria Shire Council</td>
<td>Chief Executive Officer</td>
</tr>
<tr>
<td>PO Box 31 NORMANTON QLD 4890</td>
<td></td>
</tr>
<tr>
<td>Maritime Safety Queensland</td>
<td>Regional Harbour Master</td>
</tr>
<tr>
<td>PO Box 1787 CAIRNS QLD 4870</td>
<td></td>
</tr>
<tr>
<td>Queensland Department of Agriculture Forestry and</td>
<td>Principal Scientist</td>
</tr>
<tr>
<td>Fisheries (DAFF) including Fisheries Queensland</td>
<td></td>
</tr>
<tr>
<td>PO Box 5396 CAIRNS QLD 4870</td>
<td></td>
</tr>
<tr>
<td>Northern Gulf Catchments Natural Resource Management Group</td>
<td>Chief Executive Officer - contact point for Traditional Owner groups</td>
</tr>
<tr>
<td>PO Box 63 GEORGETOWN QLD 4871</td>
<td></td>
</tr>
<tr>
<td>Port Advisory Group</td>
<td>Facilitated by Ports North General Manager Corporate Services</td>
</tr>
<tr>
<td>- commercial fishing</td>
<td></td>
</tr>
<tr>
<td>- community</td>
<td></td>
</tr>
<tr>
<td>- other commercial port users</td>
<td></td>
</tr>
</tbody>
</table>

Stakeholders noted above are the key stakeholders with an interest in long term management of the Port of Karumba in respect of dredging, and other organisations will be invited to contribute on specific issues as they are identified and suitable representatives are confirmed via the TACC forum.

Any variations or updated versions of the LTMMMP are to be provided to the TACC and DSEWPaC is to approve in writing prior to implementation. An updated version of the LTMMMP is to be made available and uploaded to Ports North’s website (www.portsnorth.com.au) within the timeframe outlined in the DSEWPaC guidelines on LTMMMP development and management.
3. DREDGING AND DISPOSAL

3.1 History of Dredging Works
The Port of Karumba has been servicing the remote Gulf communities since the late 1800’s. In 1996 the current entrance channel to the Port was developed and extends for a distance of approximately 9.5km offshore. This channel was developed over two capital dredging campaigns. In 1996 the small trailer suction hopper dredge “Pelican” with a hopper capacity of 965 m³ removed 730 individual loads, representing a campaign of 183,000 m³ to achieve a change in channel depth from 1.1. down to 2.0m LAT. In 1998, a total of 1,004,000 m³ was removed under a second capital dredging campaign to take the channel close to 3.5 m LAT. The channel has been maintained generally on a biennial basis since. Dredge material from each of these campaigns was placed in the Port of Karumba’s approved spoil ground 6 km north-west of the seaward end of the channel (Hillman & Raaymakers, 1997).

3.2 Channel Alignment
As a result of the extreme flooding activity during early 2009, deposition of sediment within the channel adjacent to Beacon No. 10, and the predicted ongoing encroachment of Elbow Bank led to a review of channel alignment in that section by Ports North during 2009 and mid-2010. Outcomes of an assessment of dredging activity and hydrographic surveys identified that by re-aligning a portion of the channel to naturally deeper water, the need for excessive dredging activity adjacent to Beacon No. 10 may be minimised. Development Approval was granted by the former DERM on 6 May 2010 for the new alignment as is the predicted channel profile shown in cross section (refer Plan provided in Appendix 2).

By moving the channel navigation marking to the south, the requirement for actual spoil removal from this section is significantly reduced. This approach was considered on an understanding of the existing environment, and potential environmental impacts of the re-alignment, including an absence of seagrass distribution within the channel due to light limitation, chemical composition and benthic fauna composition of the area being not significantly different to the existing channel (refer 2009 SAP Report Appendix 4). Amendments to the respective State environmental approvals at Section 2.8 were obtained for this channel management option.

An outcome of the 2010 campaign identified that an additional request for amendment to the channel alignment was supported, and respective applications, including updated channel design drawings were submitted to the relevant State agencies for approval during December 2010 and January 2011 as shown in Appendix 2.

3.3 Evaluation of the Need for Dredging and Disposal
The need for maintenance dredging of navigation channels arises periodically due to sedimentation of existing channels. Declared operational depths are determined for various channels, and these depths are routinely monitored via hydrographic surveys. When the channel depth approaches the minimum operational depth (via sedimentation), the need for maintenance dredging arises. In the case of the Port of Karumba, sedimentation may either be a gradual and predictable process, or may be rapid and unpredictable, as is the case when flood events lead to sudden sedimentation of port berths and channels.

Ports North has a requirement to discharge obligations placed upon it under the Queensland Transport Infrastructure Act 1994, including maintenance of navigable depths and safe port operations. The need for maintenance dredging is assessed by Ports North’s Surveyor in conjunction with Maritime Safety Queensland and subsequently the General Manager
Projects and Planning will review routine hydrographic surveys (Refer Section 2.5 for description of responsibilities) to determine the requirement for a dredging campaign.

Yearly planning of the channel maintenance dredging campaigns is based on post wet season (or “pre-dredge”) hydrographic surveys and a calculation, from this, the volumes required for removal to achieve the target channel depths.

The units of volume from this are therefore “in-situ” cubic metres.

During the process of the dredging, a significant volume of water is added by the dredge equipment and progressive quantities can only be ascertained by totalling (from the daily dredge logs) the “wet hopper” cubic metres dumped. The conversion factor from “in-situ” to “wet hopper” volume varies subject to the material and accretion characteristics but is estimated as a factor of 2.0 based on recent data. The actual in-situ volume of material removed from the channel can only be ascertained by a final hydrographic survey after completion of the dredging and allowing some days for settlement of disturbed material.

All volumes presented in this document are “in-situ” cubic metres unless stated otherwise.

3.4 Estimated Dredging and Sea Disposal Requirements

3.4.1 Maintenance Dredging

Ports North proposes to undertake maintenance dredging of the entrance channel to maintain declared depths. Routine maintenance dredging of the entrance channel has been required approximately every two years to remove accumulated sediments and maintain navigable depths. Table 3-1 indicates an average maintenance dredging campaign is around 434,469 in-situ m$^3$ with a maximum campaign of 544,200 in-situ m$^3$ and Figure 3-1 indicates those past volumes and statistics for evaluation of future dredging requirements.

Table 3-1 Previous maintenance campaign volumes

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (in-situ m$^3$)</td>
<td>454,000</td>
<td>513,000</td>
<td>395,000</td>
<td>399,000</td>
<td>466,200</td>
<td>544,200</td>
<td>269,889</td>
</tr>
</tbody>
</table>
Figure 3-1 Dredge volume statistics

A review of the past volumes suggests that based on the observed unpredictable climate influences, and the resultant high degree of variability of siltation, and corresponding impact on dredging campaign required to achieve channel design, use of a predicted maximum annual volume method is supported, rather than use of a predicted average.

Therefore, Ports North propose to maintain the channel under the following scenarios as shown in Table 3-2:

- Scenario 1 – annual campaigns, of an estimated 300,000 in-situ m$^3$ per year or,
- Scenario 2 – continuation of biennial sequence with an estimated 600,000 in-situ m$^3$ per event.

This represents a forecast total maintenance volume of 3,000,000 in-situ m$^3$.

Table 3-2 Predicted dredge volume schedule

<table>
<thead>
<tr>
<th>Year</th>
<th>In-situ surveyed Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>300,000 (or 600,000 if no dredging in 2012)</td>
</tr>
<tr>
<td>2014</td>
<td>300,000</td>
</tr>
<tr>
<td>2015</td>
<td>300,000 (or 600,000 if no dredging in 2014)</td>
</tr>
<tr>
<td>2016</td>
<td>300,000</td>
</tr>
<tr>
<td>2017</td>
<td>300,000 (or 600,000 if no dredging in 2016)</td>
</tr>
<tr>
<td>2018</td>
<td>300,000</td>
</tr>
<tr>
<td>2019</td>
<td>300,000 (or 600,000 if no dredging in 2018)</td>
</tr>
<tr>
<td>2020</td>
<td>300,000</td>
</tr>
<tr>
<td>2021</td>
<td>300,000 (or 600,000 if no dredging in 2020)</td>
</tr>
<tr>
<td>2022</td>
<td>300,000</td>
</tr>
<tr>
<td>Total</td>
<td>3,000,000 in-situ m$^3$</td>
</tr>
</tbody>
</table>
3.4.2 Emergency Dredging

Approval is sought to dispose to a volume of 300,000 in-situ m$^3$ per event, to allow for any event that causes sedimentation of the channel and subsequent loss of navigable depth in the period prior to next scheduled campaign. Therefore, based on frequency of need for emergency dredging, two events are predicted in the next ten year period, and an allowance of 600,000 in-situ m$^3$ is identified. The need for emergency dredging will be assessed in light of other channel management options, such as bed levelling, and changes to vessel loading which may reduce the need for dredging.

Magnitude or timing of an emergency dredging campaign is unable to be clearly forecast, and would be dependent on the scale of the natural disaster or event. In such an event, management of port operations and mitigation of possible environmental and economic effects, emergency dredging may be required, and notification to DSEWPC regarding the need for such dredging would be provided in accordance with applicable Sea Dumping Permit conditions and management measures outlined in Section 10.

3.4.3 Total Maintenance Dredging Requirements

Estimated dredging and disposal need is therefore 3,000,000 in-situ m$^3$ plus 600,000 in-situ m$^3$ totalling 3.6 million in-situ m$^3$ over next ten (10) years as shown in Table 3-3.

Table 3-3 Estimated maintenance dredging/spoil disposal quantities

<table>
<thead>
<tr>
<th>Operational case</th>
<th>Volume (in-situ m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum of maintenance dredging</td>
<td>5 x 600,000 or, 10 x 300,000</td>
</tr>
<tr>
<td>Emergency dredging – allow additional maintenance dredging volume twice within 10 year sea dumping permit period</td>
<td>2 x 300,000</td>
</tr>
<tr>
<td>Total requirement for 10 year permit period</td>
<td>3,600,000 in-situ m$^3$</td>
</tr>
</tbody>
</table>
4. WASTE PREVENTION

4.1 Guideline Arrangements

The NAGD requires that a waste prevention audit be undertaken to identify opportunities for preventing or minimising pollution and any future sediment contamination. The audit should evaluate the following:

- The types, amounts and relative hazard of wastes generated;
- The waste sources; and
- The feasibility of waste reduction and prevention techniques.

The NAGD identifies that for dredged material, the audit should focus on identifying and managing controllable sources of contamination, such as port loading and unloading activities.

In the context of the Port of Karumba, previous extensive monitoring of Entrance Channel sediments has not identified any sediment contamination issues. Sediments have always been identified as suitable for sea disposal at the screening level of assessment. Anthropogenic contaminants are either below detection or well below screening levels. These reflect a catchment with minimal industrial or urban disturbance or contaminant inputs.

One of the biggest advances in waste prevention undertaken by Ports North has been the realignment of the channel so as to minimise dredging near Beacon 10. This realignment works with prevailing natural processes and is predicted to reduce dredging in what is otherwise a problem area for routine maintenance. By moving the channel navigation marking to the south, the requirement for actual spoil removal from this section is significantly reduced and disposal of “waste” is prevented.

4.2 Catchment Contaminant Sources

Land based activities with potential to contribute waste and contaminants to the Norman River and entrance channel are confined to a minor number of operations on private and strategic port land water front areas. The dominant operations are the zinc and lead concentrate dewatering and bulk loading conducted by MMG Century. Adjacent land uses include ancillary operations to the fishing fleet, namely re-fuelling and re-supply activities. There are no major slipway or vessel maintenance facilities at the Port of Karumba.

Due to natural hydrodynamic patterns within the Norman River adjacent to the main port facilities, there is no requirement for regular maintenance dredging and subsequent spoil disposal. Sediments in the port operations area near the main loading and unloading activities are managed and monitored by MMG Century to meet State environmental licence requirements.

There is no loading or unloading of materials of any sort in the entrance channel.

4.3 Port Catchment Contaminant Management Arrangements

Ports North’s Environmental Management System (EMS) is an environmental management initiative which applies to our business systems and is consistent with the applicable Australian Standard ISO: 14001. As the port operator, Ports North is responsible for general environmental management of leases, tenants and common users on strategic port land. Conditions within each lease or agreement outline specific environmental clauses, including
requirements to hold and maintain all relevant environmental approvals from respective
administering agencies.

Ports North does not conduct any of the loading/unloading activities at Karumba, nor ERA
activities with potential to contribute contaminants or waste to the port environment, Norman
River or subsequently to the channel dredge area subject to maintenance dredging under
this LTMMMP.

PN’s EMS includes the Tenant Environmental Management Program. This management
initiative focuses on regular engagement with tenants to verify operators are meeting their
environmental obligations and guide improved site management. Ports North focuses efforts
to ensure long term or established operators at leased sites implement a site based
operational environmental management plan, including a detailed stormwater management
plan.

Ports North has a landlord role in managing the relationship between lessee, tenants and
common users, and the administering authorities. Table 4-1 indicates the general principals
applied to managing potential sources of waste that may enter the dredge area through
potential dispersal from Strategic Port Land, via the Norman River to the channel dredge
area. To date, no evidence of waste or pollution issues from activities on Strategic Port Land
has been detected within the channel dredge area.

For operations at Port of Karumba, Ports North’s routine schedule of engaging with
operators aims to ensure sound environmental performance and risk of contaminant inputs
to the dredge area is minimised. This process of engagement is based on evaluation of an
environmental risk rating dependant on scope of activities and performance history.

Minor contaminants and waste arise from other uses within the Norman River catchment
which is influenced by diffuse agricultural sources, rather than point sources such as urban
storm water or sewage treatment plants as often is the case at other coastal port
catchments. These diffuse rural inputs are beyond the operational control of Ports North and
may vary due to significant flood events.

As outlined above, operations by Ports North consequently has minor potential to contribute
to contaminant / waste concentrations in proposed dredge spoil, but through the role of
managing dredging and disposal of spoil from the entrance channel, ultimately bears the
outcome of the actions by other stakeholders adjacent to and on strategic port land and
within the Norman River catchment.

Operators on port land may conduct activities that meet the criteria of Environmentally
Relevant Activities listed under Schedule 2 of the State Environmental Protection Regulation
2008. Management of those activities is the responsibility of the DEHP, or for certain
devolved activities, the local Council.

Ports North’s environmental management process mirrors, but does not replace the role of,
State and Local environment agencies in verifying compliance by operators and tenants, as
it is the responsibility of DEHP and Local Council to monitor condition compliance. These
agencies hold responsibility for management of operator’s compliance with licence and
approval conditions, including those that cause or have potential to cause discharge of
contaminants or waste to the port area and ultimately, with potential spread to proposed
dredge spoil.

State and Local agencies may implement enforcement or I management programs where
performance is unsatisfactory, and require capital expenditure, on site improvements,
remedial actions or implementation of environmental improvement initiatives.
Ports North may request that summary findings of operational audits and inspections from DEHP and Local Council to be reported to the TACC as part of strategic management of the Port and issue of potential spoil contaminant sources at the port, as part of the role that these Agencies have on the TACC.

Table 4-1 General principles for waste minimisation

<table>
<thead>
<tr>
<th>General principle</th>
<th>Application to disposal strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste avoidance or reduction</td>
<td>The volume of material to be dredged cannot be reduced without compromising the navigational safety of the Port. Proposed volumes are required to be removed to allow the Port to continue operating safely. Optimisation of channel alignment in 2009 and 2010 reduced the volume of dredging material.</td>
</tr>
<tr>
<td>– Can the volume of material to be dredged be reduced?</td>
<td></td>
</tr>
<tr>
<td>Waste reuse, recycling or reclamation</td>
<td>The type of material within Karumba precludes the potential for reuse due to both the composition of the material, generally being fine sediments, and lack of demand for material within the region. There are limited beneficial use options in the Karumba region given its remoteness and hence general lack of development in the area. Material is generally unsuitable for beach nourishment due to the fine silt content, and the small numbers of potential nourishment areas are not capable of taking all the volume over the life of the Permit/Plan. There is limited demand for additional land in via reclamation at Karumba. Furthermore, reclamation works would most likely have a negative environmental impact, given that the Karumba-Norman River intertidal area supports extensive wetland, mangrove and seagrass communities.</td>
</tr>
<tr>
<td>– Can the material be beneficially reused, such as for beach nourishment or reclamation?</td>
<td></td>
</tr>
<tr>
<td>Waste treatment</td>
<td>Based on historical data, the material to be dredged in the Port of Karumba is not hazardous and management measures are currently in place to minimise the potential for contamination to occur. The nuisance relates to its generally very fine particle size and unsuitability as fill material. Currently there are no feasible treatment techniques available to remedy this.</td>
</tr>
<tr>
<td>– Are there feasible treatments to reduce hazard or nuisance?</td>
<td></td>
</tr>
<tr>
<td>Waste disposal</td>
<td>The existing maintenance dredging program has operated for an extended period and to date no measurable environmental harm can be attributed to dredging operations, nor at the placement site. Management strategies have been developed in this LTMMP and supporting Dredging Environmental Management Plans for the project to ensure ecological risk is minimised as much as practical.</td>
</tr>
<tr>
<td>– Can disposal be managed to reduce ecological risks?</td>
<td></td>
</tr>
</tbody>
</table>
5. DISPOSAL OPTIONS AND CAPACITY

5.1 Disposal Options Assessment

Australia is a signatory to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Convention), and to the more recent, 1996 Protocol to the London Convention. These agreements, and the Environment Protection (Sea Dumping) Act 1981, which implements these agreements in Australian Commonwealth legislation, aim to prevent pollution of the sea from the dumping of wastes or other matter, including dredged material.

All alternatives to ocean disposal need to be evaluated, including environmental, social and economic impacts of each disposal option. The NAGD identifies important elements for assessing disposal options are:

- Are there opportunities to beneficially use or recycle such materials?
- If they have no beneficial use, can they be treated to destroy, reduce or remove the hazardous constituents?
- If hazardous constituents are destroyed, reduced or removed, do the materials have beneficial uses?
- What are the comparative risks to the environment and human health of the alternatives?
- What are the costs of the alternatives?

It is noted that these assessment options were developed under the London Convention to minimise the volume of material being placed at sea from dredging of highly contaminated sediments in highly industrialised ports in Europe and North America; thus the focus was on management of hazardous constituents at levels of environmental or human health concern. Sediments at the Port of Karumba entrance channel have consistently been found suitable for unconfined sea disposal. Consequently, there are no significant risks to the environment or human health from contaminants in dredged sediments.

There are no viable, economic, or environmentally acceptable upland or littoral disposal strategies or beneficial uses for the dredge spoil at or near the Port of Karumba. A key constraint is the lack of ecologically suitable land available for the reception and dewatering of the sediments, where an alternative facility or area would need to be relatively large to ensure the non-discharge of turbid tail waters and hence compliance with State environment and water quality protection policies. Nor is it anticipated that a high percentage of the material would be suitable for beach nourishment purposes due to the silt/clay content. The trend in dredging effort appears to reflect the trend in observed grain size distribution, with higher proportions of the annual dredge volume required for removal in the outer channel where silt and clay fractions are relatively higher.

The material is also not ideally suited, or required, for any nearby land reclamation, or construction of coastal development needs, including soil beneficiation purposes. Due to the remote location of the port and low demand for additional land based industry the potential use of spoil for reclamation purposes is absent. Furthermore, as the port area is largely surrounded by substantial areas of mangroves and seagrass, any proposed reclamation works could cause substantial impacts to these areas of environmental significance.

The preferred offshore disposal option to the designated spoil ground was assessed during the Environmental Impact Assessment process that led to construction of the channel and selection of the existing spoil ground in 1996. This disposal option was considered to have
the least potential to exert any risk to human health or the environment. All alternatives are predicted to cause unacceptable loss, alteration and disturbance to local littoral or terrestrial habitats. The spoil ground has been successfully used for the eight (8) previous dredging programs and associated monitoring has not identified any evidence that dredge plumes and the relocation of dredge material has caused unacceptable impacts on water quality, ecologically significant habitats, trawling areas or commercially important fish species.

Relocating the material to the sea disposal site also retains it within the coastal zone system, thus minimising any interruptions to natural processes that supply material to the shoreline, which is a stated policy requirement in the Queensland Government’s State Coastal Management Plan – Queensland’s Coastal Policy. This is particularly important for entrance channel dredging, since principal sedimentation would be due to the lateral inflow of fine silty sediments mobilised from the surrounding shallow sub tidal regions by wave action (Dames & Moore and WBM, 1996). Fluvial material transported downstream from the Norman River catchment was expected to comprise only a minor component of the material, as is the lateral inflow of coarser material from the intertidal banks.

Table 5-1 summarises the above discussion and outlines a qualitative evaluation of environmental risks, economic and social aspects and impacts of spoil disposal options in the context of a remote rural port with minimal development.

The offshore disposal option is preferred due to nil contamination of the material and minimal human or environmental impact compared to onshore disposal. Ocean disposal presents the least risk long term management option from both a human health and coastal zone environmental health aspects. Due to the nature and quality of the material to be dredged, there are no social, economic or environmental feasible options for beneficial reuse. Ocean disposal was assessed as the most sustainable management option for spoil during the Environmental Impact Assessment and approval process for the capital program in 1996 to develop the channel. Given that the nature and quality of the material has not changed significantly, and demand for reclaimed land or other uses at Karumba has not changed, these conclusions are still valid.

Port of Karumba and the surrounding region is generally pristine, identifiable by intact remnant vegetation, extensive wetlands and surrounded by areas with low rural impacts, therefore the demand for restoration or environmental enhancement is nil. Any such activities are more likely to have a deleterious impact to existing habitats, fisheries resources or terrestrial ecosystems.
<table>
<thead>
<tr>
<th>Aspects</th>
<th>Impacts</th>
<th>Beneficial Reuse</th>
<th>Land Disposal</th>
<th>Reclamation</th>
<th>Ocean Disposal</th>
<th>Sub Tidal Dispersion-SideCast</th>
<th>Beach Nourishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>dilution of large volumes of turbid water into intertidal zone - less ability to control discharge</td>
<td>M VH 2 M</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
</tr>
<tr>
<td>Groundwater</td>
<td>discharge during dewatering</td>
<td>M VH 3 H</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
</tr>
<tr>
<td>Flora</td>
<td>potential impacts to seagrass - nil if spoil ground is &gt;1.5m depth</td>
<td>L VH 1 L</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
</tr>
<tr>
<td>Fauna</td>
<td>changes to current patterns, ensuring continued population trends</td>
<td>M VH 1 M</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
</tr>
<tr>
<td>Coastal Zone</td>
<td>change in sediment within the coastal zone cycle for re-distribution</td>
<td>VH VH 1 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
</tr>
<tr>
<td>Air</td>
<td>nil emissions during processing</td>
<td>L M 1 L</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
</tr>
<tr>
<td>Noise</td>
<td>nil emissions during mining</td>
<td>L M 1 L</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
</tr>
<tr>
<td>Resource Use</td>
<td>pump sinkage fuel use</td>
<td>M VH 1 M</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
</tr>
<tr>
<td>Marine Bats</td>
<td></td>
<td>L L 1 L</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
</tr>
<tr>
<td>Social</td>
<td>minimal demand at present for additional fill, no existing landfill site identified or facility available</td>
<td>M VH 3 H</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
<td>VH VH 4 VH</td>
</tr>
</tbody>
</table>

Notes and Justifications:
- nil demand or need for this type of activity at this Port - major disturbance to existing generally intact coastal zone
- Similar to OD slightly less than reclaim
- SL slightly less than reclaim
- OD times 3 OD times 4 OD cost Similar to OD
- minor risk to marine environment due turbid plume promulgation
- nil existing or foreseeable demand
- cost dependent on pumping/transfer method and distance from source to site
- Existing arrangement, most consistent lowest impact option across each aspect and potential impact as well as social, human health and economic criteria
5.2 Sea Disposal Site Selection and Capacity

Spoil generated from the routine maintenance dredging works is proposed to be disposed at the existing approved spoil ground, which has been used for all of the previous campaigns (capital and maintenance) (refer Section 3.1). This spoil ground is located to the west of the Port/channel in approximately 5 metres depth (refer Figure 1-3).

The centre of the existing spoil ground is located directly west of the outer end of the channel. Its boundary is circular, with a radius of 1,600 m centred on the following coordinate (eastings and northings referenced to the MGA GDA94 projection, Zone 54):

464 767 E, 8 074 168 N or Latitude/Longitude 140° 40’ 5.72" E, and -17° 25’ 4.94” S

The spoil ground covers an area of over 8 million m². Due to shallow depths in the area, Ports North does not intend to dispose of spoil in the south-eastern quadrant of the spoil ground due to the natural shallow profile and to ensure the material is evenly distributed. This management measure has been continually implemented in previous campaigns and Ports North is aware of this restriction. This restriction reduces the useful area of the spoil ground, however it is predicted the rest of the site has adequate capacity for the term of this LTMMMP in the absence of any future extreme events or change to seafloor bathymetry profile that give cause to a reduction in such capacity.

The area where the spoil ground is situated has a natural seabed level of approximately -4.8 m to -6.4 m below LAT, deepening toward the northwest.

The selection of the spoil ground was based on a consideration of the following factors during the initial capital project (Dames and Moore, WBM 1996) and included:

- The characteristics of the dredged material and the material at the spoil ground site;
- Proximity to areas of environmental significance;
- Minimising impacts on marine habitats and fauna, including seagrasses and benthic infauna;
- Logistic and economic considerations, including optimisation of dredge cycle times; and
- Safety considerations in the operation of dredging equipment at the spoil ground site.

A review of prior studies completed during preparation of this LTMMMP, especially Sections 8 and 9 in this Plan, and the absence of any significant changes or issues identified during the period since commencement of the use of the present spoil ground has indicated that the spoil ground is considered a suitable location for the continued placement of dredged material and to have sufficient capacity for the Sea Dumping Permit period and this LTMMMP.

Assessment of suitability of the spoil ground location during the EIS (Dames & Moore, 1996) was based on the following positive factors, which are considered to remain valid for the term of this LTMMMP:

- The distance between the spoil ground and shore which prevents impacts to areas of environmental significance from turbid plumes;
- The absence of seagrasses in areas similar to the spoil ground due to light attenuation constraint of Gulf waters;
- Probable re-suspension and mobilisation following placement;
- The previous disturbance history of the site;
- Its location being outside any shipping navigation channels; and
- Lack of other uses of the spoil ground (existing or potential).

During 2008, PCQ attempted to quantify the volume of accumulation or migration of spoil from the site through use of calculations based on pre and post dredge campaign hydrographic surveys.
Due to the degree of error in hydrographic and GIS methodology, the range of cumulative errors were an order of magnitude greater than the actual values being measured and no strict conclusion could be drawn. Hence, use of this methodology for assessing capacity of the ground was not supported for that or subsequent investigations. Visual comparison of sequences of depth matched colour rendered pre and post dredge hydrographic surveys is presented in Figure 5-1 as a method to determining trends of disposal and subsequent patterns of accumulation or erosion at the spoil ground and to demonstrate changes in topography, although this is not clearly defined on a year to year comparison, but becomes apparent on a longer timescale once magnitude of change is greater than precision of the hydrographic survey.

Consideration of the above survey and attempts to quantify the status of the spoil ground indicate the site (along with most other areas of the nearby southern gulf region) are of highly dispersive material. Given the range of particle sizes in disposed material, it is likely that a significant percentage of the placed material likely to be mobilised within a few weeks of placement. Other processes such as consolidation and surface levelling as well as a moderate amount of accumulation and consolidation is predicted to occur which may be detectable in follow up bathymetric surveys over a longer timeframe than inter year comparison. Subsequent seasonal weather and prevailing currents and wave action, magnified during extreme seasonal weather events such as tropical cyclones, may act to readily mobilise the fine dredge material, hence a portion of the spoil may be dispersed.

The spoil ground has previously been used for the aforementioned dredging campaigns and, at present, has depths that vary between 4.0 to 6.0 metres below LAT, which are forecast to be sufficient for the proposed dredging campaign to at least 2022. The shallower depths occur largely in the south eastern quadrant of the spoil ground, due to the natural shallow coastal zone shelf/seafloor extending from the coast.

A pragmatic approach to determining the future capacity of the site is proposed, whereby differential plots of pre and post surveys will be reported for future campaigns and late in the Sea Dumping Permit and this LTMMP term, consideration will be made to use higher resolution bathymetric surveys, and or benthic video survey pre and post disposal to assess potential changes over such a large shallow area to address this information gap.

In order to assess when a new disposal ground is required, Ports North will define a target depth based requirements for navigation, consideration of wave induced re-suspension effect and surrounding depth topography. The process of regular post dredge surveys, differential plots and change mapping will assist in defining potential timeframes. Comparing the earliest to the latest data sets will be descriptive, showing changes over the last 14 + years. However, as discussed above, if the survey data is not captured at the appropriate resolution, there will be difficulty in measuring the changes.
Figure 5-1 Spoil ground hydrographic survey images – 2002 to 2011

Hydrography m(LAT)

- 4.0 to 4.5
- 4.5 to 5.0
- 5.0 to 5.5
- 5.5 to 6.0
- 6.0 to 6.5
- 6.5 to 7.0
Pre Dredge 2010

Post Dredge 2010
6. PROPOSED MAINTENANCE DREDGING: 2013 – 2022

6.1 Description of the Proposed Dredging

Ports North proposes to undertake maintenance dredging of the entrance channel, seaward from the mouth of the Norman River to maintain declared depths with routine dredging required approximately every two years to remove accumulated sediments and maintain navigable depths. An estimated 3,000,000 m$^3$ is forecast to be removed over the ten year period.

Dredging volume estimates are generated following conduct of a post wet season bathymetric survey and comparison of those soundings to the design depth and channel specification. This informs the scope of the maintenance campaign as to if a bed levelling or dredging is required for a given year, and determines the contract with dredge operator, such as the Port of Brisbane Pty Ltd. Detailed survey plans can then be provided for upload to the computer system aboard the bed levelling vessel or dredger vessel “Brisbane” to allow an automated dredging process and targeting priority areas as required and maximise time/dredging efficiency.

Dredging is to be undertaken using the trailing suction hopper dredge (TSHD) ‘Brisbane’ or similar vessel. The material is to be placed at the approved Port of Karumba spoil ground, which has been used for all prior dredging campaigns (capital and maintenance). The spoil ground is located approximately 5km west of the seaward end of the entrance channel (refer Figure 1-3). Due to shallow depths within one of the spoil ground sectors, no spoil will be placed within the south-eastern quadrant. Spoil will be distributed evenly over the remainder of the spoil ground.

It is anticipated that the existing spoil ground sectors have capacity for the dredged material at the forecast extraction rates for the term of this LTMMP. In the event that a need for an additional material placement site arises, a detailed site options investigation would be triggered and utilise knowledge used in selection of the existing site during the 1996 capital development EIS process, and subsequent information gathered on the spoil site since that time. This process would be facilitated through the TACC to meet assessment and approval requirements of DSEWPaC.

Post dredging bed levelling using sweep bars may be required to rectify any peaks and troughs left by the passage of the dredge heads to ensure an even channel profile.

All dredging under the proposed LTMMP will be confined to the channel area illustrated in Figure 6-2 (Approved Specification Plan provided in Appendix 2), which are all situated on unallocated state land.

No dredging is proposed for the inner port areas, such as in the vicinity of the MMG Century ship loader wharf, which is located approximately 6 km from the entrance channel in a naturally deep section of the Norman River that is maintained by natural scouring activity and is between -4 and -12m LAT.
Figure 6-1 Locations to be dredged-channel relative to Karumba and Norman River
Figure 6-2 Priority Areas For Dredging – Port of Karumba Entrance Channel

NOTE:
1. ALL DIMENSIONS ARE IN METRES.
2. ALL LEVELS AND DISTANCES ARE IN METRES AND ARE REFERRED TO "M.A." VERTICAL DATUM FOR LEVELS EX ALIGNED FROM PM 50222 RL AT THE KARUMBA FERM SURGE GAUGE L.T. Dillon Bay BELM PM 50222.
3. HORIZONTAL DATUM FOR THIS CONTACT IS GDA94 ZONE 54 (MATERIAL DESCRIPTION).
4. DETAILS OF CHANNEL LIMITS ARE DESCRIBED ON DRAWING 41-10585-03.
5. DETAILS OF CHANNEL INTERSECTION POINTS, CHANNELS AND NAVIGATION AIDS ARE DESCRIBED ON MARITIME SERVICE QUEENSLAND PLAN NO. KS98-152.
6. VERTICAL LIMITS DEFINING THE CHANNEL IS INDICATIVE ONLY.
7. LOT OF WORKS INCLUDES THE REDDING AREA, MATERIAL RELOCATION AREA.
6.2 Dredge and Disposal Methods

Methods for dredging at Port of Karumba are intended to continue in a similar way to past campaigns, namely the use of a trailing suction hopper dredger, (TSHD) such as the dredge "Brisbane," or similar vessel for dredging and placement of material at sea. The dredge would remove the spoil directly into its hopper and then cart the material to the spoil ground for disposal. An example of the typical TSHD operation based on the vessel "Brisbane" is outlined below;

Typical operation of a trailing suction hopper dredger involves material to be dredged being removed through two suction heads, which are lowered into position on either side of the vessel. As the vessel steams slowly at around 1 – 3 knots, large pumps draw water through the heads, which entrain the sediment and transport the water/sediment mixture aboard into a central collection hopper. Whilst the suction heads are fitted with high-pressure water jets, which can be used to agitate consolidated sediment, they are rarely required for maintenance dredging.

The sediment/water mix ratio of material delivered to the central hopper is typically quite low. Whilst it varies depending on the type of sediment being dredged, the sediment concentration is generally in the order of 10 – 30 % solids. To maximise dredge spoil capacity, the large volumes of water are managed using a central column weir, which is incorporated into the hopper. This arrangement allows excess water to decant from the sediment and overflow to discharge. The capacity of the hopper is therefore dependant on the design capacity of the vessel, and sediment type – with volumes (including both sediment and water) approximating 2,800 m³ for fine silts and 1,700 m³ for sands (of a maximum hopper capacity of 2,900m³) for a dredge such as the Brisbane. Considering that more water is held in the silt matrix than sands, the dry weight cubic metres of sand able to be practically collected in each load is therefore generally greater than that in silts.

Once the dredge has filled its hopper with dredged material from the channel, the vessel will then relocate the material to the designated spoil ground. Upon entering the designated area for dumping, the dredge would typically slow whilst material is being placed, however, a minimum steaming speed is required to maximise agitation within the hopper and clear dredged material, which would not otherwise be effected if the dredge were to remain stationary.

Each spoil placement is manually logged using both satellite navigation and standard bridge equipment, and is electronically fixed using a differentially corrected global positioning system (GPS). The electronic track plot marks the start of the placement process (hopper open), and the end of the process (hopper closed). This track usually shows an arc, which the dredge follows to ensure that all dredged material is placed within the designated spoil ground boundary.

During the dredging works, electronic logs of each spoil dump event will be maintained. These logs will be downloaded weekly and stored at the survey office. At the completion of the project, these logs will be reported to the relevant government agencies to demonstrate compliance with permit conditions.

TSHD's undertaking dredging works at the Port of Karumba will include the following minimum specifications to minimise environmental impact from dredging and disposal:

- Central weir discharge system;
- Below keel discharge point;
- Turtle exclusion devices fitted;
- Low wash hull design; and
- Electronic positioning and recording system.

The dredge dumping procedures and associated monitoring arrangements are developed by the dredging contractor to at least comply with the EMP measures for TSHD dredging as outlined in
Appendix 10. The documents prepared by the contractors will be reviewed for compliance with EMP requirements by Ports North prior to each campaign.

6.3 Proposed Schedule

6.3.1 Maintenance Dredging

Past dredge campaigns at Karumba have been conducted within a five month “Dredging Window” of 1 May to 30 September. This management constraint was established as an outcome of the original Port of Karumba EIS, as a mechanism to avoid dredging impacts during the prawn migration period based on advice from CSIRO who had identified the critical period for prawn migration from October to January in the Norman River.

CSIRO, who previously advised PCQ regarding prawn migration, is also a stakeholder representative on the Karumba dredging Technical Advisory Consultative Committee (TACC) which is consulted prior to and during each campaign (refer Section 10.12).

Confirmation of the latest information on the requirement for a dredging window is provided within Appendix 5 which concludes that the requirement for a restriction on dredging activity between October and January should remain, and only be altered by negotiation between CSIRO, TACC, Ports North and DSEWPaC should a specific requirement be identified to prompt such a request.

Ports North is committed to ensuring that the standard dredge window is endorsed for the routine maintenance dredging works at the Port of Karumba. Routine maintenance dredging has, and will continue to be scheduled to occur after the conclusion of the wet season at approximately the end of April each year, when possible inflows of sediments have concluded. Routine maintenance dredging can occur between 1 May and 30 September each year. This period is also consistent with the “dredging window” to protect marine resources from possible effects of dredging.

Ports North forecasts that the annual window for dredging between May and September is acceptable and a workable arrangement, given the practicalities of the wet season dictating that conditions could be unsuitable for dredging outside this period. The need for dredging outside this window is not considered a necessity for the Port under existing operational requirements.

A typical annual campaign (shown in Table 6-1 below) is forecast to take approximately 3 weeks, or a biennial campaign of 6 weeks duration. Interim bed levelling or drag barring campaigns of approximately 1 to 2 weeks duration could also be implemented dependant on nature of event causing loss of channel depth.

Table 6-1 Typical Dredging Program

<table>
<thead>
<tr>
<th>Bathymetric Surveys</th>
<th>Post Wet Season</th>
<th>March-April</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Dredge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During Dredging</td>
<td>To refine priority areas</td>
<td></td>
</tr>
<tr>
<td>Post Dredge—and Post Disposal at Spoil Ground</td>
<td>September-October</td>
<td></td>
</tr>
<tr>
<td>Dredging</td>
<td>May to September</td>
<td>3 weeks</td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bed Levelling Campaign</td>
<td>May to July</td>
<td>1 to 2 weeks</td>
</tr>
<tr>
<td>If no dredge campaign is required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bed Levelling also used at end of dredging campaign to finalise channel profile</td>
<td>4-5 Days</td>
<td></td>
</tr>
</tbody>
</table>
6.3.2 Potential for Emergency Dredging

Extreme weather event related sediment deposition in the port area is controlled by unpredictable flooding events or storm surges associated with cyclones. As such, the Ports North has no control over the extent or timing of emergency dredging required to ensure continued operation of the entrance channel.

The deposition of sediments to the entrance channel as a result of storm surge is influenced by natural weather events. Such deposition was experienced in January 2009 due to storm surge and king tides generated by Tropical Cyclone Charlotte. King tides and torrential rain caused large scale flooding, beach erosion and slippages throughout the Karumba area (refer Figure 6-3).

Prior to March 2009, the channel at Karumba was declared at 3.6 metres below LAT. On 20 April 2009, the Regional Harbour Master (RHM) re-declared the channel at 2.5 metres below Lowest Astronomical Tide (LAT), following a post wet survey carried out in late March 2009. This re-declaration restricted the capacity and size of vessels which use the shipping channel of Karumba, specifically commercial exporting vessels. A similar scenario occurred during early 2012 when MSQ re-declared the channel at <3.6m LAT due to findings of the post-wet season/event hydrographic survey. Based on assessment of prior campaigns, including the bed levelling works completed in 2009, and 2012, the volume required for possible emergency dredging at the Port of Karumba is 300,000 in-situ m³ in any unscheduled year, to allow for any event that causes sedimentation of the channel and reductions in navigable depth.

The timing for flood or storm surge that triggers a need for emergency dredging is uncertain, but is most likely to occur during or immediately following the summer or early autumn wet season when monsoonal activity is greatest and after all possible sediment inflows due to wet season extreme weather events have concluded.
It is possible, but highly unlikely, that major weather events of sufficient intensity so as to cause acute sedimentation of the channel, could occur during the dry season. Need for emergency dredging is therefore most probable within the latter stage of the seven month no-dredging period (February, March or April inclusive). This timing however coincides with loggerhead turtle nesting season (October to February inclusive) and prawn migration in the area. Should the need for emergency dredging be identified during that period, Ports North will, via the TACC, identify any technical ecological issues and consult with the DSEWPaC.

Therefore, there is a very low probability of the need for emergency dredging (i.e. a volume significantly above forecast annual amount) within the preferred non-dredging period October to April inclusive) and a much higher probability that such dredging would be delayed and included within the normal “dredging period” of 1 May to 30 September of a given year.

It is expected that it would take at least 5-7 days for a dredge to be mobilised to site. During this time, Ports North would liaise with DSEWPaC, the Regional Harbour Master and CSIRO to establish dredging requirements and any specific measures to be undertaken to mitigate potential impacts to turtles nesting and prawn migration.

Management process for potential emergency dredging during the non-dredging period is outlined further in Section 10.
7. CHARACTERISATION OF THE EXISTING ENVIRONMENT

7.1 Climate and Coastal Conditions

Karumba is situated on the Norman River in the southeast section of the Gulf of Carpentaria. The average annual rainfall at Karumba is 922mm and the area experiences a tropical monsoonal climate with a pronounced wet season from December to March, with generally dry conditions for the remainder of the year. The cyclone season in the region extends from December to April and severe cyclones, with a central pressure less than or equal to 970hPa, pass within 100km of Karumba at a frequency of once every 40 years based on Bureau of Meteorology (BOM) data.

Karumba typically experiences relatively strong south-easterly winds in the dry season and light northeast to north-westerly onshore winds in the wet season with Figure 7-1 below showing a the annual 9am and 3pm observations at nearby Normanton.

![Figure 7-1 Bureau of Metrology-Wind Climate](image)

Tides at Karumba typically occur once per day, with a spring tidal range of 4.7m. This tide phenomenon is one of only a few in the world where one tide per day occurs, and has a significant impact on timing of shipping as well as scheduling of dredging activity. Prolonged periods of offshore winds also influence the tidal level with drops in level of up to one metre being recorded previously.

Generally, wave heights are typically below one metre inshore, with the wave action increasing with distance from shore. Higher waves occur more frequently in winter months.

Similar to other rivers in the region, the Norman River transports large volumes of suspended material into the Gulf, particularly during the wet season. The intertidal and sub tidal zones remain turbid throughout the majority of the year.
7.2 Areas or Species of National Environmental Significance

Coastal areas surrounding Karumba include salt flats, mangrove communities, extensive intertidal flats and shallow subtidal seagrass beds. These habitats are highly productive and support a high diversity of animals and plants including some species that are valuable to commercial fisheries and some which have high conservation value. The distribution of the key environmental values at Karumba is illustrated in Figure 7-2.

There are no listed World Heritage Areas or conservation reserves within or near the port area. There are also no listed RAMSAR wetlands, however, the Southern Gulf Aggregation wetlands, which are listed on the Directory of Important Wetlands, extend along the coastal fringes around the port area.

There are no threatened ecological communities in the area recorded in the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) database. However, there are a large number of recorded threatened and migratory species known to frequent the region. Refer to Appendix 1. For full species listing and names in the EPBC database search, which identifies fifteen threatened species could occur in the Karumba region:

- Two species of Bird;
- Three species of Mammal, including two species of whale;
- Six species of Reptile, with the loggerhead and Olive/Pacific Ridley turtles considered endangered; and
- Four species of shark.

There are 51 migratory species currently noted in the database as likely to occur in the region. There are ninety Listed Marine Species.

Assessment of these matters and the likely effects of dredging campaigns indicate that impacts on matters of National Environmental Significant (NES) are low and an EPBC Referral is not required under the EPBC Act. This is supported by EPBC Act Significant Impact Guidelines 1.1 (Commonwealth of Australia, 2009), which states that:

"Dredging to maintain existing navigational channels would not normally be expected to have a significant impact on the environment where the activity is undertaken as part of normal operations and the disposal of spoil does not have a significant impact."

Previous Sea Dumping Permit applications (i.e. 2008, 2010 campaigns) have not triggered EPBC Act referral.

7.3 Terrestrial Habitats

The southern gulf region is known for areas of extensive seasonal wetland areas, connected intermittently and dependant on the scale of wet season rainfall to adjacent marine systems. An outline of wetlands is depicted in Figure 7-2 derived from Coastal Habitat Resources Information System (CHRIS). CHRIS is a resource centre for Queensland coastal fish habitat, fisheries resources and environmental datasets (layers) developed by Fisheries Queensland (DAFF) and other agencies. This demonstrates the landward habitat constraints on development at the Port of Karumba due to the adjacent Norman and Bynoe River systems and the areas between Karumba township and the existing port and Karumba Point.
Figure 7-2 Coastal resources in the vicinity of the Port of Karumba
7.4 Heritage

7.4.1 Indigenous

No areas of cultural significance have been identified in the assessment process for previous approvals and no further items have been identified for the purposes of this application. The areas to be impacted by routine maintenance dredging works will have similar impact to the eight previous dredging campaigns and will not extend beyond the existing dredging design. Indigenous cultural heritage matters primarily involve the interests of Gkuthaarn, Kukatj and Kurtijar peoples of the lower south western Gulf of Carpentaria as recognised by the National Native Title Tribunal (NTT, 2006). These are predominantly land based interests, not extending to the sub-tidal areas subject to dredging and disposal.

Indigenous cultural values of the Karumba area are generally understood to be confined to seasonal use of some areas for hunting, fishing and gathering zones. Contemporary indigenous use of the entrance channel is considered minimal.

7.4.2 European heritage

Karumba has had a varied past, with areas of contemporary importance including:
- its role as one of the most important ‘gateways’ for European settlement of the Gulf in the early 1800’s
- A base for Catalina Flying Boats and extensive use by allied forces during second world war
- As a major base for prawn trawlers during the 1970’s
- Its role as a significant live cattle export, and since late 1990’s, for bulk minerals export, and
- More recently as a fishing, holiday destination as well as ongoing general supply port for inland communities.

These historical connections provide important links with the past and are worthy of recognition of the role of this town as the dominant southern gulf Port.

There have been no specific issues of cultural or indigenous cultural heritage discussed by the TACC in the past five years. Heritage issues are to be addressed via consultation with applicable stakeholder groups via TACC representative organisations.

7.5 Marine Habitats

The Port of Karumba and the broader southern Gulf of Carpentaria comprise a wide range of tropical estuary and near shore habitats, including; mangroves, seagrass, intertidal mud/sand flats, saltpans/marsh, and subtidal soft sediment. Detailed marine monitoring of the region has been completed by CSIRO, AIMS and Fisheries Queensland over past years to determine marine resource condition and trends, as well as determining economic considerations for the Gulf prawn fishery. The distribution of key habitats and communities within the study area are well known and outlined further below.

7.5.1 Mangroves

Extensive mangrove communities occur along the foreshore around the mouth of the Norman River, and extend a significant distance along the shoreline and up the river. Mangroves are a key feature of the Gulf of Carpentaria coastline. It is unlikely that this habitat type will be exposed to potential impacts from routine maintenance dredging as they are outside the dredging footprint, and have a significantly lower susceptibility to impacts from turbid plumes or sedimentation, due to adaption features which suit them to high sediment load locations such as the southern Gulf.
Mangroves are the primary vegetation type along the more protected shorelines of the mouths and banks of the Norman and Bynoe Rivers, often extending for several kilometres upstream (refer Figure 7-2). They also form a fringe of coastal vegetation on accreting shorelines immediately behind the lower sand flats to the north and to the west of the mouth of the Norman River within the Port limits. Mangrove habitats are a significant and ecologically important feature of the transition from shallow coastal gulf waters, to the arid terrestrial inland. Mangroves form a well-developed community and the coastal fringe of mangroves is dominated by *Avicennia marina*, whereas the tidal creeks behind the coastal fringe typically support a variety of mangrove species.

Extensive saltpan and wetland areas are located in and around the Port of Karumba some of which are listed on the Register of the National Estate as the *Southern Gulf Plains*. The size of these wetland areas is extremely dynamic, expanding and contracting due to the extremes of the wet and dry seasons.

### 7.5.2 Seagrass

Seagrass beds occur at the mouth of the Norman River and on the northern and southern banks of the channel (refer Figure 7-2). The most abundant seagrass area in the Port is located on Alligator Banks, which is located outside the mouth of the Norman River and south of the channel.

Eighteen years of monitoring has been undertaken by Fisheries Queensland, formerly the Department of Primary Industries and Fisheries (DPI&F), which involves annual seagrass monitoring at the Port of Karumba. Monitoring at Karumba is part of a network of long term seagrass monitoring sites that have been established at various port locations throughout Queensland to assist port managers in the planning and development of port operations to achieve minimal impacts on the marine environment and fish habitats. The programs are also “used as an indicator of overall marine environmental health of ports and as an example of international best practice in the management of port environments” (Unsworth *et al.*, 2009). Seagrass surveys completed in October 2008, revealed the seagrass in Karumba is “in a healthy state, supporting dugong populations and providing a fisheries resource. Seagrasses on Alligator Bank have varied considerably in density during the 15 years of monitoring with the majority of changes linked to regional and local climate variations” (Unsworth *et al.*, 2009). The report also stated that there is “strong evidence to suggest that throughout 15 years of monitoring, seagrass variability has not been caused by local anthropogenic factors. Intertidal seagrass meadows in Karumba are thought to be principally driven by atmospheric temperature, tidal exposure and catchment rainfall” (Unsworth *et al.*, 2009). This is similar to reported changes in Torres Strait and Weipa seagrass beds being primarily driven by climatic and tidal variables such as exposure, temperature and solar irradiance (Chartrand & Rasheed, 2009).

Due to the prolonged wet season flooding at start of 2009, extensive turbid plumes occurred over the lower Gulf of Carpentaria for many weeks. Concern was raised by both PCQ and Fisheries Queensland that substantial losses of seagrass were likely to have occurred during that time. Without a post flood seagrass assessment it was not possible to quantify the initial extent of seagrass loss, however it is possible that some recovery occurred through the seed bank and from surviving plants by the time of the annual monitoring survey in October 2009. Results of that survey completed by Fisheries Queensland in mid-October 2009 found the area of seagrass presented a 7% increase on the 2008 survey, but the biomass had declined from the 2008 survey. Despite the minor reductions, these biomass values were double the 16 year long term average and the main monitoring meadow was classified as “dense” (Unsworth & Rasheed, 2010).

Findings of the annual survey in October 2010 provided by Fisheries Queensland (McKenna & Rasheed, 2011) indicated the main monitoring meadows were again of good general overall condition.
Again in 2011, Fisheries Queensland concluded after field studies were completed that "Karumba seagrass meadows were in a stable and productive state. The Karumba meadow remains spatially expansive and dense, with biomass and area values above 18-year averages. Meadow area had increased 13% and meadow biomass increased 17% since the 2010 monitoring survey. Above average seagrass area and biomass continued to be correlated with above average river flow and below average air temperature. Results of the survey indicate that anthropogenic activities including dredging and other port and urban activities are unlikely to have had a negative impact on seagrasses in Karumba during 2011. This survey also indicated that seagrass was in a robust condition and likely to be resilient to impacts associated with regular scheduled maintenance dredging in 2012. However, natural variation in climatic conditions has the capacity to reduce seagrass resilience in the future to the point where meadows become vulnerable to activities such as dredging. Long-term monitoring of Karumba’s seagrass meadows provides an understanding of factors which influence natural variability in seagrass meadows. Information is vital when separating the effects of any future anthropogenic disturbance from natural variability (Carter et. al. 2012). Seagrass meadows on the northern bank which were detected during the baseline survey (refer baseline seagrass meadow boundary mapped in Figure 7-2) is an ephemeral, sparse and highly variable meadow due to higher sandy topography, and which did not support establishment of this area as a regular monitoring area however it is periodically checked for presence/absence at time of main survey program.

An extract of reports provided by DAFF-Fisheries Queensland as shown in Figure 7-3 below indicates the general spatial extent, and observed variations in the main monitoring meadow over the most recent years.

![Map 5: Changes in the Port of Karumba seagrass monitoring meadows October 2003 to November 2011.](Figure 7-3 Distribution of Seagrass in vicinity of Norman and Bynoe Rivers)
7.5.3 Marine Fauna

A variety of marine fauna has been observed in the Karumba region. Dugongs have been regularly observed in aerial surveys of the area and their feeding trails have been noted throughout local seagrass beds, whilst sea turtles, including green, loggerhead, flatback, hawksbill and Olive Ridley turtles, have been recorded from the southern Gulf of Carpentaria and are likely to inhabit coastal waters around Karumba. Figure 7.1 above indicates data from the DEHP database resulting in a generic positioning of a symbol for a turtle rookery at the mouth of the Bynoe and Norman Rivers. Those two locations are of no more significance than the actual rookery habitat along the adjacent sandy foreshore/dune areas of the southern gulf region.

There is little information relating to the number of cetaceans in the southeast Gulf. Dolphins have been sighted in the entrance channel and it is possible that inshore species such as Australian Snub-fin Dolphin, Indo-Pacific Humpback and Bottlenose dolphins inhabit coastal and estuarine areas, including port waters, near Karumba.

Interactions between dredging operations and large marine fauna have not been a significant management issue for past campaigns at Port of Karumba, with only one event recorded during the 2010 campaign, involving a strike by the TSHD Brisbane whilst it was outside the channel and not during the action of dredging. The type of marine animal involved in that event was not able to be determined and could have been a log, marine debris or one of a number of potential large species known to occur in the Karumba area, however was recorded and investigated as an un-verified marine animal strike via the dredging contractors EMP process.

7.5.4 Intertidal Sand and Mud Flats

Broad intertidal sand flats extend for distances of 3 km to 10 km from the shoreline to shallow subtidal areas on both sides of the mouth of the Norman River. Sparse populations of gastropod molluscs live on the surface sediments of these flats.

During the dry season, up to 30 to 40 metres of mud banks along the edges of the Norman and Bynoe rivers may be exposed during spring low tides. Juvenile prawns are abundant over the riverbanks during ebb flows. Gastropod molluscs and crabs may be present on the upper banks adjacent to mangroves, whilst mudskippers and other species of gobies are present on lower sections.

Previous sampling events from the banks of the Norman River have found that sediment is largely dominated by crabs, amphipods and polychaete worms.

The intertidal habitats provide habitat for a high diversity of birds including migratory waders. These sand and mudflats provide important feeding and roosting habitat, and represent a readily accessible area frequented by scientists and the general public as an educational and recreational resource.

7.5.5 Subtidal Soft Sediment

The subtidal soft sediment habitat is largely undescribed within the existing literature even though it is the dominant habitat within the Port area. High turbidity and low light regimes preclude the establishment of significant subtidal marine communities such as reef, algae or seagrass beds.

Surveys of the channel area focused on the bend area subject to the channel re-alignment in 2009-10, and aimed to determine the types of sediment and status (presence or absence) of significant benthic flora or fauna of this section of the channel. Findings of those surveys indicated a predominance of underlying consolidated clays with overlying sandy silts and an absence of significant benthic habitat (WorleyParsons (2010)).
7.6 Fisheries and Aquaculture

Commercial, Aboriginal subsistence and recreational fishing is conducted in the waters of the southeast Gulf of Carpentaria and in the Norman and Bynoe rivers. Commercial fisheries include prawn trawling, coastal net and line fishing and crab pot fisheries. Trawling is not permitted in the waters of either the Norman or the Bynoe rivers.

Coastal and estuarine species targeted by commercial fishers and Aboriginal communities engaged in traditional subsistence fishing include barramundi, threadfin salmon and mud crabs. Barramundi are taken in gill nets and by line along the tidal reaches of rivers and on the coastal flats, except during the summer closure between November and February. At the start of each wet season, maturing males migrate down the rivers to spawn with resident females in outer estuaries and over tidal flats outside river mouths. Juvenile barramundi, which develop from larvae about 28 days after hatching, migrate up the rivers and creeks where they spend the first three to five years of their life. Larvae and juveniles feed on plankton whilst adults feed on prawns and fish. A barramundi stock farm is also operating in Karumba.

Two species of threadfin salmon, king and blue salmon are taken in the Gulf. King salmon comprises the second largest catch after barramundi which spawn near the mouths of estuaries and possibly further offshore. King salmon feed on a variety of prey including prawns, lobsters, crabs, octopus, squid and fish.

Mud crabs inhabit the mud banks and mangrove fringes along creeks and rivers where they feed on worms, bivalve and gastropod molluscs and other crabs. Mud crabs are also caught for commercial or recreational purposes.

In addition to species commonly taken by commercial fishers, recreational fishers also target grunter, mackerel, flathead, bream and queenfish. Most recreational fishing takes place around Karumba and in the lower reaches of the Norman River, although in recent years, the fishery has moved further offshore. The recreational fishery is of high commercial importance to the local community with around 25,000 tourists, with a primary purpose of fishing, visiting Karumba each year. Aboriginal fishing activities are usually conducted closer to the communities to the north and to the west of Karumba, as well as further upstream near Normanton.

Four species of prawns, the banana, brown tiger, blue endeavour and the blue-leg king prawn, are fished commercially in the southeast Gulf. These species spawn offshore and give rise to larvae that migrate into 'nursery' grounds, usually seagrass beds or mangrove areas, in shallow coastal areas where they feed and grow. After three months in these nursery grounds, juveniles migrate offshore into the fishing grounds where they feed and grow for at least another three months before attaining commercial size.

Of the local species, banana prawns are the most dominant in the Karumba area, attributing to 99% of all juveniles sampled within the Norman River (Dames & Moore and WBM 1996). Banana prawns spawn offshore during two peak periods (Autumn – March to April, and Spring – September to November), following which the larvae migrate toward the estuary areas, including those within the Norman River system, in the subsequent season (i.e. winter and summer). Once in the estuary, juveniles remain close to the water’s edge along the mangrove lined mud banks, with 80% of the prawns located within two metres of the waterline (Dames & Moore and WBM 1996). Following a period of one to four months, the juveniles migrate back to the spawning grounds over a period of months (Rothlisberg et al. 1985).

Whilst the spring spawning season has been identified as the dominant of the two, with higher numbers of juveniles inhabiting the inshore areas over the ensuing months of summer, the breeding cycle nonetheless highlights the continuous movement of different prawn cohorts across the port area throughout the year.

During the EIA process for development of the channel, knowledge provided by CSIRO on patterns of prawn migration led to Sea Dumping Permit conditions which include a period where dredging was permitted, to minimise potential impacts to the peak time in prawn movement. Hence a
“Dredging Window” was established, which restricts dredging activity to the period between 1 May and 30 September.

Advice provided by CSIRO (refer Appendix 5) supports continuation of managing dredging activity to occur in the lower risk periods and recommends a dredging window for activity between 1st May and 30th September of each year.

The Karumba Aquaculture Centre operates as a stock enhancement initiative of the local community to ensure ongoing and productive barramundi fishery in the Karumba-Normanton region. There are no intertidal aquaculture ventures within the Norman River or foreshore flats adjacent to dredge area.

7.7 Water and Sediment Quality

The waters offshore from Karumba are generally very turbid. Due to the relatively shallow water depths, fine silts are continually mobilised and remain in suspension. Turbidity is also increased from freshwater runoff from the Norman and Bynoe rivers and hence is particularly high during the wet season.

With a lead and zinc concentrate export operation in the Port; sediment quality is an important issue in the inner port area. Marine sediment testing has been routinely undertaken by MMG Century (formerly OzMinerals), which has indicated an absence of significant increases in heavy metals since the commencement of the concentrate exports. MMG Century is required under licence approvals issued by the State environment agency DEHP to continue this sediment testing on a regular basis.

There is no requirement for dredging of the inner port area or near the MMG Century facility due to the presence of naturally deep waters of the lower Norman River. The inner port area and concentrate load out wharf are distant to the channel maintenance dredging area.

Ports North (and formerly PCQ) have undertaken routine sediment testing within the channel in accordance with the NAGD (and formerly the NODGDM) prior to maintenance dredging campaigns and have not detected elevated levels of lead or zinc, indicating a low occurrence of sediment or contaminant transport from the inner port to the entrance channel dredging area.

This LTMMP is only relevant to dredging of the entrance channel where the constraint on ship transit occurs. The inner port area, where loading of zinc and lead concentrate occurs, is not part of the proposed works and is not considered part of the LTMMP. No dredging is required due to the naturally deep section of the Norman River. Refer to Figure 6-1 for delineation of the two areas.

Detailed information regarding water and sediment quality within the channel is presented in Section 8.
8. CHARACTERISATION OF THE DREDGE AND DISPOSAL SITES

For the various Sea Dumping Permit and State approvals and conditioned monitoring requirements there have been requirements to undertake a range of environmental monitoring activities during and after each dredging campaign. The primary focus of these monitoring programs was to either provide baseline data and/or to assess the risk of impacts associated with dredging activities.

The following sections provide a summary of the relevant data collected to date, which is relevant to the LTMMP. The following studies have provided the primary sources for this information:

- 2000 Karumba dredging program: Environmental site supervision report (EPA 2000)
- Karumba maintenance dredging sediment sampling and analysis plan (GHD 2002a)
- Survey of potential contamination of dredge material – Port of Karumba: Report on May and June 2002 survey (GHD 2002b)
- Background surveys for polycyclic aromatic hydrocarbons at the Port of Karumba (GHD 2002c)
- Survey of the Port of Karumba: Port marine baseline surveys and surveys for introduced marine pests (Neill et al. 2001)
- Report on baseline study for southeast Gulf of Carpentaria (Parry & Munksgaard 2000)
- Port of Karumba maintenance dredging 2004 monitoring report (PCQ 2004)
- Turbidity monitoring of maintenance dredging Karumba 2002 (WBM 2002)
- Seagrass monitoring report 2008 (Unsworth et al., 2009)
- Port of Karumba Maintenance Dredging: Sediment Characterisation Report (Worley Parsons 2009)

8.1 Sediment Quality

8.1.1 Entrance Channel

In addition to the initial investigations that were undertaken to characterise the nature of the capital material to be dredged in developing the channel, sediment sampling and analysis was undertaken in 2000, 2002, 2004 and 2009 as preparation for maintenance dredging campaigns and this LTMMP. These investigations were undertaken in accordance with approved sediment sampling and analysis plans (SAPs). The SAPs required that all relevant sampling results be assessed against the requirements of the NODGDM/NAGD, with the exception of nickel, for which a background trigger level (that is higher than that specified in the NODGDM/NAGD) was permitted for comparison. Each SAP also provided background trigger levels for the following metals, which were not covered by the NODGDM/NAGD - cobalt, iron and manganese.
A thorough review of the results of these sediment quality investigations is provided in the sections below. Data from 2002 and 2004 surveys are included in addition to the testing during 2009 in order to provide an indication of trends over time. Data is considered good quality on the basis that:

- data met NODGDM (and NAGD) quality requirements of the time; and
- there have been no significant changes or major developments within the catchment area that have the potential to considerably alter the potential contaminant status of the entrance channel sediments.

**PHYSICAL CHARACTERISTICS**

Entrance channel sediments were characterised during the preparation of the Karumba dredging environmental impact assessment (EIA) (Dames & Moore and WBM, 1996). In the EIA, it was reported that principal sedimentation would be due to the lateral inflow of fine silty sediments mobilised from the surrounding shallow sub tidal regions by wave action. Fluvial material transported downstream from the Norman River catchment was expected to comprise only a minor component of the material, as is the lateral inflow of coarser material from the intertidal banks.

Physical characterisation of the sediments was completed by Parry & Munksgaard (2000) who identified that the sediments within the Norman River and the channel are dominated by homogeneous silt and clay sized sediments with occasional lenses of fine sand a few centimetres thick. The sediment analysis plan completed in 2004 did not include physical characterisation of the maintenance material.

Findings of the 2009 Sediment Analysis Plan determined that there is a trend for decreasing sand content from inshore to offshore and a corresponding increasing trend of clay and silt content. The particle size distribution (PSD) analysis of 11 sites along the channel identified that the five inshore sites were relatively consistent in particle size distribution being dominated by medium grain sands. The outer three sites were dominated by clay and silts. **Section 3.1 of Appendix 4** provides further detail, also summarised in **Figure 8-1** below.

**CHEMICAL CHARACTERISTICS**

During the SAP completed in 2004, sediment samples from 22 sites along the entrance channel were tested for trace metals, organotins and PAHs. Samples were taken from up to three horizons (0-0.5m; 0.5-1.0m; and >1.0m) and submitted for analyses. The results indicated:

- There were no detectable concentrations of Tributyltin (TBT) above PQL;
- Concentrations of all metals were below the relevant screening levels in all samples. 95%UCL of the means for metals were well below screening levels; and
- There were no detectable concentrations of PAHs above respective PQLs.

A revised sampling protocol based on the NAGD, 2009 was approved for implementation during 2009 at eleven (11) sites using a 1m piston core or a van-Veen grab sampler when sediment was unsuitable for retention in the piston core. Sampling and analysis at the eleven sites identified the following:

- Tributyl-tin was below detection limits at all sites;
- Arsenic was detected in eight of the 11 sites below NAGD screening levels. The three most inshore sites had no detection of arsenic. Arsenic showed a trend of increasing in concentration moving offshore and correlated with change in fraction size;
- Cadmium was below detection levels at all sites;
- Chromium, lead, and zinc were above detection limits in all samples, but below respective NAGD screening levels. Each of these metals shows a general trend of increasing concentration moving offshore;
- Copper was above detection limits at nine of the 11 sites and nickel was above detection limits at 10 of the 11 sites. All detections were below the respective NAGD screening levels. Both metals show a general trend of increasing concentration moving offshore; and
- Mercury was below detection limits in all but two sites. Detections were below the NAGD screening level.

Results of this study are summarised in Table 8-1 and Figure 8-1 shown below;

### Table 8-1 2009 Results of metals in channel sediments

<table>
<thead>
<tr>
<th>Sample</th>
<th>Units</th>
<th>NAGD Screening Level</th>
<th>Mean</th>
<th>SD</th>
<th>95%UCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>mg/kg</td>
<td>20</td>
<td>1.67</td>
<td>2.153</td>
<td>3.67</td>
</tr>
<tr>
<td>Cadmium</td>
<td>mg/kg</td>
<td>1.5</td>
<td>&lt;0.1</td>
<td>-</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Chromium</td>
<td>mg/kg</td>
<td>80</td>
<td>8.56</td>
<td>10.3</td>
<td>17.65</td>
</tr>
<tr>
<td>Copper</td>
<td>mg/kg</td>
<td>65</td>
<td>2.8</td>
<td>4.743</td>
<td>13.6</td>
</tr>
<tr>
<td>Mercury</td>
<td>mg/kg</td>
<td>0.15</td>
<td>0.009</td>
<td>0.011</td>
<td>0.014</td>
</tr>
<tr>
<td>Nickel</td>
<td>mg/kg</td>
<td>21</td>
<td>3.12</td>
<td>4.662</td>
<td>7.58</td>
</tr>
<tr>
<td>Lead</td>
<td>mg/kg</td>
<td>50</td>
<td>5.16</td>
<td>6.325</td>
<td>10.86</td>
</tr>
<tr>
<td>Zinc</td>
<td>mg/kg</td>
<td>200</td>
<td>9.33</td>
<td>13.9</td>
<td>22.35</td>
</tr>
</tbody>
</table>

Based on these results, the material assessed during the 2009 SAP implementation and to inform this LTMP document is considered clean under the NAGD requirements and was assessed by DEWHA as suitable for unconfined ocean disposal. These results were generally consistent with prior sampling. Outcomes of the 2009 SAP will be considered a valid assessment of the sediment quality for a period of five years, with the next SAP implementation scheduled for 2014.
8.1.2 Spoil Ground

Testing of spoil ground sediments has been limited primarily to that associated with the dredging EIA (Dames & Moore and WBM, 1996) and is described in further detail in the two following sections.

Physical Classification

In preparation for the dredging EIA, van Veen grab samples were collected from three locations at the spoil ground for particle size distribution analysis. At each location, two replicate samples were collected and the results of the analyses are provided below in Table 8-2. Based on these results, it is evident that the sediments at the spoil ground are predominantly clay silts (mud), with a minor sand/gravel fraction.

Table 8-2 Particle size distribution of spoil ground sediments

(Dames & Moore and WBM 1996)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Gravel/Sand &gt; 0.06 mm</th>
<th>Silt 0.06 - 0.002 mm</th>
<th>Clay &lt; 0.002 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR1</td>
<td>8.8</td>
<td>55.2</td>
<td>36.0</td>
</tr>
<tr>
<td>OR2</td>
<td>10.1</td>
<td>51.5</td>
<td>38.4</td>
</tr>
<tr>
<td>OR3</td>
<td>42.7</td>
<td>20.7</td>
<td>36.6</td>
</tr>
<tr>
<td>OR1</td>
<td>8.2</td>
<td>48.7</td>
<td>43.1</td>
</tr>
<tr>
<td>OR2</td>
<td>11.3</td>
<td>55.1</td>
<td>33.6</td>
</tr>
<tr>
<td>Average</td>
<td>15.0</td>
<td>47.8</td>
<td>37.2</td>
</tr>
</tbody>
</table>

Chemical Composition

In preparation for the dredging EIA, a sediment quality investigation was undertaken, which collected van Veen grab samples from three locations within the current spoil ground. These samples were then analysed for total organic carbon (TOC), total carbonate and trace metals. The results of this investigation are provided below in Table 8-3, which demonstrate that no results exceeded the relevant NODGDM (now NAGD) Screening Levels.

Table 8-3 Measured metals concentrations of spoil ground sediments

(Dames & Moore and WBM, 1996)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Cr</th>
<th>Cu</th>
<th>Zn</th>
<th>Ni</th>
<th>Cd</th>
<th>Pb</th>
<th>Fe</th>
<th>Al</th>
<th>Se</th>
<th>As</th>
<th>Hg</th>
<th>Mn</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR 1.1</td>
<td>18</td>
<td>11</td>
<td>33</td>
<td>15</td>
<td>0.2</td>
<td>13</td>
<td>17</td>
<td>500</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>1.3</td>
</tr>
<tr>
<td>OR 1.3</td>
<td>15</td>
<td>9</td>
<td>23</td>
<td>12</td>
<td>0.2</td>
<td>10</td>
<td>14</td>
<td>1100</td>
<td>-</td>
<td>-</td>
<td>1.2</td>
<td>0.2</td>
</tr>
<tr>
<td>OR 2.1</td>
<td>23</td>
<td>16</td>
<td>39</td>
<td>20</td>
<td>0.4</td>
<td>16</td>
<td>21</td>
<td>100</td>
<td>1400</td>
<td>1100</td>
<td>1.4</td>
<td>0.2</td>
</tr>
<tr>
<td>OR 2.3</td>
<td>17</td>
<td>11</td>
<td>29</td>
<td>15</td>
<td>0.3</td>
<td>13</td>
<td>14</td>
<td>800</td>
<td>13</td>
<td>000</td>
<td>0.9</td>
<td>0.2</td>
</tr>
<tr>
<td>OR 3.1</td>
<td>17</td>
<td>12</td>
<td>29</td>
<td>15</td>
<td>0.2</td>
<td>11</td>
<td>14</td>
<td>400</td>
<td>13</td>
<td>200</td>
<td>1.4</td>
<td>0.2</td>
</tr>
<tr>
<td>OR 3.3</td>
<td>17</td>
<td>12</td>
<td>29</td>
<td>15</td>
<td>0.3</td>
<td>12</td>
<td>16</td>
<td>000</td>
<td>13</td>
<td>900</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Average</td>
<td>18.0</td>
<td>11.7</td>
<td>30.3</td>
<td>15.5</td>
<td>0.27</td>
<td>12.5</td>
<td>16.3</td>
<td>13</td>
<td>767</td>
<td>&lt; 0.2</td>
<td>1.12</td>
<td>&lt; 0.2</td>
</tr>
</tbody>
</table>

In 2002, two van Veen grab samples were collected from the spoil ground and tested for polycyclic aromatic hydrocarbons (PAH) and TOC levels. All PAH concentrations were below detection in both samples.
8.2 Sources and History of Possible Anthropogenic Contamination

The entrance channel is used solely for the passage of ships (i.e. no loading/unloading of ships occurs in the channel) to and from the Port berths which are located approximately 2 km upstream from the mouth of the Norman River. As such, there are no direct sources of potential contamination in the entrance channel. Any anthropogenic contaminants found in entrance channel sediments would originate from upstream sources in the catchment such as the Port or surrounding catchment. The major activities at the Port, with respect to potential contaminant input, are the MMG Century lead and zinc concentrate export operations and refuelling of commercial and recreational vessels.

Previous marine sediment testing has been undertaken at the port area within the Norman River and has indicated that no significant increase in heavy metals concentrations has occurred since the commencement of concentrate exports. Historical testing within the entrance channel has also shown that all potential contaminants are below relevant screening level guidelines.

Investigation of various concentrate spills and routine water and sediment sampling has been conducted by MMG Century to fulfil State licence and general environmental duty requirements. Localised areas of contamination have been identified adjacent to loading facilities and reported to the State environment department (now DEHP), however further detailed investigation by MMG Century and its appointed consultant did not identified any significant issues that contribute anthropogenic contaminants to the entrance channel sediments.

8.3 Water Quality

8.3.1 Background Values

The primary water quality impacts associated with dredging is an increase in turbidity levels and or mobilisation of contaminants. Predominantly, attention is drawn to turbidity and suspended solids concentrations during dredging activity and any subsequent impacts to nearby environmental assets or receptors susceptible to deposition or light attenuation. Duration and concentration of the exposure are key determining factors in the actual impact. Generation of turbid or sediment laden water surrounding dredge operations is largely due to excavation of the sediments and/or dredge hopper overflow. At the Port of Karumba, due to the close proximity of the inner channel to Alligator Bank, the impact of potentially elevated turbidity levels on seagrass meadows and marine biota (i.e. prawns) has been recognised in previous investigations and approvals for dredging, which have required monitoring of water quality, including in the area of the meadows during dredge campaigns. Typically, this monitoring has compared turbidity levels during dredging to a reference site or trigger level that has been calculated using a best estimate of background levels.

Initial assessment of water quality parameters during the baseline survey (Dennison et al 1996) recorded turbidity values between 17 and 72 NTU (median 38.5 NTU and 80th Percentile =42.8 NTU) under tidal conditions of between 0.4 and 1.25m over Alligator Bank during wind conditions of between 5-7 knots SE and 10-15 knots NW to NE. Further evidence of local background conditions is also summarised in Section 7.7.

PCQ completed an investigation of “background or ambient” turbidity during 2004 and 2005 at five locations at Alligator Bank to define a suitable trigger value for future monitoring. Locations of sampling are shown in Figure 8-2.
Ambient turbidity data collected by PCQ in past monitoring and that available from Zinifex (now MMG Century) were assessed by consultants Hydrobiology in 2004, and combined to derive an estimate of natural average turbidity of 42.7NTU. This was then calculated to form a trigger level of observed ambient turbidity plus 25 % to derive a value of 53.3 NTU. This value was then used as a trigger for an action based program where Approval conditions did not permit the trigger level to be exceeded by more than 25% for more than nine out of any ten day dredging period. Individual records above the trigger were recorded, but the overall project trigger was not exceeded.

In preparation for the 2006 campaign, another assessment of ambient turbidity was made using new data collected in 2005. The data demonstrated a high level of variability, with values between 1.0 and 196.7 NTU, with monthly averages ranging between 3.0 NTU in August and 78.5 NTU in October. Two key conclusions were drawn;

- Turbidity levels were broadly comparable across the five locations, with no apparent spatial trends.
- Levels measured at 3.0 m depth appear to be higher than those at 1.0 m at some locations, however, due to the small sample size of 3.0 m observations (n = 7), it is difficult to identify a conclusive trend.

Results from the 2004 and 2005 datasets where combined and assessed to derive a value based on the 80th percentile of the combined dataset which was determined to be 62 NTU. This value was used as the action based trigger for the 2006, 2008 and 2010 campaigns.

Therefore, investigations to determine a local reference turbidity value have concluded a value of either 53 or 62 NTU to which a comparison of values observed during dredging events has been made. Based on the assessment of potential impacts to seagrass (refer Section 9.2) and the adaption by local species to habitats of naturally high turbidity and sedimentation, a trigger value of 60 NTU is considered a conservative value.
8.3.2 During Dredging

2002 Dredging Campaign

An extensive water quality monitoring program, which involved the deployment of three real time turbidity buoys at the channel-side boundary of the seagrass meadow, aerial surveillance of the spatial extent and movement of turbidity plumes generated by the dredge and the collection of spot turbidity measurements in and around the identified dredge plumes was undertaken. This study, undertaken by WBM (2002), demonstrated that there is a high level of natural variation in the background turbidity levels and that the relative impact of dredging on turbidity levels overlaying the seagrass meadows was comparatively low. Whereas turbidity levels within plumes immediately adjacent to the dredge were usually greater than 100 NTU, these levels were typically reduced to around 30 to 40 NTU by the time that the plumes had migrated to the seagrass meadows, which was well within the identified background levels for the area (typically within 0 to 100 NTU). Furthermore, the monitoring demonstrated compliance with all approval conditions. Aerial surveillance was also undertaken in 2002. This monitoring demonstrated that the potential for turbid plumes generated by dredging to impact on the Alligator Bank seagrass meadows was only relevant during the flood tide, when currents would transport them in a predominantly south to southwest direction. During the ebb tide, plumes typically migrated in a northern direction.

2004 Dredging Campaign

Following the information gathered during the 2002 monitoring program, the TACC agreed with PCQ to a reduced monitoring program in 2004, which involved only a limited amount of aerial surveillance and the implementation of a shorter program of daily turbidity monitoring. Using data collected in the lead up to the 2004 works PCQ calculated a best estimate (average) of background turbidity, which was then used to calculate a trigger level (best estimate plus 25 % = 53.3 NTU) in accordance with PCQ’s approvals for dredging. Turbidity monitoring of the locations illustrated in Figure 8-2 was then generally undertaken on a daily basis for the first four weeks of dredging, with the daily median turbidity value then compared to the trigger level. This monitoring demonstrated that the daily median varied between 1.9 and 35.6 NTU, and hence no instances of non-compliance with PCQ’s approval conditions were identified.

Aerial surveillance was undertaken at the commencement of dredging to visually assess the impacts of dredging on both the ebb and flood tides. This monitoring demonstrated that plumes generated by the dredge heads were not visible over the seagrass meadows and that, furthermore, they were not even discernible from background conditions within the immediate vicinity of the dredge. Instead, the only elevated turbidity levels associated with dredging were identified as a result of ‘prop wash’, which occurred due to the shallow depths and the dredge’s minimal under keel clearance. Such an effect is regularly experienced in Karumba during the transit of the channel by other large vessels and is unlikely to cause any ongoing harm to the adjacent seagrass meadows.

2006 Dredging Campaign;

Monitoring was completed on 6 days during the 3 week campaign, with one daily median value exceeding “background” condition. Overall the monitoring did not exceed the trigger of “four out of five days”.

2008 Dredging Campaign

A six day program was implemented during the 2008 dredging campaign to determine turbidity levels at five proposed sites at Alligator Bank, for comparison to two reference sites located on the northern side of the channel (Figure 8-3), well outside the zone of predicted dredging induced
impact. Sampling was conducted on the incoming tide phase. Median daily values ranged between 2 and 11 NTU. No results exceeded the 62 NTU trigger, and consequently did not exceeded the four out of five day trigger.

Figure 8-3 Turbidity Monitoring Locations (2008)

Figure 8-4 Results of 2008 Turbidity Monitoring
2009 Bed Levelling works

A reactive, trigger based monitoring program was developed as a component of the EMP for the 2009 bed levelling works. This monitoring was a targeted program based on determining what were the highest risk periods for plume impact to areas of environmental significance and proposed to monitor turbidity at those five sites used in the 2008 works, prior to and during the works, dependant on the location of dredging relative to areas of environmental significance, the duration of dredging and predicted sea state/tide pattern. Due to the very short period of actual bed levelling works only three time periods were consistent with those of highest risk. However due to low water levels over Alligator Bank, and no observed plume emanating from the works in the direction of the sampling sites, no sampling was conducted.

2010 Dredging Campaign

Requirements of the State approval for Environmentally Relevant Activity (ERA16) Extractive and Screening Activity, including dredging, required that turbidity be monitored at two locations on edge of Alligator Bank seagrass meadows and a background site on a daily basis during flood tides when the dredge was operating on a flood tide adjacent to Alligator Bank. A reactive monitoring trigger of background plus 25% or 62 NTU, whichever is greater, for a duration of not more than 72 hours. This trigger was not exceeded; with monitoring results well below these trigger levels.

![Figure 8-5 Results of 2010 Turbidity Monitoring](image)

2011 Dredging Campaign

Management of the dredging campaign was implemented so as to minimise the time at which the dredge operated on flood tides adjacent to Alligator Bank, and hence avoided highest risk potential turbidity conditions. Therefore the trigger for implementing a campaign specific turbidity monitoring as set out in Table 10.2 were not met and monitoring was not warranted during the campaign.

2012 Bed-Levelling Campaign

Triggers for implementing of a campaign specific turbidity monitoring were not met and monitoring was not warranted during the campaign. Works were scheduled for a period when tide conditions were favourable and low risk of potential impacts to Alligator Bank area due to short duration of works in that section of channel, and hence avoided highest risk potential turbidity conditions.
Summary
As outlined above, previous efforts to determine possible turbidity impacts to seagrass during dredging have adopted the approach of comparing the level observed during a campaign with purported “normal” conditions at which seagrass is perceived to be functioning at an acceptable level. The findings of turbidity and seagrass monitoring to date supports a conclusion that plumes generated during dredging activities are unlikely to have reached concentrations, durations or distributions that have had a deleterious impact to these areas of environmental significance.

When triggered, dredge-event based turbidity monitoring consistent with prior campaigns is proposed to continue within this LTMMP where a trigger value of 62NTU will be maintained until further reliable levels of seagrass tolerance are identified in the scientific literature or by DAFF. Any proposed changes will be discussed with the TACC with any changes in monitoring design requiring approval by DSEWPaC.

To ensure the above interpretations of prior monitoring outcomes are periodically reassessed, it is proposed that verification of the dredge induced turbidity plume extent is undertaken at a future campaign as outlined in Section 10.7.

8.4 Benthic Fauna
PCQ commissioned WBM to undertake macroinvertebrate sampling of the spoil ground, channel and associated control areas both prior to (providing a baseline) and following the first dredging campaign in 1998 (WBM, 1999). The baseline monitoring was undertaken immediately prior to dredging, whilst the post dredge work was undertaken around eight months after completion of dredging. Each monitoring event sampled six impact and six control sites at the spoil ground, and six impact and four control sites in the channel area.

The study highlighted the following points:

- Comparison of the study results and data from previous studies demonstrated a high degree of temporal variability in the Port’s benthic communities, which was consistent with that reported in other tropical subtidal soft sediment environments in Australia and overseas.

- Benthic community structure characteristics at the offshore areas (i.e. the spoil ground and associated control sites) were relatively similar between the impact and control locations between both the pre and post-dredge surveys. Whilst statistically significant variations in the number of taxa, diversity and number of individuals were identified, they appeared to be independent of material placement. This indicated that either dumping had minimal impact on benthic communities at the spoil ground or they had been impacted during dredging, but had recovered to their pre-dredging condition within the time between surveys (i.e. eight months).

- There was evidence that dredging activities had a significant impact on benthic communities within the entrance channel that was still observable eight months following the works. Whilst natural variability could not be discounted as the cause of the variation, the observed patterns were consistent with an environmental impact.

In conclusion, the study considered it unnecessary to undertake any further benthic monitoring of the spoil ground where future dredging was to be similar in nature to that completed in 1998. The study noted that, in particular, any future monitoring of the entrance channel would be superfluous as benthic impacts in this area are largely unavoidable and there are few management options to mitigate such effects. As such, no benthic in-fauna monitoring has been undertaken since that time, nor is proposed for the channel in forthcoming period.
8.5 Introduced Marine Pest Species

A baseline survey within the Port for introduced marine pests was commissioned in August 2000, and was undertaken in consistent with the sampling protocols developed by the CSIRO Centre for Research on Introduced Marine Pests. The survey, which was undertaken by Neil et al. (2001), surveyed marine habitats for the presence and/or prevalence of introduced marine species and to determine the biodiversity of the native marine assemblages present. Efforts during the survey were primarily focussed on the habitats within the vicinity of the berths in the Norman River; however, some samples were also collected from the entrance channel to ensure comprehensive coverage of all available marine habitats.

During the survey, a total of 435 taxa were recorded within the Port, of which none were species designated as pests by the Australian Ballast Water Management Advisory Committee. Furthermore, whilst five species collected at the Port were classified as cryptogenic (i.e. their origin was uncertain and not demonstratively native or introduced), none of the taxa were considered to be exerting a detrimental effect on local marine assemblages within the area, and each were in relatively low abundance.

In addition to the 2000 survey, PCQ installed artificial settling plate devices in the Port following the detection of the black-stripe mussel at the Port of Darwin in 1999/2000. PCQ and subsequently Ports North, have continued to use these plates at main wharf area which are retrieved and inspected every three months by Karumba’s Port Supervisor for Asian green mussel, Caribbean tube worm, black stripe mussel and any other unusual growth. To date, no suspect pest species have been identified.

Regardless of the previous identification of cryptogenic species within the Port, the overall risk of translocation from the channel to the spoil ground through the action of dredging is considered very low and comparable to potential risk of natural translocation mechanisms given the short distance between the two locations.
9. POTENTIAL IMPACTS OF DREDGING AND DISPOSAL

The environmental impacts of dredging at Karumba have been studied and documented during past dredging campaigns, and as such, the following assessment of potential impacts is based on information drawn from these studies and longer-term environmental health monitoring undertaken in the Karumba area.

Assessment of impacts of ongoing maintenance dredging must be undertaken in the context of historical dredging and spoil disposal activities and the ongoing requirements for maintenance dredging at Port of Karumba. The activities proposed during routine maintenance dredging and disposal have been detailed in Section 6.2, and prevailing environmental conditions detailed within Sections 7 and 8.

The impacts associated with the proposed dredging and disposal can be defined as either short or long-term effects. Short-term effects include physical removal of habitat, smothering and burial of benthic organisms, and impacts to water quality. Long-term effects relate to changes in habitat conditions, primarily through events which cause significant sediment mobilisation to outside the spoil ground. Environmental aspects that have the potential for impact are identified in Figure 9-1 and management strategies are introduced in Table 9-1 below.

![Figure 9-1 Aspects potentially impacted by dredging and sea disposal](image-url)
Table 9-1 Aspects potentially impacted and management strategies

<table>
<thead>
<tr>
<th>Aspect (then Potential Impacts)</th>
<th>Management Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Quality</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Turbid dredge induced plumes encroaching on areas of environmental significance | • Revise dredging strategy if dredge plumes are determined [e.g. advice by Fisheries Queensland - DAFF via TACC] to be impacting upon areas of environmental significance (e.g. seagrass) in a manner that will lead to long term degradation or loss of the resource, or if advice indicates marine flora is in a degraded state due to other factors and concern is raised that it is more susceptible to potential impacts of dredging.  
 • Consider actions inclusive of alteration to temporal and spatial control on dredge operations through technical consultation with relevant expertise.  
 • Gauge effectiveness of these mitigation measures through targeted water quality or sedimentation monitoring to quantify impact and assess against species tolerances if known. |
| **Sediment – Physical Disturbance** |                     |
| Physical and chemical impacts from dredging and disposal of dredged material | • Physical and chemical disturbance at the spoil ground is unavoidable but previous monitoring has identified that impacts are localised and benthic recovery is rapid.  
 • Disposal management practices will continue to be implemented to ensure dredge material is disposed evenly across the spoil ground to reduce the depth of smothering disturbance at the site.  
 • All routine dredging activities will be undertaken outside potentially sensitive lifecycle stages of commercially important prawn species in the study area (i.e. dredging only to occur between 1 May – 30 September inclusive and in accordance with CSIRO recommendation). |
| Injury to large marine fauna (e.g. turtles, dugong) | • Turtle exclusion devices will be used at all times as a standard operationally specification to ensure the risk of injury to turtles during dredging is minimised.  
 • The vessel will not be operating at speeds capable of injuring large marine species; therefore the potential for injury to large marine fauna through boat strikes is extremely low.  
 • Vessel crew will observe for large marine fauna within a monitoring zone to meet Permit conditions applicable to the dredging and disposal. Dredging will cease while marine mammals are within this zone and not restart until they are outside the monitoring zone. |
<table>
<thead>
<tr>
<th>Aspect (Potential Impact)</th>
<th>Management Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sediment - Quality</strong></td>
<td></td>
</tr>
</tbody>
</table>
| Introduction of chemical contaminants to the water column and benthic environment of spoil ground | • Results from SAP show that sediments from the Port of Karumba are not toxic and therefore suitable for unconfined sea disposal.  
• Sediment Analysis Plans will be implemented every 5 years to determine whether the contamination status of the sediments change, or more frequently depending on changes in port operations that lead to changes in sediment quality. |
| **Marine Pests**          |                     |
| Translocation of marine pests to the port due to hull fouling or ballast water of the dredge vessel or associated plant | • Contract requirements and the EMP are developed for each campaign and require that the appointed contractor meets the inspection, preventative maintenance and action required to manage hull fouling and ballast water, including AQIS requirements and the *National Biofouling Management Guidance for Non-trading Vessels*.  
• Measures set out in the guidelines applicable to management of internal areas of the dredge, suction pipes and hoppers to be implemented by the appointed Contractor. |
| Translocation of any marine pests (in the event that they establish viable population within the port) to the spoil ground | • Assessment of proposed dredge spoil/area is to be included in any subsequent SAP, where an increased risk is identified due to the detection of confirmed marine pests aboard vessels or within the port. |
| **Air Quality**           |                     |
| Increase in exhaust emissions from plant and equipment. | • Plant and equipment maintained in sound working order. |
| **Noise and Vibration**   |                     |
| Increased noise impacting on areas of environmental significance. | • Ensure all plant and equipment is maintained and meets relevant guidelines for noise emissions.  
• Minimise duration of dredging campaign |
| **Socio-economic**        |                     |
| Alteration to movement of recreational and commercial vessel. | • Maritime Safety Queensland’s Regional Harbour Master will manage all shipping and vessel movements within the Port limits and issue notifications to mariners during works.  
• Ports North will issue advice for distribution to key businesses in Karumba, including fishing and tackle stores, caravan parks, and also boat ramps to alert them to forthcoming dredging campaign. |
| Provision of navigable port channel | • Routine maintenance dredging is required to maintain port access, facilities, trade and recreation access. |

The following section reviews these aspects and any uncertainties regarding them. This is then applied to the monitoring and management framework, detailed within Section 10.
9.1 Water Quality

Impacts to water quality from dredging and disposal activities relate to increased turbidity and suspended solids concentrations and mobilisation of nutrients. While water quality can be impacted during dredging processes, water is a vector of the disturbance to the ‘true’ receptors, including, adjacent benthic communities, nekton (fishes) and mega fauna such as turtles, dolphins and dugong. The alterations to water quality only are described below, with impacts to the true receptors discussed in other sections.

9.1.1 Turbidity and Suspended Solids Impacts at the Dredge Site

Increases in turbidity and suspended solids will occur within the zone of operation of the dredging plant. In the case of areas of sandy material, these water column effects will be short lived as the heavy fractions settle quickly and plume generation and migration is minimal. In areas of fine silty clays however, the impacts to the water column are more pronounced and longer lived due to the fine particle size and slow rate of deposition. Areas of fine silty clays present the highest potential for generation of turbid plumes and if current, tide and wind conditions are suitable, may lead to secondary impacts to areas of environmental significance. Changes in chemical composition can also occur, as anoxic and sulphide containing layers of sediment are disturbed creating oxygen depleted conditions in the adjacent water column. Potential acid generation due to disturbance of potential acid sulphate soil is possible, however due to the buffering capacity of seawater and the minimal exposure of dredge material to air, impacts from potential acid generation is highly unlikely.

Dredgers such as trailing suction hopper dredgers, which operates in the channel, generate most turbidity when operating in overflow mode as the hopper approaches its maximum capacity. The extent of impact from overflow mode can be reduced by using more modern trailing suction hopper dredgers, such as the Brisbane, which have subsurface discharges and moveable internal weirs to manage discharge turbidity and overflow duration. It should be noted that any turbidity generated in the entrance channel by overflow dredging would be limited to about 15 minutes during an approximate three hour dredge cycle, so the turbidity plumes are limited both spatially and temporally. Observations of plume extent (PCQ, 2004 and 2008) indicate prop wash from the dredge and the passage of the vessel over the shallow channel was notable.

There is a great degree of certainty that turbidity generation within the water column will occur, these have been quantified and understood through extensive previous monitoring. These are impacts not uncommon under natural extreme events and some routine tidal movements.

9.1.2 Turbidity and Suspended Solids Impacts at the Spoil Ground

Water quality impacts at the spoil ground during the disposal phase of the operation follow those described above. The duration of impact is short lived as material falls to the sea floor. However, dispersion rates vary depending on current conditions at the time of release from the hopper. Extensive sampling and aerial surveillance during previous dredging campaigns has shown that turbid plumes are generated within the water column and can persist for several hours where fine silts are disposed and low current conditions prevail. Details of the most recent observation of disposal events are outlined in PCQ (2008).

In conclusion, maintenance dredging of the outer channel (which has the greatest potential to generate turbid plumes over seagrass habitat) typically lasts for only short periods within the campaign as the dredge enters overflow operation at the end of the dredging cycle. Plume generation at the spoil ground extends up to about one kilometre over muddy substrate. While the previously recorded turbidity plumes reflect possible maximum extent, confirmation of this is proposed during a future routine maintenance dredging campaign in the outer channel and following deposition at the spoil ground.
9.1.3 Mobilisation of Toxicants

Prior to the disposal of dredge spoil, sediment sampling and analysis defines the overall suitability of the material for unconfined ocean disposal. Sediment quality has been discussed in Section 8.1. Where analytes record 95%UCL values in excess of guideline criteria, elutriate testing is undertaken to predict impacts to water quality. The results of laboratory analyses, which essentially test the supernatant water from a settled 1:5 mixture of sediment and seawater, can be afforded a level of dilution which allows for at least 100 time dilution. To date, investigation of Phase 1 and II testing has not identified any substances that require elutriate testing, which was confirmed during the 2009 SAP (refer Section 8.1 and Appendix 4).

Field monitoring during dredging and disposal would therefore be predicted to record water quality concentrations for toxicants well below the respective guideline criteria. Sediments have been assessed according to an approved SAP and remain within the adopted screening criteria detailed within the NAGD. Given these findings, dredge materials are considered suitable for unconfined ocean disposal and mobilisation of toxicants during disposal is considered to be of low probability and hence low risk to the marine environment, and does not warrant further study under existing conditions.

9.1.4 Nutrients

Nutrient concentrations from marine sediments are a potential water quality concern, where nutrients can be released to the water column during dredging and disposal. The similarity between offshore sediment chemical and physical parameters and proposed spoil suggests that deposited sediments are unlikely to drive a significant variation in nutrient release to that already occurring within the background sediments. Natural forces driving algal blooms, such as periods of warm calm weather following a turbulent period would have a far wider impact than that of dredging and disposal. Given the low frequency and duration of dredging disturbance, problematic impacts associated with potential nutrient release are unlikely to manifest within the marine environment (i.e. algal blooms, seagrass health and epiphytic algal growth. Such effects would be associated with sustained nutrient elevations and not driven by episodic dredging campaigns.

In conclusion, whilst the potential of nutrient release during dredging and disposal is perceivable, the existing background concentrations, and short duration of maintenance dredging activity lowers the overall likelihood and consequence of problematic nutrient elevations. On that basis, analysis of dredge and disposal locations during disposal for nutrients in water is not considered warranted.

9.2 Benthic Flora and Fauna

9.2.1 Benthic Flora – Seagrass

The only benthic flora in the vicinity of dredging and disposal activities is seagrass meadows adjacent to the inner sections of the channel close to Alligator Banks and Karumba Point. A substantial body of knowledge regarding the distribution and health of seagrass at Port of Karumba has been developed over the last 16 years. Dedicated programs undertaken by Fisheries Queensland (DAFF) and supported by Ports North (and predecessors) has established an understanding of annual trends in key seagrass communities as well as observed fluctuations in both distribution and health indicators for seagrass, no impacts attributable to operation of the Port have been identified. Rather, the key drivers of observed variation in distribution, cover and biomass, are reported to be largely driven by physical climatic factors such as wind, wave, cyclones, and flood. The identification of climatic factors being primary drivers of seagrass variability, rather than port operations or routine maintenance dredging, is a consistent conclusion of Fisheries Queensland (DEEDI) seagrass monitoring at ports around Queensland.
Although the processes of dredging and resulting increased turbidity, reduced light, mobilisation of nutrients/toxicants and increased deposition have the capacity to impact seagrasses, evidence from the study area outlines a significant resilience to such affects, resulting in a reduced risk from dredging and port operations.

**Low Light Availability**

Dennison *et al* (1997) investigated baseline availability of light to *Halodule pinifolia* and *H. ovalis* across Alligator Bank and determined that those species, dominant in the Karumba area, as being well adapted to low light intensity and high turbidity. These communities receive the highest quantities of light during periods of daytime low spring tides when shallow clear pools of low suspended solids waters cover the meadows. A highly variable intertidal light climate is present at Karumba, due to the naturally very turbid, high suspended solids waters adjacent to the coast, coupled with the variable tidal and wind regimes. As a consequence of these natural events, there are specific periods when dredge induced turbidity plumes would not impact the seagrass community. Obviously it is physically impossible for plumes to cover the seagrass when the meadows are exposed at low tide. Further, dredge induced plumes would have little impact on seagrass when background turbidity is so high that the seagrass is not receiving sufficient light for photosynthesis. Dennison *et al* 1997 described the seagrass found at Alligator Bank as being well adapted to low light intensity and high turbidity. These communities receive approximately 5.2 hours of saturated photosynthesis light per day. Manipulative experimentation using shading and measurements of chlorophyll a and b content were conducted by Dennison *et al* (1997) and determined that health indicators of *Halodule pinifolia* remained constant through 80 days of reduced light, and 40 days at 0% light. However *Halodule ovalis* biomass declined after 80 days at 20% light, and 40 days at 0% light.

Studies by Longstaff and Dennison (1999) summarised that pulsed turbidity events caused by factors such as flooding rivers have the potential to seriously impact seagrass communities by depriving the plants of all available light. They investigated effects of light deprivation on the survival, morphology and physiology of the tropical seagrasses *Halodule pinifolia* and *Halophila ovalis* growing at Karumba where pulsed flood events are common. That study determined that for seagrass species found at Karumba, *H. ovalis* displayed little tolerance to light deprivation, with plant death occurring after 38 days in the dark. *H. pinifolia* showed a high degree of tolerance to light deprivation with no biomass loss before day 38 days and complete die-off predicted after 100 days. Shoot density, biomass and canopy height all declined after 38 days. They concluded that only long duration (>38 days) pulsed turbidity events would have a detrimental impact on *H. pinifolia* growing in the Gulf of Carpentaria.

These figures indicate that local seagrass species are well adapted to periodic high turbidity periods and are likely to exhibit a very high photosynthetic efficiency, and ability to recover from periodic high turbidity conditions.

**Physical Conditions**

Seagrass reported from Karumba exists in a very limited depth range, between 0 and -1.1m LAT (Dennison *et al* 1997). Adaptation to significant variations in salinity, temperature, exposure, turbidity and light availability demonstrates a high level of tolerance to environmental perturbations. However, the reduced depth range also induces a constant physical disturbance to seagrass communities within the study area, and acts to mitigate impacts often associated with dredging processes, such as deposition and increased turbidity. The frequency of natural physical disturbance over these seagrass beds is thought to limit potentially harmful effects associated with maintenance dredging and day-to-day port operations and port traffic. Detrimental effects of additional deposition or light availability associated with fine sediment fractions released by dredge operations would be readily reduced in even the slightest wind and sea conditions or at the turn of the next tide by prevailing currents.
Spatial and Temporal Effects

The minor temporal and spatial scale of maintenance dredging operations results in a very small potential for impact to seagrass communities. Channel dredging operations (works closest to the seagrass habitats) are undertaken over a relatively short period (typically a number of days) by the trailing suction hopper dredger. In addition, the temporal effect of the dredge is further reduced, as a TSHD, which operates in overflow mode for only a small proportion of the dredging cycle (approximately 15 minutes out of three hour cycle), further reduces the actual impacting period substantially.

Many naturally occurring events (wind, wave and cyclone) exceed both the duration and magnitude of turbidity and sediment generating processes such as that experienced during maintenance dredging. Similarly, the fluctuation of ambient turbidity during the change of tide and shift between neap and spring conditions drives a flux of increased turbidity over seagrass beds (particularly those adjacent to the channel) on a daily to weekly basis.

While significant capital dredge programs or sustained land based reclamation programs have the capacity to generate significant quantities of suspended and fine sediment deposits, over extended periods, the present maintenance program is not considered to be of sufficient spatial extent or duration to result in long term irreversible negative impacts to adjacent meadows. This conclusion has been supported by the findings of the Fisheries Queensland (DAFF) long-term seagrass monitoring program (Unsworth et al 2008, and McKenna & Rasheed 2011, Carter et al. 2012).

In summary, the frequent and naturally occurring disturbance to seagrass beds within the study area precludes any sustained impact associated with maintenance dredging and day-to-day port operations. Any deposited sediments reaching seagrass beds would be rapidly remobilised and exported from the area during the passage of the tide and prevailing wind and wave conditions. In combination with the limited spatial and temporal scale of dredge derived impacts, impact to seagrass during maintenance dredging is considered a very low risk. Impacts attributable to dredging such as increased turbidity, reduced light penetration and increased deposition, are vastly exceeded by natural seasonal physical processes experienced within the study area.

Based on findings of these studies noted above, a conservative duration of up to 20 days is proposed as the management trigger for determining the point at which dredge induced turbidity plumes retained over seagrass meadows may start to have an impact.

9.2.2 Benthic Fauna

DREDGE AREA

The entrance channel is an important migratory route for fish and crustacean species that move between the estuary, Norman River and the offshore areas during their lifecycles. As such the benthic communities represent an important food source to these organisms. Significant migrations of prawn larvae through the channel area during the wet season (November to March) were identified by CSIRO as a key consideration in scheduling of dredging during the EIA process in 1996. As a result conditions of previous dredging and sea disposal permits have included a “Dredging Window” to proactively ensure potential impacts to prawn stocks is minimised.

The maintenance dredging area of the entrance channel is primarily open muddy substrates, with limited areas of open sandy/gravelly substrate. These habitats contain only benthic infauna and would be subject to disturbance or removal on an annual basis when dredging was undertaken. The recovery process between dredging events is anticipated to be rapid for the more common, opportunistic invertebrate species. While some recovery of the benthic community can occur following dredging, it may be subject to removal again in subsequent campaigns. It should also be noted, however, that maintenance dredging targets only those areas that are considered high spots, so there will be patchy areas of sediment removal only and recovery of infauna communities in the dredged area can be seeded by adjacent, undisturbed areas.
The area of substrate removal is minor in relation to the extent of similar substrates within the broader areas, so impacts to benthic communities would be relatively minor. Any flow-on impacts to fish and mobile crustaceans from periodic dredging are expected to be negligible since volumes of material to be extracted will be similar to previous years.

Outcomes of investigation of the proposed minor channel realignment adjacent to Beacon No. 10 are summarised in Appendix 4 and indicate no predicted impacts to benthic fauna within the proposed area and a reduced impact to adjacent areas due to reduced dredging activity in this channel sector.

### 9.3 Smothering and Burial of Benthic Organisms

#### DREDGE AREA

The maintenance dredging area of the channel contains primarily open muddy substrates, with areas of open sandy/gravelly substrate and absence of hard bedrock substrates. These habitats contain only benthic infauna and would be subject to smothering disturbance or removal periodically when dredging was undertaken. The recovery process between dredging events is anticipated to be rapid for the more common, opportunistic invertebrate species. While some recovery of the benthic community may occur following dredging, it can be subject to removal again in subsequent years. It should be noted, however, that dredging within channels targets only those areas that are considered high spots, so there will be patchy areas of sediment deposition only and recovery of infauna communities in the dredged area can be seeded by adjacent, undisturbed areas.

The area of disturbance within the entrance channel is minor in relation to the extent of similar substrates within the remainder of the Karumba area, so impacts to benthic communities would be relatively minor. Any flow-on impacts to fish and mobile crustaceans from dredging are expected to be negligible since volumes of material to be extracted will be similar to previous years.

There is a great degree of certainty that direct smothering and burial impacts will occur to specific patchy areas of the channel due to passage of the dredge heads or post campaign bed levelling works.

#### SPOIL GROUND

Potential impacts to the abundance and diversity of the benthic macro-invertebrate assemblage at the Karumba spoil ground were assessed by Rose (1997) in a detailed pre and post campaign benthic investigation. Key conclusions of those surveys include seasonality as a significant driver of change in benthic community abundance and richness, and that impacts detected did not support future benthic monitoring unless the scale or intensity of disposal was significantly different to the 1996 dredging works.

Changes to the trophic structure of benthic macro-invertebrate assemblages can result from deposition of dredge spoil (Harvey et al., 1998). Invertebrate communities at spoil grounds may be categorised into feeding guilds as a guide to examine the function of the assemblage. Deposit feeders are generally the dominant feeding guild in muddy sediments (Long and Poiner, 1994), and suspension feeders tend to be the more dominant guild in coarse grain substrates. Grazers are likely to be largely absent largely due to the area being devoid of marine plants due to natural light inhabitation. Therefore evidence of changes to trophic structures of the benthic macro-invertebrate assemblage at areas adjacent to the spoil ground in response to dredge spoil deposition are likely to be of short duration and minimal.

In summary, potential impacts to benthic infauna assemblage at the spoil ground are predicted to be minimal, if any, and any influence on areas adjacent to the spoil ground attributable to spoil disposal would be limited to within tens of metres of the spoil ground. The apparent lack of impact to infauna communities in the vicinity of the spoil ground would be driven primarily by the similarity between
the sediments located at the site and in the nearby entrance channel, namely the similar physical characters of the spoil being disposed.

There is a high degree of certainty that direct smothering and burial impacts to benthic organisms within various sectors of the spoil ground will occur during each campaign. On the basis that the existing spoil ground has been determined to be a suitable site for permitted deleterious impact to the benthic environment, focus of monitoring should be to ensure extent of impact is focused on the permitted area, minimised to surrounding areas and evaluation of conditions be periodically made to gauge how the benthic flora and fauna can respond at a stage when disposal is no longer required or spoil ground reaches end of design capacity.

9.4 Sediment Quality

Analysis of sediment quality is an essential component of the NAGD assessment framework and required to demonstrate that disposal of sediments is suitably managed to minimise impacts to the environment. Monitoring of sediment quality at the Port of Karumba has demonstrated suitability for unconfined sea disposal.

It is highly likely that, in the absence of additional sources of contamination, that sediment of the entrance channel will continue to be suitable for unconfined sea disposal. On that basis, is proposed to continue with the current frequency of survey (every five years), primarily to ensure that data remains within the NAGD five-year currency period.

If an additional potential contaminant source arises that can impact entrance channel sediments, then the need for additional testing would be reviewed by Ports North and resolved with DSEWPaC prior to sampling and the next dredge campaign.

9.5 Direct Impacts to Marine Turtles and Cetaceans during Dredging

Several marine turtles and cetacean species (refer Section 7.5.3) are known to occur in the vicinity of the dredging and disposal locations. To date, dredging projects in the Port of Karumba have not resulted in any verified impacts on turtles, dugongs or cetaceans whilst actively engaged in dredging or disposal operations.

Potential impacts to these fauna have been managed in recent years through several conditions attached to the Sea Dumping Permit and operational EMPs, including:

For cetaceans:
- Lookout for cetaceans within a 300m monitoring zone before dredging or dumping begins; and
- Not commencing dredging or dumping if cetaceans have been seen within monitoring zone until such time as they mobilise away from the area.

For marine turtles:
- Requiring any dredge used in connection with the dumping activities to be fitted with a turtle exclusion device; and
- Undertaking routine maintenance dredging outside October to February (inclusive), which is the nesting period of the endangered loggerhead turtle.

Use of a dredge with a design specification such as the TSHD “Brisbane”, which undertakes dredging under contract to Ports North, whereby it is equipped with a turtle exclusion device on each trailing suction arm. Compliance with these conditions has avoided injury or mortality to marine turtles and cetaceans over the previous Sea Dumping Permit period (2005 - 2010).
There is no uncertainty regarding direct impacts to marine, mammals, turtles or cetaceans. Risks from routine maintenance dredging operations to these megafauna are low, based on experience under the previous permit.

Similar mitigation and monitoring conditions regarding turtle and cetacean protection measures will again be undertaken within this LTMMP.

Undertaking emergency dredging inside the October to February turtle nesting period could result in increased risk to turtles due to their likely increased presence in the inshore areas. Ports North would be required to obtain approval from DSEWPaC to undertake such works and would require increased management to mitigate risks particularly of direct impact to turtles. It should be recognised though that the likelihood of being able to undertake dredging works between October and February is limited since this remains within the monsoon season and availability of dredgers and staff being able to access the area can be limited.

9.6 Modification of Habitats outside the Spoil Ground

Assessment of potential impacts to habitats outside the spoil ground due to spoil deposition, drift or remobilisation was considered in the EIA (Dames & Moore, WBM, 1996) and investigated by Rose (1997) who generally concluded that off-site impacts of spoil disposal during the initial campaign using the site were minimal. There have been limited subsequent studies to verify this, however it is considered that potential impacts to surrounding habitats is constrained to impacts on soft sediment benthic infauna and minor temporary impacts to mobile megafauna. An absence of areas of environmental significance and habitats such as coral reefs, seagrass meadows or species specific feeding areas is also noted, with no significant impacts therefore predicted. Extreme weather events such as prolonged flooding or wave actions due to cyclone activity over relatively shallow coastal gulf waters may potentially lead to some spoil remobilisation, however this is not considered to be a significant impact, given the minimal difference in physical and chemical characteristics of the site compared to adjacent sediments.

Potential impacts to benthic infauna assemblage outside the spoil ground are predicted to be minimal, if any, and within a short distance adjacent to the spoil ground under normal conditions. The assemblage of infauna communities in the vicinity of the spoil ground would be driven primarily by the similarity between the muddy sediments located at the site and in the nearby entrance channel namely the high fines content of the spoil being disposed.

On the basis that the existing spoil ground has been determined to be a suitable site for permitted deleterious impact to the benthic environment, focus of any future monitoring should be to verify extent of impact is contained to the permitted area, minimised to surrounding areas and to periodically gauge how the benthic flora and fauna may respond at a stage when disposal is no longer required or the spoil ground reaches end of design capacity.

9.7 Potential Translocation of Marine Pests

CRC Reef Ports and Shipping Introduced Marine Pests Group undertook a baseline survey of the coastal biota within the port in August 2000 to determine whether any introduced marine taxa, of pest status or otherwise, were present within the Port of Karumba. This survey also described the status of native marine assemblages within the Port. The survey of the Port of Karumba collected a total of 435 taxa and detected no designated marine pests. Five taxa were recorded as cryptogenic or being of uncertain origin. This information was utilised to assist in managing the port and in raising public and industry awareness of marine pest issues. The information also underpins the Decision Support System that AQIS manages, which enables the risk of exotic marine organisms introductions (via ballast water) to be managed on a port-by-port basis.

Since the survey by CRC in 2000, no reports or detections of marine pests have been made on vessels or in sediments at Port of Karumba. Based on assessment of vessel traffic utilising the port, the highest potential for introduced pests comes from live cattle export vessels, followed by coastal
supply barges, and the fishing fleet. Movements of vessels such as the vessel “Wunma”, used for the short coastal transfer of minerals concentrates, is considered a low potential as it essentially remains within the southern Gulf. The risk of translocation of marine pests between the entrance channel and the spoil ground via dredging and disposal is considered a minor risk, as any marine pests that colonise the channel, may equally colonise the spoil ground by natural dispersal mechanisms as the spoil ground is of similar sediment characteristics and is located a very short distance from the channel. Therefore the risk of translocations is consider low, however the potential impacts are comparable to an event where marine pests established and spread by natural dispersal mechanisms.

The absence of any past detection of marine pests indicates that there is a limited risk associated the relocation of dredge sediments to the offshore disposal ground from the channel.

Any TSHD dredger contracted to undertake dredging works will be required to comply with best quarantine practices, including AQIS and Bio-Security Queensland requirements in relation to ballast water and marine pest management, hull protection systems management prior to and during dredging campaigns.

9.8 Significant Marine Megafauna

Impacts to marine megafauna are not anticipated to result from ongoing routine maintenance dredging at Port of Karumba.

Direct physical impact from collision with the TSHD or other plant is unlikely as the vessel master routinely looks out for megafauna and takes evasive action if it is safe to do so. Direct impacts to megafauna through intake into the suction heads is unlikely as most fauna would temporarily move away from the dredging operation area and the drag heads will continue to be fitted with turtle exclusion devices, as a requirement of the vessel specification.

Dredging operations are unlikely to impact marine megafauna, primarily because the dredging operations are stationary or slow moving to or from the spoil ground. Megafauna would temporarily move from the active dredge site and would be mobile enough to avoid collision with the moving barges.

Indirect impacts to megafauna dependent on seagrass as a food resource, such as dugong and some marine turtles would only be relevant in the situation where these resources were impacted. As described in Section 9.2, risk of impact to seagrasses from routine maintenance dredging and port operations is low, with long-term monitoring not identifying any impacts attributable to maintenance dredging or routine port operations.

9.9 Cultural Heritage

From the consideration of description of the existing environment at Section 7.4, there are no known areas of cultural significance identified within the dredge area, disposal ground or surrounding areas. The areas to be impacted by routine maintenance dredging works will have similar impact to the six previous dredging campaigns and will not extend beyond the existing dredging design. Volumes for each campaign will be similar to that for historic maintenance dredging and the likelihood of uncovering items of cultural heritage significance is considered low.

9.10 Cultural Values

Modern and indigenous cultural values of the Karumba area are generally understood to be confined to seasonal use of some areas for hunting, fishing and gathering zones. Contemporary indigenous use of the entrance channel is considered minimal.

There have been no specific issues of cultural or indigenous cultural heritage raised via TACC in the past five years. The areas to be impacted by routine maintenance dredging works will have similar
impact to the six previous dredging campaigns and will not extend beyond the existing dredging
design. Volumes for each campaign will be similar to that for historic maintenance dredging and the
likelihood of disturbing of physical cultural heritage significance is considered low. Impacts to visual
amenity and physical presence of dredging fleet are considered plausible, of minor impact and low
likelihood of occurrence given sparse population and demographic of potential receptors.

9.11 Fisheries and Aquaculture

Commercial, Aboriginal subsistence and recreational fishing is a significant aspect of the present
environment at Port of Karumba. Commercial and recreational effort for estuarine fisheries
resources is significant. These fisheries resources are influenced by the strong seasonal trends in
rainfall, temperature, and subsequent outflow of the vast gulf catchment river systems. Many of the
fisheries resources have life cycles triggered by the wet and dry seasons. These resources also
experience increased recreational and commercial fishing pressures following improved access at the
end of the wet season.

As described in Section 7.6, during the EIA process for development of the channel, knowledge
provided by CSIRO on patterns of prawn migration led to Sea Dumping Permit conditions which
include a period where dredging was permitted, to minimise potential impacts to the peak time in
prawn movement. Hence a "dredging window" was established, which restricts dredging activity to
the period between 1 May and 30 September. Potential impact risks to fisheries from dredging, such
as direct physical uptake and disturbance to early life stages of fisheries resources, was assessed
as high, and hence controls on timing of works through a dredge window has been implemented
and shall continue under this LTMMP. Conversely, actions of the TSHD and any ancillary bed
levelling works creates a mosaic of disturbed and undisturbed areas of seafloor, with resultant
variable patterns of primary colonising species and subsequent food sources to fisheries resources,
thereby limiting to some extent, the overall impact of the operation on fisheries resources.

Potential impacts from routine maintenance dredging that could affect fisheries resources include
disturbance to food resources through either acute or chronic alteration to seagrass meadows and
disturbance to food source, or ambient interactions through physical presence of dredge and
operations. It is assessed that although potential impact hazards are present, likelihood and
consequence of those impacts is low under the proposed short term, annual or biennial frequency
dredging campaigns within the defined “dredge window” of 1 May and 30 September.

9.12 Matters of National Environmental Significance

The waters of southern Gulf of Carpentaria provide potential habitat for a number of fauna species
of conservation or economic importance as described below. This section reviews the likely
presence of marine species of conservation significance in Karumba region and discussion of those
species that could be impacted by dredging or spoil disposal.

EPBC Act Protected Matters Database search results are provided in Appendix 1 and summarised
in Table 9-2. Species status under both the Commonwealth Environment Protection and
Biodiversity Conservation Act (EPBC Act) and Queensland Nature Conservation Act (NC Act) are
provided where applicable.

An assessment of Section 7.2 – Characterisation of Existing Environment for potential impacts of
dredging campaigns indicate that impacts on matters of National Environmental Significant (NES)
are low and an EPBC Referral is not required under the EPBC Act. This conclusion is supported by
EPBC Act Administrative Guidelines on Significance, July 2000, which states that:

“Dredging to maintain existing navigational channels would not normally be expected to have a
significant impact on the environment where the activity is undertaken as part of normal operations
and the disposal of spoil does not have a significant impact.”
Further to this, coastal areas surrounding Karumba include salt flats, mangrove communities, extensive intertidal flats and shallow subtidal seagrass beds. These habitats are highly productive and support a high diversity of animals and plants including some species that are valuable to commercial fisheries and some which have high conservation value. The distribution of the key environmental values at Karumba is illustrated in Figure 7-2 which identifies the matters to be considered in managing potential impacts of dredging and disposal.

There are no listed World Heritage Areas, Marine Protected Areas, or conservation reserves within or near the dredging or disposal areas. There are also no listed RAMSAR wetlands, however, the Southern Gulf Plains. Aggregation wetlands, which are listed on the Directory of Important Wetlands, extend along the coastal fringes around the port area.

There are no threatened ecological communities in the area recorded in the EPBC Act Protected Matters database (refer Appendix 1). However, there are a large number of recorded threatened and migratory species in the region that could interact with dredging and disposal activity. The EPBC Act Protected Matters Database search identifies fifteen threatened species could occur in the Karumba region:

- Two species of bird;
- Three species of mammal;
- Six species of reptile, with the loggerhead and Olive/Pacific Ridley turtles considered endangered; and
- Four species of shark.

There are 51 migratory species currently noted in the database as likely to occur in the region. Ninety Listed Marine Species are identified, including cetaceans, turtles, dugong, whale shark and saltwater crocodile, whilst the remaining species are birds.

A summary of these matters, their likely presence in the dredge and disposal locations, and the likely effects of dredging campaigns is provided in Table 9-2 and Table 9-3 and following discussion, indicating that risk of impacts on matters of National Environmental Significant (NES) are low.

Knowledge of and listing status of threatened and migratory species and communities identified in Appendix 1 will change over the term of the LTMMP and the listing is to be subject of the half term periodic review of the LTMMP, or as advised by the TACC.
## Table 9-2 Matters of NES

<table>
<thead>
<tr>
<th>Matter of National Environmental Significance</th>
<th>Details</th>
<th>Possible impacts from Dredging and Disposal</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Listed threatened species and ecological communities</td>
<td>Fifteen threatened species could occur in the Karumba region:  - Two species of Bird;  - Three species of Mammal, with two species of whale considered endangered;  - Six species of Reptile, with the loggerhead and Olive/Pacific Ridley turtles considered endangered; and  - Four species of shark</td>
<td>Discussed in text section below</td>
<td><a href="http://www.environment.gov.au/biodiversity/threatened">http://www.environment.gov.au/biodiversity/threatened</a></td>
</tr>
<tr>
<td>2) Migratory species protected under international agreements</td>
<td>Fifty one migratory species listed in EPBC database as likely to occur in the Karumba region, including cetaceans, turtles, dugong, whale shark and saltwater crocodile, whilst the remaining species are birds.</td>
<td>Discussed in text section below</td>
<td><a href="http://www.environment.gov.au/biodiversity/migratory">http://www.environment.gov.au/biodiversity/migratory</a></td>
</tr>
<tr>
<td>3) RAMSAR wetlands of international importance</td>
<td>Proposed location is not within or adjacent to one of the 65 RAMSAR wetlands listed within Australia</td>
<td>Nil</td>
<td><a href="http://www.environment.gov.au/water/topics/wetlands/database/ramsar">http://www.environment.gov.au/water/topics/wetlands/database/ramsar</a></td>
</tr>
<tr>
<td>4) The commonwealth marine environment</td>
<td>Proposed site is within state and commonwealth waters, within the EEZ, but in or adjacent to a listed Marine Protected Area</td>
<td>Nil</td>
<td><a href="http://www.environment.gov.au/coasts/mpa">http://www.environment.gov.au/coasts/mpa</a></td>
</tr>
<tr>
<td>5) World Heritage Properties</td>
<td>Proposed location is not within or adjacent to a listed National Heritage Place</td>
<td>Nil- nearest site is greater than 300 kms away at Riversleigh</td>
<td><a href="http://www.environment.gov.au/heritage/places/qld">http://www.environment.gov.au/heritage/places/qld</a></td>
</tr>
<tr>
<td>6) National Heritage Places</td>
<td>Proposed location is not within or adjacent to a listed National Heritage Place</td>
<td>Nil– nearest site is greater than 300 kms away at Riversleigh</td>
<td><a href="http://www.environment.gov.au/heritage/places/national">http://www.environment.gov.au/heritage/places/national</a></td>
</tr>
<tr>
<td>7) Great Barrier Reef Marine Park</td>
<td>Proposed location is not within or adjacent to the GBRMP</td>
<td>Nil</td>
<td><a href="http://www.environment.gov.au/heritage/places/qld">http://www.environment.gov.au/heritage/places/qld</a></td>
</tr>
<tr>
<td>8) Nuclear actions</td>
<td>Proposed action does not involve use, movement or disturbance of matter to cause a nuclear action</td>
<td>Nil</td>
<td></td>
</tr>
<tr>
<td>Scientific Name</td>
<td>EPBC Act Status</td>
<td>NC Act Status</td>
<td>Preferred Habitat</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------</td>
<td>---------------</td>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Balaenoptera musculus</em> Blue Whale</td>
<td>Endangered, Migratory, Cetacean</td>
<td>-</td>
<td>This species is predominantly an offshore pelagic species.</td>
</tr>
<tr>
<td><em>Megaptera novaeangliae</em> Humpback Whale</td>
<td>Vulnerable, Migratory, Cetacean</td>
<td>Vulnerable</td>
<td>During spring, travels from Antarctic feeding grounds to breeding grounds in the Great Barrier Reef.</td>
</tr>
<tr>
<td><em>Balaenoptera edeni</em> Bryde’s Whale</td>
<td>Migratory, Cetacean</td>
<td>-</td>
<td>This species is predominantly an offshore species.</td>
</tr>
<tr>
<td><em>Dugong dugon</em> Dugong</td>
<td>Migratory, Listed, Cetacean</td>
<td>Vulnerable</td>
<td>Predominantly shallow coastal waters in association with seagrass beds.</td>
</tr>
<tr>
<td><em>Orcaella heinsohni</em> Australian Snubfin Dolphin</td>
<td>Migratory, Cetacean</td>
<td>Rare</td>
<td>Shallow coastal waters of less than 20m depth. Often associated with tidal riverine and estuarine systems, enclosed bays and coastal lagoons.</td>
</tr>
<tr>
<td><em>Orcinus orca</em> Killer Whale</td>
<td>Migratory, Cetacean</td>
<td></td>
<td>The species is predominantly associated with continental shelf and slope environments. While it inhabits all oceans of the world it is most abundant in temperate waters.</td>
</tr>
<tr>
<td><em>Sousa chinensis</em> Indo-Pacific Humpback Dolphin</td>
<td>Migratory, Cetacean</td>
<td>Rare</td>
<td>Shallow coastal waters of less than 20m depth. Often associated with tidal riverine and estuarine systems, enclosed bays and coastal lagoons.</td>
</tr>
<tr>
<td><strong>Reptiles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Caretta caretta</em> Loggerhead Turtle</td>
<td>Endangered, Migratory, Listed</td>
<td>Endangered</td>
<td>Waters with both hard and soft substrates including rocky and coral reefs, muddy bays, sandflats, estuaries and seagrass meadows.</td>
</tr>
<tr>
<td><em>Chelonia mydas</em> Green Turtle</td>
<td>Vulnerable, Migratory, Listed</td>
<td>Vulnerable</td>
<td>Marine, tropical and warm subtropical seas of northern Australia. Shallow benthic foraging habitats containing seagrass and/or algae including inshore seagrass beds.</td>
</tr>
<tr>
<td>Scientific Name</td>
<td>EPBC Act Status</td>
<td>NC Act Status</td>
<td>Preferred Habitat</td>
</tr>
<tr>
<td>------------------------------</td>
<td>----------------------------------</td>
<td>---------------</td>
<td>------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><em>Dermochelys coriacea</em></td>
<td>Endangered, Migratory, Listed</td>
<td>Endangered</td>
<td>Leatherback turtles are generally considered to be an oceanic species with little nesting occurring in Australia. The individuals that occurring in Australian waters are considered to be foraging migrants.</td>
</tr>
<tr>
<td><em>Eretmochelys imbricata</em></td>
<td>Vulnerable, Migratory, Listed</td>
<td>Vulnerable</td>
<td>Coastal marine waters with a foraging preference for rocky reef and coral reef habitats. Breeding predominantly on beaches in the Gulf of Carpentaria and the Great Barrier Reef Islands</td>
</tr>
<tr>
<td><em>Lepidochelys olivacea</em></td>
<td>Endangered, Migratory, Listed</td>
<td>Endangered</td>
<td>Benthic and pelagic foraging habitats ranging from 1 – 100m depth. Scattered nesting records on beaches of inshore islands in Arnhem Land and the Gulf of Carpentaria.</td>
</tr>
<tr>
<td><em>Natator depressus</em></td>
<td>Vulnerable, Migratory, Listed</td>
<td>Vulnerable</td>
<td>Inshore coastal waters of northern Australia with a preference for shallow, soft-bottomed sea bed habitats away from reefs. Breeds exclusively on Australian beaches. On the east coast mainland major nesting sites occur from Bundaberg to Mackay.</td>
</tr>
<tr>
<td><em>Crocodylus porosus</em></td>
<td>Migratory, Listed</td>
<td>Vulnerable</td>
<td>Tidal reaches of rivers between Gladstone and Cape York. Also occur along beaches and offshore islands in the Great Barrier Reef and in freshwater lagoons, rivers and swamps.</td>
</tr>
<tr>
<td><strong>Sharks</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Pristis zijsron</em></td>
<td>Vulnerable</td>
<td>-</td>
<td>Marine/ Estuarine. Typically inhabit inshore coastal areas in muddy or sandy-mud soft bottom habitats. Most common in tropical and subtropical waters.</td>
</tr>
<tr>
<td><em>Rhincodon typus</em></td>
<td>Vulnerable, Migratory</td>
<td>-</td>
<td>The whale shark prefers pelagic environments near the continental shelf. Forms aggregations in areas of high seasonal food resources – particularly at Ningaloo Reef (Western Australia)</td>
</tr>
</tbody>
</table>
**Marine Turtles**

Marine turtles are long-lived and late maturing with maturity reached at between 30 and 50 years of age (Miller, 1996). The foraging habitats and preferred items of the various marine turtle species are described in **Table 9-4**. The southern Gulf region provides potential foraging habitat for flatback turtles, olive Ridley turtles, loggerhead turtles and green turtles. Such habitats are known and widely distributed throughout the Gulf.

The sub-tidal areas of Port of Karumba support patches of seagrass beds, principally due to the elevated turbidity levels. The seagrass beds are largely restricted to the intertidal and very shallow sub-tidal areas and it is these areas that provide the main foraging habitat for green turtles.

Port of Karumba and surrounding beaches are not recognised as a major nesting area for any marine turtle species. This is based on review of the available species profiles on the **EPBC Act** website, and the conclusions drawn by Elliot (1993) and Marsh (1994) as referenced in the Draft EIS (Dames & Moore, 1996). The EIS states in Section 7.3.2 that “Significant Marine Wildlife in respect of Dugongs, Turtles, Dolphins and Whales that “The Karumba region is considered not to have greater significance to any of these species than any other section of the Queensland coastline”.
Table 9-4 Foraging habitats and preferred food items of marine turtle species

<table>
<thead>
<tr>
<th>Turtle Species</th>
<th>Foraging Habitats</th>
<th>Preferred Food Items</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green turtle (Chelonia mydas)</td>
<td>Shallow coastal area, in particular seagrass beds</td>
<td>Seagrass and seaweeds although juveniles are also carnivorous</td>
<td>Brand-Gardner et al. (1999)</td>
</tr>
<tr>
<td>Hawksbill turtle (Eretmochelys imbricata)</td>
<td>Rocky reef and coral reef habitats</td>
<td>Algae, seagrass and sponges</td>
<td>Limpus (2009a)</td>
</tr>
<tr>
<td>Flatback turtle (Natator depressus)</td>
<td>Shallow coastal environments including rocky reef and sedimentary habitats</td>
<td>A wide variety of soft bodied animals including soft corals, sea pens, sea cucumbers, jellyfish and other large plankton.</td>
<td>Limpus (2007)</td>
</tr>
<tr>
<td>Loggerhead turtle (Caretta caretta)</td>
<td>A wide range of intertidal and subtidal habitats including coral and rocky reefs, seagrass meadows, and unvegetated sand or mud areas</td>
<td>Although their diet is diverse, typical items include bivalve and gastropod molluscs and crabs</td>
<td>Limpus (2008a)</td>
</tr>
<tr>
<td>Olive Ridley turtle (Lepidochelys olivacea)</td>
<td>Principally shallow unvegetated coastal environments</td>
<td>Principally feeds on gastropod molluscs and crabs</td>
<td>Limpus (2008b)</td>
</tr>
<tr>
<td>Leatherback turtle (Dermochelys coriacea)</td>
<td>Oceanic environments from the sea surface to the seabed</td>
<td>Principally feeds on colonial tunicates such as Pyrosoma spp., jellyfish such as Catostylus spp. and other soft-bodied invertebrates</td>
<td>Limpus (2009b)</td>
</tr>
</tbody>
</table>

Regular sightings of turtles are made within the Port of Karumba. Most likely potential impacts from dredging that could affect turtles include vessel strike, disturbance to food resources through either acute or chronic alteration to seagrass meadows and disruption of food source, or ambient interactions through physical presence of dredge and operations (including ingestion). It is assessed that although potential impacts to turtles are present, the likelihood of those impacts is low under the proposed short term, annual or biennial frequency dredging campaigns. Management arrangements and minimum dredge specification for the TSHD listed in Section 10 include the use of turtle deflection devices on TSHD dredge heads to minimise the likelihood of uptake. The dredge vessel TSHD “Brisbane” was specifically designed for operations within the shallow Gulf of Carpentaria and has conducted operations at the Port of Karumba for several years. In consideration of advice from the TACC representatives, a “dredge window” has been in place to avoid potential interactions between wet season activity of turtles and dredging operation. This window is the same as that for
prawn and fisheries resources and will be implemented for routine maintenance dredging campaigns under this LTMMP.

**Estuarine Crocodile**

Estuarine crocodiles occur in the Port of Karumba. The key areas for estuarine crocodile populations in Queensland is the north western Cape York Peninsula, particularly parts of the Wenlock River and the Lakefield National Park (Read et al., 2004). Regular sightings of crocodiles are made within the Port of Karumba. The most probable potential impacts from dredging that may affect crocodiles include vessel strike, disturbance to food resources through either acute or chronic alteration to seagrass meadows and disruption to food source, or ambient interactions through physical presence of dredge and operations. It is assessed that although potential impacts to crocodiles are present, likelihood and consequence of those impacts is low under the proposed short term, annual or biennial frequency dredging campaigns.

**Cetaceans**

The Indo-Pacific humpback dolphin (*Sousa chinensis*), and the bottlenose dolphin (*Tursiops aduncus* and *Tursiops truncatus*) – are known to or likely to occur in the southern Gulf region. These species of dolphins usually inhabit shallow coastal waters of less than 20 m depth and are often associated with rivers and estuarine systems, enclosed bays and coastal lagoons (Corkeron et al., 1997, Hale et al., 1998; Parra, 2006).

Elsewhere in Australia these dolphin species co-exist with coastal development including extensive port facilities (Hale et al., 1998). For example, Indo-Pacific humpback dolphins and Australian snubfin dolphins are associated with port infrastructure at Cleveland Bay, Townsville (Parra, 2006) and the Indo-Pacific humpback dolphin also occurs in the Brisbane River (Hale et al., 1998). Bottlenose dolphins also inhabit inshore areas where significant amounts of recreational vessel and commercial water-based activities occur including Moreton Bay (Chilvers et al., 2005), Richmond and Clarence Rivers (NSW) (Fury and Harrison, 2008) and Port Stephens and Jervis Bay (NSW) (Möller et al., 2002).

The humpback whale migrates along the Australian east coast with the northern boundary of this migration being approximately Princess Charlotte Bay on the east coast of QLD, however the EPBC Act Protected Matters Database search results identifies humpback whales or their habitat occurring in the area. While it is plausible that Humpback whales could occur in the gulf, or in the vicinity of the spoil ground this is extremely unlikely as demonstrated in mapping in Figure 9-2.
Figure 9-2 Distribution migration and recognised aggregations of the Humpback whale

While it is plausible that Humpback whales could occur in the southern Gulf, or in the vicinity of the spoil ground this is extremely unlikely.

**Dugong**

Dugong are known to occur at the Port of Karumba, however there is no established State Dugong Protection Areas or Special Management Areas. There are significant marine flora meadows, a primary dugong food, adjacent to the proposed dredging site. Evidence of feeding trails has been regularly reported by Fisheries Queensland (DEEDI) during the annual surveys of seagrass resources. Regular sightings of dugong are made within the Port of Karumba, with periodic reports of boat strike, net entanglement etc. Most probable potential impacts from dredging that may affect dugong include vessel strike, disturbance to food resources through either acute or chronic alteration to seagrass meadows, or ambient interactions through physical presence of dredge and operations. It is assessed that although potential impacts to dugong are present, likelihood and consequence of those impacts is low under the proposed short term, annual or biennial frequency dredging campaigns.

**Birds**

Five species of terrestrial migratory species are listed on the *EPBC Act* extract, however only one of those, the White-Bellied Sea Eagle periodically utilises the foreshore or intertidal area. There is a low probability of actions of dredging or disposal will interact directly or indirectly to impact this species. Of the listed marine avian species, the majority of these have potential to occur in intertidal...
areas at or adjacent to the proposed site. Numerous of those are likely to overfly the site en-route to nearby roosting or feeding areas.

Comparison of the *EPBC Act* Policy Statement 3.21 for Significant Impact Guidelines for 36 Migratory Shorebird Species (Commonwealth of Australia, 2009), indicates that the southern Gulf region, including Karumba can be considered of International Significance. Further, of the EPBC Act listed species identified in Appendix 1, there are 21 species that potentially use the Karumba region, being greater that the “significance” trigger of 15 species.

Direct disturbance due to “Habitat Loss” (filling, reclamation) of the tidal foreshore is not part of this proposal hence no habitat loss for migratory wader birds is not predicted to occur. There is a low potential for habitat degradation if impacts of dredging occur due to water quality, including turbidity and sedimentation, to benthic habitats, i.e. seagrass meadows, upon which migratory wader bird species may forage at low tides. To date, as indicated in prior sections, there has been no quantified direct habitat degradation due to maintenance dredging identified in marine resource surveys.

There is a moderate potential for “Disturbance” impacts if dredge plant and equipment were to operate adjacent to the intertidal foraging areas used by the wader birds, however, due to the shallow depths of the entrance channel, dredge vessels are generally restricted by draft to operate mainly during the one high tide period that occurs at Port of Karumba. This provides a temporal mitigation measure to disturbance of migratory waders on adjacent sand flat areas, as those areas are covered by tidal waters at high tide when the dredge is working closest to those habitats, at which time the wader birds have moved to beach front or inland salt flat areas some 3-7km away from the nearest dredging activity.

Seasonality of passage of migratory waders via the East Asian – Australasian Flyway is generally more concentrated and of importance in the Southern Gulf region generally in the latter dry season (Bamford et. al., 2008), This is also a period when most dredging campaigns have historically been completed, and hence when interaction of dredging and potential disturbance effects is of highest likelihood.

Based upon available water quality and seagrass condition information previously presented, and the practicalities requiring dredging during the upper tidal periods only, impacts to wader bird habitat and general disturbance to wader birds by the process of dredging is remote. The likelihood and consequence of impacts is low under the proposed short term, annual or biennial frequency dredging campaigns.

**OTHER SPECIES**

Although not listed threatened or migratory species, a large number of sea snakes, ray finned fish, and pipefish/seahorse (sygnathids) species that are listed marine species on the *EPBC Act* extract. There are clear and significant knowledge gaps with respect to the distribution and abundance of sea snakes, sygnathids and some ray finned fishes in Australia. Some of these species are considered to prefer inshore waters with sandy/muddy substrata and moderate turbidity such as that found in southern Gulf region. There is insufficient information to determine which of these less well known species are likely to be found at the proposed site, or potentially impacted by proposed action.
9.13 Socio-Economic Impacts

As outlined in Section 5.2 consideration of impacts of dredging on the social and economic aspects should include both positive and negative impacts to both aspects. There are clear economic benefits from the presence of a dredged channel and resultant social benefits to the community of Karumba and surrounding gulf region. There is however periodic negative impacts to the social aspects due to visual amenity and physical presence of dredging fleet, however these are small in temporal scale, and given the low number of possible sensitive receptors in the region is assessed as a low probability, but moderate consequence. Mitigation Actions listed in above identify that an adequately managed campaign, where the community is informed of the dredging activity will minimise this impact. Economic impacts were a significant consideration in the EIA for the establishment of the location of the channel and spoil ground and included consideration of the following:

- The characteristics of the dredged material and the material at the spoil ground site;
- Proximity to areas of environmental significance;
- Minimising impacts on marine habitats and fauna, including seagrasses and benthic infauna;
- Logistic and economic considerations, including optimisation of dredge cycle times; and
- Safety considerations in the operation of dredging equipment at the spoil ground site.

Assessment of suitability of the spoil ground location during the EIS (Dames & Moore, 1996) was based on the following positive factors, which are considered to remain valid for the term of this LTMMMP;

- The distance between the spoil ground and shore which prevents impacts to areas of environmental significance from turbid plumes;
- The absence of seagrasses in areas similar to the spoil ground due to light attenuation constraint of Gulf waters;
- The absence of evidence of impacts from spoil that is resuspended and relocated following placement;
- The previous disturbance history of the site;
- Its location being outside any shipping navigation channels; and
- Lack of other uses of the spoil ground (existing or potential).

Although there are possible negative impacts identified in previous sections on some environmental and social aspects, the net impact of a well-designed, and managed dredging campaign with appropriate mitigation measures on a socio-economic front is considered positive.
10. Management Strategies and Actions

Ports North has a corporate commitment as set out in the Environment Policy to ensure operations are completed in a manner that minimises risk and impact to the surrounding environment. An Environment Management System is in place including mechanisms for continual improvement in management of dredging activities. Ports North has measures in place to minimise contaminant input sources and managing potential impacts from dredging and dredge spoil disposal as far as practicable. Key management strategies and actions to minimise the impact from dredging and disposal operations are introduced below.

10.1 Environmental Management Plans (EMPs)

A contract deliverable item for activities conducted by operators of dredging plant such as a TSHD or bed-levelling vessel is the development and implementation of a works specific Environmental Management Plan. Ports North’s dredging contract will require the contractor to adhere to the template framework set out in this section or have in place an EMP that meets or exceeds these requirements.

An EMP template is shown at Appendix 10 and Appendix 11 for a typical TSHD campaign and a bed-levelling campaign respectively. These documents are considered as sub-ordinate documents to the LTMMMP and outline the very specific operational control mechanisms to complement and achieve the high level strategic dredging and disposal management and actions set out in this LTMMMP.

The applicable EMP template will be used as the basis for development of the campaign specific EMP by the appointed dredging contractor. It is acknowledged that the contractor could already have an established EMP and procedures for operation of their respective vessels. In such a case, the relevant EMP as provided in Appendix 10 or Appendix 11 to this LTMMMP, as well as permit conditions, will be the basis for formal auditing.
At a minimum, the EMPs for campaigns will include management plans for the following aspects:

- Waste management;
- Noise;
- Turbidity control;
- Protected marine fauna;
- Cultural heritage;
- Ballast water management;
- Vessel washdown; and
- Bunkering of fuel.

Within each of these elements, the EMP clearly defines:

- Impacts;
- Objectives;
- Management actions and mitigation measures;
- Performance indicators;
- Monitoring;
- Reporting;
- Corrective action;
- Term; and
- Responsibility.

Prior to the commencement of each campaign, Ports North environmental staff will review the EMP provided as a contract deliverable to ensure that all Sea Dumping Permit conditions are addressed. Ports North staff will conduct audits as per the schedule cited in the EMP to ensure that the dredge operators are familiar with the EMP procedures and that the EMP is implemented and addresses the LTMMMP and Sea Dumping Permit condition requirements.

### 10.2 Vessel Specifications

It is forecast that a trailing suction hopper dredger (TSHD) such as the vessel “Brisbane” will continue to be contracted to undertake the work at Port of Karumba for all future maintenance dredging campaigns. However, in the event that the contract is finished, or another dredging contractor is appointed, the DSEWPaC and TACC shall be duly advised and any necessary actions triggered within the LTMMMP proposed management actions or monitoring programs will be enacted. Similarly, details of ancillary dredge vessels, plant or equipment, including drag baring or bed levelling vessels shall be advised to DSEWPaC in the event there is a change.

Mitigation of potential turbidity and suspended solids impacts from dredging and spoil disposal by the trailing suction hopper dredge operations is achieved through requirement for modern vessel specifications. These specifications are considered the minimum standard for trailing suction hopper dredges that will be selected to undertake dredging works in the channel and includes:

- Low wash hull-design;
- Below keel discharge;
- Central weir discharge system;
- Electronic positioning systems;
- Well maintained seals on the dumping doors or valves to minimise any leakage whilst in transit;
- Ability to distribute material uniformly over the spoil ground, which will be confirmed by GPS reference plots for each dumping event; and
- Turtle exclusion devices fitted to suction heads.

Technical specifications for associated dredging plant such as bed levelling barges include well maintained plant and ancillary equipment, a method of accurately achieving dredging location (e.g. GPS) and an effective mooring system.

10.3 Dredging Window

Routine maintenance dredging has, and will continue to be scheduled to occur after the conclusion of the wet season at approximately the end of April each year, when possible inflows of sediments have concluded. Routine maintenance dredging will be scheduled between 1 May and 30 September each year. This period is also consistent with the “dredging window” to protect marine resources from possible effects of dredging.

Ports North forecasts that the annual window for dredging between May and September is acceptable and a workable arrangement, given the practicalities of the wet season dictating that conditions can be unsuitable for dredging outside this period. The need for dredging between October and April inclusive) is not considered a necessity for the Port under existing operational requirements.

Routine maintenance dredging campaigns at Karumba have had a “dredging window” of 1 May to 30 September each year primarily to avoid the prawn migration period and the marine turtle nesting season.

As identified in Section 6.3.2, extreme weather events may result in flooding or storm surges depositing sediments in the channel to the extent that it requires emergency dredging to re-establish navigable depths. These events are typically associated with cyclones. As such, Ports North has no control over the extent or timing of deposition and little control over when emergency dredging may be required.

Although the exact timing of cyclonic events is uncertain, they are most likely to occur during or immediately following the summer or early autumn wet season when monsoonal activity is greatest. This timing however coincides with loggerhead turtle nesting season (October to February inclusive) and prawn migration in the area (October to January), when routine maintenance dredging is not permitted.

Technical expertise from CSIRO with respect to dredging outside the existing dredge window has been sought on two occasions (in 2008 and 2011) to gain an understanding of the season specific status of prawn migration for minor variations to the term of dredging. A short seven day extension to the dredging period beyond 30 September 2011 was approved by DSEWPaC on the basis of information supplied by CSIRO to enable completion of a campaign delayed by extreme weather events throughout other parts of Queensland delaying the availability of the TSHD dredge vessel “Brisbane”. However, those works were able to be completed by the contractor on time, within the original dredge window.

CSIRO has provided concise recommendations and identified periods critical to the migration of prawns between October and January, with a February to March outside the critical period. Given this response from the CSIRO, (refer Appendix 5), and the very low probability of need for dredging, or practicalities at that part of the wet season, the need to document a framework or process for reviewing the dredge window or identifying research or studies for such a review is not warranted at this stage.
In the scenario where the frequency of request for variation to dredge outside the “window” becomes apparent, and these are order of a month or greater timeframe, Ports North will commence a process with the TACC to develop a terms of reference and subsequent research profile to potentially refine the dredge window. This scenario is forecast to be of a very low likelihood.

Most probable, is the status quo, as confirmed in Section 6.3, where each campaign is scheduled within the existing dry season, May to September period.

Of moderate probability is the scenario where variation of the dredging period for a small period (by a number of days up to three weeks), for dredging in the period between October and April inclusive.

In the event that dredging is required outside of the existing dredge window, Ports North will submit a request to vary the Sea Dumping Permit to DSEWPaC. Supporting information for the variation request would include the following minimum information;

- Advice from the TACC specifically from stakeholders with expertise in prawn and turtle ecology;
- evidence to verify that sediment contamination status has not changed since last SAP;
- and any additional supporting information as stated in other sections of this LTMMP.

If the need for dredging outside the window period is identified and dredger availability and operational conditions are suitable for dredging operations, Ports North will initiate management actions to mitigate additional potential impacts on the matters for which the "window' was established (nesting marine turtles and migration of prawns from the Norman River), inclusive of the following;

1. Review the anticipated vessel use and depth requirements until opening of the approved dredging window period and avoid possible impacts;
2. Liaise with the Regional Harbormaster to identify an interim declared depth to be established to enable safe vessel navigation, again to avoid possible impacts;
3. If dredging is required, identify options to minimise the volume of dredging through consideration of hydrographic information to take advantage of deeper areas if consistent with navigational safety.
4. Where possible, attempt to minimise dredging and sea disposal activities by using a bed-leveller.
5. More expansive dredging is anticipated to require the services of a TSHD, and where available, any TSHD should meet the minimum specifications identified in Section 10.2. If such a vessel is not available then Ports North will liaise with DSEWPaC to assess environment risks and agree on additional management requirements for vessel aspects that do not meet specifications identified in Section 10.2.
6. If dredging is required to establish the interim declared depth, undertake discussions with key regulatory and advisory agencies including DSEWPaC, DEHP, DAFF and CSIRO to identify specific additional management and monitoring actions in addition to those for routine maintenance dredging.
7. Additional meetings of the TACC would be sought to inform the representatives of the need for dredging and seek their comment regarding management and monitoring actions being proposed and discussed with key regulatory and advisory agencies.
8. The TACC, as defined in the NAGD has the role "to facilitate prompt resolution of a particular issue", and hence have the role of making a recommendation to DSEWPaC for the ultimate authorisation of emergency dredging operations.
9. Consider additional management measures that reflect the species specific requirements at that stage of their respective critical life cycle stages, inclusive of timing of works in respect of moon phase, tide, weather or location within the channel and critical documented habitat locations advised by the TACC stakeholders.
10. Additional monitoring programs (e.g. wildlife spotters, or water quality monitoring) would be implemented to measure the effectiveness of such management actions, and an increased frequency and content of reporting provided on such to the TACC and DSEWPaC.

Ports North proposes to provide DSEWPaC with a range of proposed mitigation and management measures when the need for an approval for emergency dredging is identified and is outside the approved window. Such measures will be commensurate with:

- the volume of material required to be dredged;
- location of that material within the channel;
- forecast impact to economic operation of the port and shipping movements;
- and
- timing of the work in relation to start or finish of the window and applicable impacts to particular species of management importance;

Such management measures would address the predicted impacts of the work based on the aspects and impacts identified in Section 9, and subsequent management measures noted in this Section 10, and would form the basis on which negotiation of conditions of an emergency campaign would be commenced.

10.4 Marine Pests

There have been no verified detections of marine pests, or potential pest species at the Port of Karumba. Despite this, all necessary bio-security measures will continue to be adopted for not only dredging and disposal operations, but also for general port operations. These will be undertaken in conjunction with the State and National departments with responsibility for marine pest management via the National System for the Prevention and Management of Marine Pest Incursions the Australian Marine Pest Monitoring Manual and accompanying Australian Marine Pest Monitoring Guidelines.

Any TSHD dredger contracted to undertake dredging works will be required to comply with best quarantine practices, including AQIS and Bio-Security Queensland requirements in relation to ballast water and marine pest management prior to and during dredging campaigns. Strategies for minimising the risk of translocation of marine pests from other locations to Karumba shall be addressed via the dredging campaign specific EMP to be developed and implemented by the contractor. This EMP will follow the guidance outlined in the National Biofouling Management Guidance for Non-trading Vessels (Commonwealth of Australia, 2009).

Management approach would follow the biofouling risk assessment framework outlined within the National Biofouling Guidance for Non-trading Vessels (Commonwealth of Australia, 2008). This document also outlines steps for minimising the risk of marine pest risks aboard dredge vessels, and other non- trading vessels, Introduced marine pest management measures include, post-service inspection and cleansing at prior area of operation, en-route ballast exchange, pre-arrival inspections and cleaning of internal systems and anchor lockers as well as ensuring the marine growth prevention system is well maintained.

Ports North will include a specific clause within each dredge contract to include requirement for vessel to be inspected prior to arrival, subject to Bio-Security QLD protocols, inspected again on arrival if required and the operator to demonstrate proof of freedom. It should also be noted that interaction with DSEWPaC via the TACC for management and advice on any specific marine pest incursion issue is to be required.

Management of any detection of possible marine pest species within the port, maintenance dredge area or spoil ground will follow the implementation protocols developed under the National System for the Prevention and Management of Marine Pest Incursions. Within the term of this LTMMP it is envisaged that monitoring and evaluation of the Port of Karumba will occur under role out of state and national bio-security initiatives in respect to marine pests. For the Port of Karumba, these
initiatives are to be facilitated by Ports North to ensure risks from marine pests to the marine environment are minimised and any potential for translocation of marine pests through dredging and disposal is also avoided.

Should additional risks be identified, management actions and monitoring arrangements will be implemented as advised by the various jurisdictions, either via the TACC or through direct engagement.

10.5 Use of the Existing Spoil Ground

The continued use of the current spoil ground mitigates impacts from smothering through preventing the need to dispose of spoil in an area that has not been disturbed previously or is closer to areas of environmental significance. Past monitoring has identified that the spoil ground is functioning well and that any impacts adjacent to the spoil ground are minor and limited to benthic infauna in open muddy substrates of relatively minor environmental significance.

It is recognised that another spoil ground will ultimately need to be used when the current spoil ground has reached capacity but initial assessments by Ports North indicate the present site has sufficient capacity this is unlikely to be required for at least 10 years and is beyond the ten-year term of this Plan. Re-assessment of spoil ground capacity is proposed for the last quarter of the term of this LTMMP as set out in Section 10.14

10.6 Uniform Spoil Deposition

Impacts to the spoil ground and adjacent areas will be minimised through spreading of the dredge spoil in such a manner as to uniformly spread it over the spoil ground and minimise sediment mobilisation and turbidity plume extent beyond the spoil ground boundary. This is achieved through deposition patterns that vary with the prevailing current direction and understanding of the spoil ground bathymetry.

10.7 Scheduled Monitoring

Ports North proposes to undertake monitoring of the marine environment for:

- those elements that have the potential for significant impact to the marine environment if the condition of sediments is not well known prior to dredging. Such elements would include sediment quality and introduced marine pest assessments; or
- particular habitats that can be impacted through the dredging or disposal activities such as seagrass beds in the vicinity of the outer channel or benthic assemblages within and adjacent to the spoil ground.

Proposed monitoring schedule activities are outlined below and will be altered as a result of the continual improvement mechanisms and following resolution of a direction based on technical advice from the TACC.

10.7.1 Benthic Infauna Surveys

Monitoring of benthic assemblages is proposed approximately every five-years (i.e. 2014 and 2019). The site is a known zone of impact, for which prior assessment has been made and a permitted impact conducted for prior campaigns. Therefore the aim of survey at the ocean disposal site is not to be primarily targeted at determining the rate or scale of recovery during continued and on-going use and impacts of spoil, but rather to determine the more relevant question of ‘is that impact remaining within the permitted zone’. Benthic infauna assessment at the spoil ground will be undertaken utilising a radial axis sampling method to determine gradient of impacts at and adjacent
to the spoil ground through use of associated uni and multivariate statistical analyses design to identify differences between spoil ground and adjacent areas for particle size and benthic infauna assemblages.

The rationale of the sampling design seeks to answer two questions:

- What is the impact at the spoil ground, in comparison to non-spoil ground areas?
- How does the impact diminish with distance from the spoil ground?

This is achieved by taking replicate samples for infauna and one sample for particle size at five sites within the spoil ground and five sites on axes extending from the boundary of the spoil ground in line with prevailing currents. Infauna samples are sorted, identified and counted, presented using a range of descriptive statistics and subjected to a range of univariate and multivariate statistical analyses.

Further detail of survey method can be found in Appendix 9. This survey design has been approved for implementation previously at the Port of Bundaberg (2006 and 2008) and Port of Cairns (2009).

The benthic infauna monitoring report will be available within three months after completion of each survey. The document will be forwarded to DSEWPaC and the TACC representatives. Monitoring results will be discussed at the subsequent TACC meeting.

In the event that impacts from spoil disposal outside the permitted spoil disposal site are identified and concern is raised by either DSEWPaC or via the TACC in regard to recovery of the surrounding areas, consultation with the TACC will be initiated to identify appropriate management responses and any required corrective actions to meet commitments at Section 10.10.

10.7.2 Introduced Marine Pests

It was identified in Section 9.7, that probability of translocation of marine pests due to dredging was low, and the potential for natural colonisation by dispersal across the short distance to the spoil ground by natural mechanism was possible, therefore the need to monitor material to be dredged is considered minimal.

On that basis, it is proposed to undertake monitoring for potential marine pest species in accordance with National and State protocols if and when detection is made, prior to the next campaign after detection is made, or in conjunction with proposed infauna surveys as per frequency outlined at Table 10-1.

10.7.3 Seagrass Survey

It has been identified in Sections 7.5 and 9.2.1 that, routine maintenance dredging and day-to-day port operations are not driving the observed variations in seagrass characteristics. Impacts to water quality from the dredging and disposal activities are not likely to be of a temporal or spatial scale large enough relative to background variability to have any measurable or ecologically meaningful impact to seagrass. Dredging activities with the potential for plume generation are managed to minimise potential for impacts: dredging operations in overflow mode occur for very short periods per dredge cycle; and deposition at the spoil ground occurs below keel level and at a location relatively distant from inshore seagrass habitat.

The high natural variability in seagrass cover and extent is primarily in response to climatic factors, such as water temperature, daily exposure, water depth, rainfall and catchment runoff, which are beyond the control of port operators and confound identification of a causal link between port operations and seagrass changes.
Overall, seagrass beds are not a good indicator for detecting short term direct or indirect environmental impacts from dredging or disposal, but offer a long term indicator of general catchment health. The existing monitoring program established by QPI&F in 1994 was designed to measure overall trends in catchment condition, rather than specifically attempt to measure influences of dredging, disposal or other port activities.

On the basis of the low impact to seagrass habitats from dredging and disposal or port operations identified above, and through the previous and proposed water quality monitoring programs summarised at Sections 8.3 and 9 respectively, monitoring of potential impacts from dredging on seagrass beds, through use of seagrass monitoring as an acute impact indicator, is not proposed.

However, Ports North will continue to implement the necessary programs, or support a collaborative monitoring program with Fisheries Queensland (DEEDI), or engage the services of another service provider in the event that Fisheries Queensland are unable to provide that service, where seagrass is used as an indicator of general environmental health of the catchment, and as a long term monitoring tool as a component of this LTMMMP.

In the event that deleterious impacts of dredging activity on seagrass resources are identified, verified and reported to Ports North, either through the TACC forum or otherwise, additional mitigation actions and management strategies shall be implemented if required within the duration of this LTMMMP. Management actions include alteration to scheduling, duration, location, intensity of dredging and disposal activity, with these being undertaken in concert with matched monitoring programs.

10.7.4 Water Quality Monitoring

DREDGE EVENT MONITORING

As outlined in Section 8.3, previous work has been completed on determining a representative “background trigger” and reactive monitoring program for monitoring plume turbidity at Karumba.

When triggered, by an event listed at Section 10.7.7 turbidity monitoring will be implemented for each dredging event; consistent with the sampling design employed for the 2006, 2008 and 2010 monitoring programs (refer to Appendix 12). Consistent with this approach, water quality sampling will use a reactive management turbidity trigger of background plus 25% or 62 NTU whichever is greater, for a duration of no more than 72 hours, for period of flood tides when dredge is working adjacent to Alligator Bank or another sensitive site if required.

Trigger value of 62NTU will be maintained until further reliable levels of seagrass tolerance are identified in the scientific literature or by DAFF. Any proposed changes will be discussed with the TACC with any changes in monitoring design requiring approval by DSEWPaC and included in the subsequent updated of this LTMMMP.

Dredge event water quality monitoring is not proposed for routine campaigns where impacts can be managed with normal range of mitigation options. However as set out in Section 10.7.7 and Table 10-2, dredge event water quality monitoring is proposed when the following criteria are met;

- If dredging is required outside the normal “dredge window” and is approved;
- Scale of works changes significantly to >690,000 in-situ m³ (i.e. greater than 50% increase over average maintenance dredging volume); or;
- Increased intensity of campaign is proposed (i.e. more than one dredge in operation, or full time overflow dredging); or
- Strong northerly weather pattern predicted for duration of works; or;
- Results of seagrass monitoring identify dredge generated turbidity or sedimentation as a quantified cause of seagrass declines; or
- Tide and wind conditions and duration of campaign is predicted to retain turbid plume over seagrass meadows for >20 days.
Implementation of Water Quality Monitoring Program (Appendix 12) is set out in the Monitoring Flowchart based on the decision points that are triggered. This may include higher frequency of sampling if the campaign is scheduled for higher risk scenarios or, at a reduced frequency in lower risk periods.

The data from any such campaign or event will then be assessed for compliance against the program targets (Appendix 12 Table B). Where exceedences occur, management measures to reduce turbidity will be implemented as documented in the EMP (refer Appendix 10 and Appendix 11).

Management measures are listed Sections 10.1 to 10.6 and within the respective campaign specific EMP’s. In cases where water quality monitoring identifies that monitoring trigger has been exceeded, corrective actions including those listed in the following ascending hierarchy of a tiered approach may be applied;

Tier 1 vessel turbidity management
   (a) Determine source of highest concentration of turbid water discharge and identify any alternate management measures (i.e. general vessel manoeuvring, or disturbance from suction heads on seafloor, verses discharge from the hopper);
   (b) Increase the frequency of non-overflow dredging;
   (c) Alter controls on the hopper discharge weir system to minimise plume generation,

Tier 2 dredging intensity
   (d) Reduce hours of operation to avoid periods of forecast tide or sea state where water quality trigger may be exceeded;
   (e) Alternate dredging with another section of channel and continue works; or;

Tier 3 campaign program
   (f) Minimise or halt hopper discharge till dredge is in transit and away from sensitive areas where trigger has been exceeded;
   (g) Cease dredge operations in area where exceedance of trigger occurs,
   (h) Re-evaluate monitoring trigger and monitoring program methodology.

These corrective actions will be progressively implemented by appointed dredging vessel operator under direction of the Dredging Supervisor and Ports North immediately the exceedence is identified as per Monitoring Flowchart in Appendix 12, and will be commensurate with the scope of the exceedence of the water quality trigger, extent of the remaining campaign, and forecast conditions.

In the event of repeated non-compliance against trigger levels following implementation of management actions, and corrective actions, consideration will be made for inclusion of emerging water quality monitoring methods, such as more intensive monitoring activities to better characterise the ambient turbidity environment and verify the suitability of the trigger value. This could include deployment of data loggers to continuously collect information on light levels and water quality parameters reaching sensitive habitats such as seagrass throughout the year. This option will be considered for implementation following a trial of such technology, verification of those results through technical review by an experienced aquatic ecologist and subsequent approval for implementation by the TACC. Such a change to the water quality monitoring program will provide critical information leading up to dredging events and enable quantification of resilience of key habitats, determine reasons for changes in such habitats, differentiate between dredge induced impacts and natural events and subsequently may provide an additional information source for consideration by the TACC.

TURBIDITY PLUME VERIFICATION

Assessment of impacts to water turbidity from dredging has drawn largely from 1996 monitoring regarding the capital dredging project by the dredge Platypus to construct the entrance channel. Because of the larger extent of dredging undertaken and lack of modern turbidity control devices
(e.g. below keel discharge), it is possible that the turbidity plumes originally identified are an overestimate of the potential turbidity plume from maintenance dredging undertaken using a modern TSHD such as the Brisbane.

Monitoring in years subsequent to the capital dredging has determined the extent of turbid plumes on several occasions via various methods. The factors affecting plume generation and dispersal are well known, however it is considered prudent to verify this periodically. Consequently, it is proposed to undertake monitoring for turbidity associated with dredging by a TSHD in the entrance channel and spoil ground during a future dredge campaign to provide a more up to date understanding of dredging and disposal dredge plumes and confirm where background turbidity is reached from the point of disturbance.

Toward achieving this, it is proposed that a monitoring program design for events in 2013 and 2020 will be developed for technical review by the TACC prior to implementation. It is envisaged that this design will take the place of any campaign specific turbidity monitoring and include the following general arrangements;

- Turbidity monitoring will be undertaken using a hand-held nephelometer while tracking a current drogue deployed adjacent to the TSHD vessel during overflow dredging within the channel or disposal at the spoil ground. The nephelometer will be deployed to take readings approximately every 100m along the drogue trajectory until the turbidity stabilises near background level. The position of the drogue and location of turbidity monitoring will be tracked using GPS. Readings will be taken at 1m above the substrate as this lower water column layer of water is that which light dependent benthic organisms such as seagrasses are exposed to.

- Monitoring will be undertaken at various tidal states during the dredging program, and will target dredging in the vicinity of significant seagrass beds adjacent to the channel.

- Similar monitoring will be undertaken at the spoil ground to identify extent of turbidity plumes. Measure will be taken at surface (-1m), mid and bottom depths.

- Use of fixed data loggers or other monitoring technology could be utilised to assist as part of this program.

A scientific report will be prepared and will include results in graphical format and contrast the outcomes against prior monitoring results and other available turbidity data for Karumba. The report will be forwarded to the TACC.

10.7.5 Sediment Sampling and Analysis

Ports North has an approved Sampling and Analysis Plan (SAP) designed to investigate the physical and chemical nature of sediments throughout the entrance channel dredge area. It is proposed to undertake two surveys during the life of the Long Term Management and Monitoring Plan, during 2014 and 2019. Under the NAGD, Section 4.2.1, testing of sediments to be dredged is not required within 5 years providing the contamination status has not changed significantly.

The sampling and analysis plan design is consistent with that undertaken in 2009, with sampling at 11 sites in total from entrance channel areas and assessed for trace metals and organotin, which were the only ‘contaminants list’ analytes.

It is noted that the 2009 SAP (refer Appendix 4), and the LTMMP SAP outlined at Appendix 7 was developed on the basis of an estimated 650,000 in-situ m$^3$, and is therefore inclusive of sufficient sample site numbers to meet the predicted maximum volumes identified above and meet the NAGD (Commonwealth of Australia, 2009) sample numbers. Power analysis performed on the 2009 results identified that the number of samples analysed was of sufficient statistical power to make a valid comparison against the NAGD screening levels at the 95%UCL of the mean.
A copy of the SAP for 2014 and 2019 is provided in Appendix 7.

If altered operations create a potential contaminant source within the port during the permit period, then an additional sediment survey will be undertaken, if required, to identify whether contamination of sediments is occurring. The timing for any additional survey and the scope of analyses will be reviewed by Ports North in consultation with the TACC.

Should any significant operational or environmental incidents or changes occur after implementation of the 2014 SAP, or the results of that SAP indicate changes to contaminant levels within proposed dredge sediment, the list of target contaminants of concern in the subsequent SAP is to be developed and submitted based on assessment of those findings.

The results of the sediment surveys will be provided to DSEWPaC and the TACC representatives for comment and discussion at the subsequent TACC meeting.

10.7.6 Summary of Monitoring Schedule

A tabulated summary of the monitoring program is provided in Table 10-1. Each of the proposed ecological health monitoring programs and the knowledge gained from these is to be used to inform management of dredging and disposal and to ensure that the level of resilience of marine flora and fauna with potential to be affected by action of dredging and disposal is established prior to dredging campaigns through open technical dialogue between Ports North, Port of Karumba TACC and DSEWPaC. Monitoring programs established by PCQ and Ports North have to date established an understanding of the seasonal fluctuations in key marine habitats, including seagrass and levels of resilience that may contribute to an increased probability of vulnerability to effects of dredging or spoil placement.

The scope of such ecological health monitoring and the mode of delivery could change over the term of the LTMMMP as future advice is provided by the TACC, regulatory requirements change, knowledge on the impacts of dredging and disposal develops, and as result of preceding monitoring inform the continual improvement process. Therefore this schedule is a proposed outline of the key items to be implemented over the term of the LTMMMP and be subject to periodic review, alteration with subsequent consultation with the TACC and approval by DSEWPaC.
Table 10-1 Summary of LTMMP Monitoring Schedule

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</tr>
</thead>
<tbody>
<tr>
<td>Disposal of dredge spoil will not result in chemical contaminant impacts to the marine environment.</td>
<td>Disposal</td>
<td>Sediment quality assessment</td>
<td>Compare contaminant levels at 95%UCL of the mean to NAGD screening levels or local derived screening level.</td>
<td>*</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dredging activities will not lead to decline in Seagrass meadows adjacent to channel attributable to impacts of dredging.</td>
<td>Dredging</td>
<td>Seagrass Monitoring Program</td>
<td>Appraise outcomes of the reports by Fisheries Queensland for the annual pre wet season surveys under the Agencies Long Term Seagrass Monitoring Program</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No significant accumulation of primary contaminant substances at the spoil ground.</td>
<td>Disposal</td>
<td>Sediment quality assessment</td>
<td>Compare contaminant levels against NAGD screening levels and historic levels</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Translocation of marine pests via dredging to the spoil ground will not occur.</td>
<td>Dredging</td>
<td>Marine Pest Surveys</td>
<td>Pre-dredge survey for marine pests in sediments to be dredged and at spoil ground</td>
<td>*</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Marine pest monitoring program</td>
<td>Ongoing larval plate and mop monitoring program for inner port area</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Continue program or amend if new program is commenced by State or Commonwealth Agencies.</td>
<td></td>
</tr>
<tr>
<td>Marine pest monitoring program</td>
<td>Cooperate with agencies implementing the National System for the Prevention and Management of Marine Pest Incursions</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>As required, contribute to design and review of any risk based programs by State or Commonwealth Agencies.</td>
<td></td>
</tr>
<tr>
<td>There will be no deleterious impact on marine benthic infauna communities adjacent to the spoil ground resulting from sediment mobilisation.</td>
<td>Disposal</td>
<td>Benthic infauna; Particle size distribution</td>
<td>Compare sites within and adjacent to spoil ground and identify gradient of impacts radiating from spoil round</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Turbidity plume during dredging of channel does not extend to Alligator Bank or other areas of environmental significance at levels above “Trigger” value.</td>
<td>Dredging and Bed Levelling</td>
<td>Water Quality Monitoring Plan</td>
<td>Implement the Plan (Appendix 12) and any reactive management triggers that arise when trigger event at Section 10.7.7 occurs</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Turbidity plume during dredging of channel does not extend further than previous studies (i.e. to Alligator Bank or other areas of environmental significance).</td>
<td>Dredging</td>
<td>Water Quality- Turbidity monitoring</td>
<td>Verify extent of plume until background levels are reached (i.e. turbidity stabilises and is consistent with that outside the plume) and or aerial surveillance to check consistency with past monitoring programs.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Disposal Site will have sufficient capacity for future dredging requirements.</td>
<td>Disposal</td>
<td>Analysis of capacity</td>
<td>Implement modelling process to verify spoil ground has capacity for future disposal, that it is not of depth where extreme wave depth may induce mobilisation, or depth may inhibit shipping movement.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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</tr>
</tbody>
</table>
10.7.7 Triggers for Changes to Monitoring Schedule

It is possible that variations to the Monitoring Schedule set out in Table 10-1 may occur throughout the life of the LTMMP, and therefore the following summary Table 10-2 outlines some of these potential changes and actions to be taken should they arise. These specific management actions will be implemented via the works specific EMP for the respective campaigns to meet acceptance by the TACC and DSEWPaC.

Table 10-2 Monitoring Triggers

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific advice on ecological receptors is provided to the TACC, and a corrective action to the existing monitoring arrangements is agreed by the TACC and Ports North.</td>
<td>Implement requested changes to monitoring arrangements.</td>
<td>Continue monitoring schedule as per Table 10-1</td>
</tr>
<tr>
<td>Scale of works changes significantly to &gt;690,000 in-situ m$^3$ (i.e. greater than 50% increase over average maintenance dredging volume).</td>
<td>Water Quality Monitoring Plan..</td>
<td>Dredge as usual</td>
</tr>
<tr>
<td>Increased intensity of campaign is proposed (i.e. more than one dredge in operation, or full time overflow dredging).</td>
<td>Include Water Quality Monitoring Plan if plume is predicted to be retained continuously over seagrass meadows for greater than 20 days refer Section 9.2.1.</td>
<td>Dredge as usual</td>
</tr>
<tr>
<td>Strong northerly weather pattern predicted for duration of works.</td>
<td>Consider constraints on timing of work to lower tides to minimise plume dispersion to Alligator Bank – implement water quality monitoring plan.</td>
<td>Dredge as usual</td>
</tr>
<tr>
<td>Timing of works is required outside normal window.</td>
<td>Seek advice from TACC and CSIRO on up to date status of prawn stocks/season and turtle nesting.</td>
<td>Dredge as usual</td>
</tr>
<tr>
<td>Method of dredging is significantly different to dredging campaigns using the TSHD “Brisbane” (i.e. such as full time overflow operation, use of a cutter suction or grab dredge etc.)</td>
<td>Assess vessel specifications and determine likelihood of changes to potential impacts.</td>
<td>Dredge as usual</td>
</tr>
<tr>
<td>Incident event causes potential contamination to proposed dredge area after completion of scheduled 2014 and 2019 SAP.</td>
<td>Modify list of contaminants of concern, conduct an interim SAP process for potentially affected area prior to the next campaign, then update the subsequent scheduled 5 year SAP.</td>
<td>Implement SAP as per Appendix 7 and Schedule in Table 10-1</td>
</tr>
<tr>
<td>Scheduled surveys of seagrass meadows adjacent to the dredging area identify dredge generated turbidity or</td>
<td>Implement management actions (change to duration of campaigns, duration in sectors, time relative to tide or wind state, and / or</td>
<td>Dredge as usual</td>
</tr>
<tr>
<td>Trigger</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>sedimentation as a quantified cause of seagrass declines.</td>
<td>Resolve a turbidity or sedimentation trigger value at which seagrass species specific responses is likely to occur and implement a trigger based water quality monitoring program during subsequent campaign.</td>
<td></td>
</tr>
<tr>
<td>Verified detection of Marine Pest (National Action List species) within proposed dredge spoil with potential to colonise disposal site. (i.e. Biosecurity Queensland or AQIS detect and positively identify a listed pest species in an area with high potential to effect the dredge area)</td>
<td>Implement risk based assessment to design and implement pre-dredge monitoring of proposed spoil under guidance from State Bio-Security and National arrangements. Monitor spoil to determine if it is affected then consider post disposal verification survey of offshore disposal site if risk evaluation determines it is needed.</td>
<td>Dredge as usual, no additional monitoring</td>
</tr>
</tbody>
</table>

**10.8 Oil Spill Response**

Ports North is responsible for first strike response to all oil spills within Karumba Port Limits and would respond in accordance with the protocols established in its First Strike Oil Response Plan. This plan is required under the Queensland Coastal Contingency Action Plan, which is administered by Maritime Safety Queensland. The First Strike Oil Response Plan responds to oil spills from ships and other sources within the Port of Karumba.

The first response team of the Port of Karumba are all trained to “Level 1 – Oil Spill Responder” and are under the management of the Regional Harbourmaster. Port of Karumba retains the necessary equipment to enable a first-strike response. The equipment is audited quarterly and maintained by staff at the Port of Karumba.

In addition to this first strike oil response capability at the Port of Karumba, any contracted dredge vessel would be required to have, and implement as necessary, a Shipboard Oil Pollution Emergency Plan, which outlines the role, responsibilities and actions to be followed should an uncontrolled release of oils/fuels occur.

**10.9 Reporting of Incidents and Contingency Arrangements**

The reporting of incidents and contingency arrangements is an element included within Ports North’s Environmental Management System, and is also a requirement of both the State ERA 16 and the Commonwealth Sea Dumping Permit.

All Ports North staff and any contractors involved, have the responsibility to report any significant incidents and emergencies:

- Reporting of incident events during dredging and disposal will be required within the timeframes set out in the Sea Dumping Permit;
- DEHP also have specific reporting and incident notification procedures as per Section 320 of the Environmental Protection Act 1994, in the case of Material or Serious Environmental Harm, which are applicable in the case of a major incident under the ERA 16 approval. Such incidents require written reporting within 24 hours;

---

1 The Queensland Coastal Contingency Action Plan is a sub-plan of the National Plan to Combat Pollution of the Sea By Oil and other Noxious Substances.
• In the first instance, reporting should be to the operational works supervisor, but generally, the Chief Executive Officer will have the responsibility to initiate corrective action for environmental incidents;

• All incidents should be reported to the Project Superintendent, as specified by Ports North;

• In the case of an environmental emergency, after first notifying the Chief Executive Officer, the operational works supervisor is to contact Ports North's Environment Manager, who would help co-ordinate and manage a response;

• Depending on the nature and magnitude of the incident, the Chief Executive Officer may be required to notify DSEWPaC and the Queensland Department of Environment and Heritage Protection (DEHP) as appropriate. It is the Environment Managers' responsibility to ensure that DSEWPaC and DEHP contact numbers and relevant officers' names are at hand prior to the commencement of the project; Refer to the campaign specific contact details as set out on the applicable copy of Table 2-1.

• Significant environmental incidents will be logged in writing, with all relevant details recorded, after corrective action has been completed. The log book will be made available for inspection by DSEWPaC, DEHP, Operational Works Supervisor and Chief Executive Officer at all times.

Ports North will report the following information to DSEWPaC and DEHP, if at any time during the course of dredging or disposal activities any unanticipated environmental risk is identified:

• Nature of incident and type of risk associated with the incident, including (where possible) volume, nature and chemical composition of substances released;

• Measures taken to mitigate the risk;

• The success of the measures undertaken; and

• Proposed future monitoring.

Specific arrangements for Incidents and Contingencies are outlined in the EMP developed for each campaign. These also reflect the "Karumba Emergency Response Plan" which is a controlled document under the supervision of Ports North Security and Emergency Manager. This document contains contingency arrangements for:

• Scope of area to which the plan applies – port limits;

• Cyclone contingency procedure;

• Risk assessment of possible emergencies; and

• Contacts list for implementation of the Plan.

For non-dredging related incidents that may occur during the term of the LTMMP, Ports North will report to DSEWPaC details of any incidents that may impact on the environment and in particular incidents that may contaminate sediments within the dredge area to which this LTMMP applies. Operators and tenants on Strategic Port Land have obligations under lease/use agreements to report incident to respective regulatory agencies, and a responsibility under s320 of the QLD Environmental Protection Act 1994. Ports North will on-forward such details to DSEWPaC within a timeframe commensurate with the scale of the recorded event, and consistent with any statutory reporting timeframe set out in the QLD Environment Protection Act 1994 and other applicable legislation. Serious and material incident events that may directly affect contamination of sediments within the dredge area will be reported to DSEWPaC within 24 hours, or 3 working days for all nuisance incidents.
10.10 Continuous Improvement

An effective and compliant LTMMMP can only be maintained through a process consistent with standard Environmental Management Systems, namely the cycle of continual improvement. Ports North is committed to ensuring that management of operations, including dredging activities at each of its Ports meets the general environmental duty and environmental policy.

Monitoring to date suggests that impacts from dredging and disposal operations at the Port of Karumba are being well managed and impacts to the marine environment are not significant. Opportunities for improvement appear to be limited given the environmental management and monitoring practices currently in place, and the limited activity within the port.

Dredging will be undertaken under a project specific EMP to ensure that all permit requirements are captured and adhered to. Placement of dredge material is through sub-surface release, which minimises dredge plume generation.

A range of monitoring is undertaken to ensure that any impacts to the dredging and disposal locations and their adjacent areas are minimised.

To facilitate discussion of opportunities for continuous improvement, an agenda item will be included to TACC meetings, whereby any stakeholder can raise an improvement for consideration.

Changes to the implementation of the LTMMMP, EMPs and subsequent monitoring programs will be implemented where impact hypothesis have been tested and determined to be acceptable and to ensure economic and resource efficiency is maintained. Any proposed changes will be incorporated into the LTMMMP which will be resubmitted to the DSEWPaC for approval.

Implementation of the LTMMMP is a component of the overall Environmental Management System for activities conducted by Ports North across the regional ports. Specifically, the EMS is implemented to manage the day to day permit and licence compliance, as well as the campaign specific EMP. The EMS implemented by Ports North is consistent with the Australian Standard AS/NZ:140001 which is based on the objective of continual improvement in management and environmental outcomes.

This LTMMMP outlines a management and monitoring structure that, over the life of the Plan and Sea Dumping Permit will enable a documented mechanism to ensure that the actions of dredging, disposal and monitoring continues to improve the management of contaminants, pollution and mitigates residual environmental impacts over the life of the LTMMMP.

It is acknowledged that this is a living document that is to be updated to meet changes to legislative requirements, informed by emerging scientific and ecological knowledge, and improvements to best practice management of dredging and disposal. Updates identified to continually improve the document will be managed via document version control, an issues log recorded against the minutes of the TACC meeting, and most recent version of document maintained on Ports North’s website.

Once approved by DSEWPaC, the LTMMMP and Permit will be uploaded to Ports North’s external website (www.portsnorth.com.au) within the recommended LTMMMP guideline timeframe, i.e. 2 weeks. Subsequent revisions will be uploaded and notification advice provided to TACC on availability of documents to facilitate access.
10.11 Record Keeping, Reporting and Auditing Requirements

Consistent with previous Sea Dumping Permit Conditions, Ports North proposes to:

a) Keep records comprising either weekly plotting sheets or a certified extract of the ship’s log which detail:
   - The times and dates of when each dumping run is commenced and finished;
   - The position of the vessel at the beginning and end of each dredging run;
   - The position (by GPS) of the vessel at the beginning and end of each dumping run with the inclusion of the path of each disposal run; and
   - The volume of dredge spoil (in cubic metres) dumped.

   These records will to be retained for audit purposes for the duration of the permit.

b) Undertake bathymetric surveys of the Disposal Site as follows:
   - One prior to the commencement of any dumping activities; and
   - One at completion of all dumping activities authorized under the permit.

c) Ports North will provide a digital copy of the final bathymetric survey to the RAN Hydrographer.

d) Ports North will provide a report on the bathymetry to DSEWPaC within the specified period of the final bathymetric survey being undertaken. The report must include a chart showing the change in sea floor bathymetry as a result of dumping and include written commentary on the volumes of dumped material that appear to have been retained within the spoil ground.

e) To facilitate annual reporting to the International Maritime Organisation, Ports North will report to DSEWPaC by 31 January each year the following:
   - Permit start date;
   - Permit expiry date;
   - Approved dumping site;
   - Nature of material;
   - Permit quantity;
   - Quantity dumped per calendar year; and
   - Dumping method used.

The responsible parties for each of these reporting requirements will be the Environment Manager. The relevant form which is to be completed detailing the above information is provided in Appendix 8.

Ports North has a requirement set out in the dredging contract for Karumba dredging that requires the Superintendent to compile a “Close Out Report” at conclusion of each annual campaign which includes commentary on volume, incidents and effectiveness of the campaign and any operational issues identified. This item is a useful reference point for each campaign and is useful audit evidence, and assists in compiling the annual IMO Return Form, required under the Sea Dumping Permit.

Compliance monitoring is one component of the Environmental Management System (EMS) as part of Ports North business management strategy. Include within the EMS are procedures for monitoring implementation of permits, licences, and management plans, auditing and subsequent reporting, as well as a corrective actions process. The Sea Dumping Permit and LTMMP for Karumba are to be subject to this system of periodic internal audits as identified in Table 2.1 and are to be facilitated by the Environment Manager. Consideration is to be made to periodic external third party auditing of the implementation of Permit, LTMMP and EMP requirements at a future campaign to measure the performance of Ports North management system for dredging and disposal.
### 10.12 Annual Dredge Management Cycle

An indicative calendar of events regarding management of dredging and disposal operations at Port of Karumba by Ports North is provided in Table 10-3. This table identifies deliverables and processes of management in relation to dredging and disposal and ecological events.

#### Table 10-3 Indicative calendar of events - deliverables and process of management

<table>
<thead>
<tr>
<th>Month</th>
<th>Ecological Events</th>
<th>Ports North</th>
<th>TACC</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>Wet Season Barraunidi spawning season ends</td>
<td></td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>Prawn migration season ends</td>
<td></td>
<td></td>
</tr>
<tr>
<td>March</td>
<td>End of wet season</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>End of wet season</td>
<td>Pre campaign check by Ports North with TACC to confirm if any amendments to forthcoming dredge campaign are required</td>
<td>Advice to Ports North regarding habitat, matters to consider for forthcoming campaign</td>
</tr>
<tr>
<td>May</td>
<td>Dry Season Peak of turtle spawning</td>
<td>Pre dredge hydrographic surveys</td>
<td>TACC meeting</td>
</tr>
<tr>
<td>June</td>
<td>Dry Season Grunter season peak</td>
<td>Dredging and disposal</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>Dry Season Barramundi spawning season starts</td>
<td>Dredging and disposal</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>Dry Season Oct-Jan prawn near shore spawning</td>
<td>Dredging and disposal Post dredge hydrographic survey</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>Wet Season Dec-April emigration of prawn larvae from nursery habitats to offshore grounds</td>
<td>Close out report provided to TACC</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>Wet Season Seagrass survey</td>
<td></td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>Wet Season Annual internal compliance audit Compile annual Sea Dump Permit Return Form to DSEWPaC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the event that advice provided by the TACC to Ports North include feedback on the most recent outcomes of seagrass surveys or other ecological monitoring prior to the planned campaign, indicate a lowered resilience to potential impacts of dredging, then higher levels of dredge mitigation strategies or monitoring will be implemented, such as:

- Detailed assessment of turbidity during dredging;
- Additional ecological assessments such as seagrass surveys prior to dredging to provide up to date assurance they are in robust or otherwise condition; and
- Potential changes to dredge operation to ensure impacts such as turbidity are reduced in their effect on sensitive receptors such as seagrass, through control on tidal (ebb vs flood), wind (onshore vs offshore), method (overflow vs non overflow).

Requirement for these additional measures are to be managed through the technical advice role of the TACC process.

Once approved by DSEWPaC, any changes to the LTMMP and Permit will be uploaded within the recommended LTMMP guideline timeframe, i.e. 2 weeks. Subsequent revisions will be uploaded in a timely manner and advice provided to TACC of such document availability to facilitate access to the document.

10.13 Compliance Monitoring

Ports North will periodically conduct an audit of management systems to ensure compliance with Permit conditions, and implementation of the LTMMP at least once per annum during December. These audits will be consistent with the Ports North Environmental Management System and any corrective actions dealt with under that system.

Any significant incidents would be reported and responded to as identified in Section 10.9. Significant incidents would include impacts to protected marine fauna and incidents potentially resulting in environmental harm. Corrective measures that Ports North is able to follow includes for example, alteration to contract conditions, implementation of additional monitoring and reporting requirements, issue of specific work instructions or directions etc. at a level sufficient to achieve the desired management response and subsequent environmental outcome.
10.14 LTMMP Deliverables and Performance Indicators

Table 10-4 identifies those items from preceding sections where commitments, initiatives and actions have been specified and these indicators will form the basis of audit criteria to indicate the success or otherwise of the management measures which is essential in verifying the effectiveness of this LTMMP.

Table 10-4 Performance Indicators - Commitments, Initiatives and Actions

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Frequency</th>
<th>Format/Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) TACC of relevant stakeholders is established and meets regularly</td>
<td>Annual for the Permit and LTMMP term</td>
<td>Established committee and formal meeting minutes</td>
</tr>
<tr>
<td>(b) TACC meeting</td>
<td>Annual</td>
<td>Meeting or teleconference, and formal meeting minutes</td>
</tr>
<tr>
<td>(c) TACC provides scientifically valid advice and consultation</td>
<td>Update from each stakeholder group per meeting, or if specifically requested at any point by Ports North or DSEWPaC</td>
<td>Meeting contribution, or advice document</td>
</tr>
<tr>
<td>(d) Latest version of LTMMP agreed between Ports North and the TACC, and once approved by DSEWPaC is available via Ports North’s website within two weeks of approval and any subsequent approvals for future versions.</td>
<td>For the Permit and LTMMP term</td>
<td>Website link</td>
</tr>
<tr>
<td>(e) Environmental Management Plan for the TSHD are in place for dredging campaigns</td>
<td>Per dredge campaign</td>
<td>EMP document and evidence of EMP implementation audits</td>
</tr>
<tr>
<td>(f) Environmental Management Plans are in place for bed levelling campaigns</td>
<td>Per campaign</td>
<td>EMP document and evidence of EMP implementation audits</td>
</tr>
<tr>
<td>(g) Dump Records up to date and available</td>
<td>Per campaign-as per Permit Condition</td>
<td>Log records – hydrographic</td>
</tr>
<tr>
<td>(h) Hydrographic plans for dredge area and dump ground are up to date and supplied to DSEWPaC, RAN and if required, the TACC</td>
<td>Post campaign-as per Permit Condition</td>
<td>Final hydrographic survey drawings held by Ports North survey section</td>
</tr>
<tr>
<td>(i) Monitoring programs are implemented</td>
<td>To meet schedule at Table 10-1</td>
<td>Final reports on each Program/Initiative available to TACC, and stakeholders</td>
</tr>
<tr>
<td>(j) Final monitoring program reports are provided via the Ports North website</td>
<td>Within 21 days of final report completion</td>
<td>Website link</td>
</tr>
<tr>
<td>Indicators</td>
<td>Frequency</td>
<td>Format/Record</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>-------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>(k) Continual improvement in the implementation of contemporary best practice environmental stewardship by Ports North in management of dredging and disposal at Port of Karumba</td>
<td>For the Permit and LTMMP term</td>
<td>Evidence of implementation of this LTMMP</td>
</tr>
<tr>
<td>(l) Maintain annual reporting requirements under the Sea Dumping Permit.</td>
<td>Annually by 31 January</td>
<td>IMO Report Form</td>
</tr>
<tr>
<td>(m) Technical review of spoil ground capacity and future needs</td>
<td>After 2019</td>
<td>Spoil ground capacity study report</td>
</tr>
<tr>
<td>(n) EMP Management Elements Performance Indicators are achieved as per respective campaign type</td>
<td>Each campaign - specific EMP applicable to or TSHD (Appendix 10) or Bed Levelling (Appendix 11) campaign</td>
<td>EMP Close Out Report and/or Internal verification audit reports</td>
</tr>
</tbody>
</table>

10.15 Review of Management Plan

This Long Term Management and Monitoring Plan will be reviewed, and updated if necessary, according to the following timetable:

- Reviewed for currency of monitoring data and monitoring design mid-term (2016);
- Where monitoring or management is proposed to be changed, any proposed modifications will be discussed with the TACC and DSEWPaC. Any changes will be incorporated into the LTMMP and the Plan will be resubmitted to DSEWPaC for approval; or
- Where unanticipated environmental risks are identified and are of a nature that warrants a review of the LTMMP.

Review shall be undertaken at a frequency of not more than five years within the proposed ten year permit period.

Outcomes of this review will inform amendments and publication of future versions of this LTMMP as identified in Section 10.10 throughout the life of the Sea Dumping Permit and LTMMP.
### 11. ABBREVIATIONS

**Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPA</td>
<td>Cairns Port Authority</td>
</tr>
<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Research Organisation</td>
</tr>
<tr>
<td>DAFF</td>
<td>QLD Dept. of Agriculture, Forestry and Fisheries (formerly DEEDI and QDPI&amp;F)</td>
</tr>
<tr>
<td>DEEDI</td>
<td>Department of Employment, Economic Development and Innovation</td>
</tr>
<tr>
<td>DEHP</td>
<td>Department of Environment and Heritage Protection (formerly DERM and EPA)</td>
</tr>
<tr>
<td>DERM</td>
<td>Department of Environment and Resource Management</td>
</tr>
<tr>
<td>DEWHA</td>
<td>Department of Environment, Water, Heritage and the Arts</td>
</tr>
<tr>
<td>DPI&amp;F</td>
<td>Queensland Department of Primary Industries and Fisheries</td>
</tr>
<tr>
<td>DSEWPaC</td>
<td>Commonwealth- Department of Sustainability, Environment, Water, Population and Communities (formerly DEWHA)</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental impact assessment</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental management plan</td>
</tr>
<tr>
<td>EP Act</td>
<td><em>Environmental Protection Act 1994</em></td>
</tr>
<tr>
<td>EPBC Act</td>
<td>Commonwealth <em>Environment Protection and Biodiversity Conservation Act 1999</em></td>
</tr>
<tr>
<td>FNQPC</td>
<td>Far North Queensland Ports Corporation Ltd, now trading as Ports North</td>
</tr>
<tr>
<td>IAS</td>
<td>Impact assessment study, prepared for the Century Project</td>
</tr>
<tr>
<td>IODG</td>
<td>Interim Ocean Disposal Guidelines</td>
</tr>
<tr>
<td>LAT</td>
<td>Lowest astronomical tide</td>
</tr>
<tr>
<td>NAGD</td>
<td>National Assessment Guidelines for Dredging 2009</td>
</tr>
<tr>
<td>NODGDM</td>
<td>National Ocean Disposal Guidelines for Dredged Material 2002</td>
</tr>
<tr>
<td>PN</td>
<td>Ports North (Far North Queensland Ports Corporation Ltd)</td>
</tr>
<tr>
<td>PAH</td>
<td>Polycyclic aromatic hydrocarbon</td>
</tr>
<tr>
<td>PCQ</td>
<td>Ports Corporation of Queensland Limited</td>
</tr>
<tr>
<td>SAP</td>
<td>Sampling and Analysis Plan</td>
</tr>
<tr>
<td>TACC</td>
<td>Technical Advisory and Consultative Committee</td>
</tr>
<tr>
<td>TBT</td>
<td>Tributyltin</td>
</tr>
<tr>
<td>UCL</td>
<td>Upper confidence level</td>
</tr>
</tbody>
</table>
12. REFERENCES


GHD (2002a) *Karumba maintenance dredging - Report on dredge spoil sampling and analysis plan*

GHD (2002b) *Survey of potential contamination of dredge material Port of Karumba May and June 2002 survey*

GHD (2002c) Background surveys for polycyclic aromatic hydrocarbons at Port of Karumba


Neil, KM, Hoedt, FE, Sheaves, J, Cruz, JJ and Choat, JH (2001) Survey of the Port of Karumba - Port marine baseline surveys and surveys for introduced marine pests, James Cook University, Townsville

Parry & Munksgaard (2000) Report on baseline study for southeast Gulf of Carpentaria, Northern Territory University, Darwin


Rose C. (1997) *Benthic Monitoring.* In EcoPorts Monograph Series No.6


13. APPENDICES

APPENDIX 1   EPBC ACT PROTECTED MATTERS SEARCH RESULTS
APPENDIX 2   SITE PLANS
APPENDIX 3   PERMIT COPY
APPENDIX 4   2009 SEDIMENT ANALYSIS PLAN RESULTS
APPENDIX 5   CSIRO ADVICE STATEMENT 2010
APPENDIX 6   MEETING MINUTES – 2010 TACC
APPENDIX 7   SEDIMENT SAMPLING AND ANALYSIS PLAN: 2014 AND 2019
APPENDIX 8   INTERNATIONAL MARITIME ORGANISATION REPORTING TEMPLATE
APPENDIX 9   SPOIL GROUND BENTHIC INFAUNA SURVEY METHOD
APPENDIX 10  ENVIRONMENTAL MANAGEMENT PLAN – DREDGING CAMPAIGN – TSHD
APPENDIX 11  ENVIRONMENTAL MANAGEMENT PLAN – BED LEVELLING CAMPAIGN
APPENDIX 12  WATER QUALITY MONITORING PLAN
Appendix 1

**EPBC Act**
Protected Matters Report Extract

Port of Karumba

Entrance Channel Maintenance Dredging
APPENDIX 13-1 EPBC Act Protected Matters Report

- as at 15 November 2010 based on Line from moth of Norman River to approx centre of spoil ground with conservative 10 km radius buffer. Search Layer images as per below

EPBC Act Protected Matters Report 15 November 2010 16:21
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have
selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.


<table>
<thead>
<tr>
<th>Search Type:</th>
<th>Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer:</td>
<td>5 km</td>
</tr>
<tr>
<td>Coordinates:</td>
<td>-17.46323,140.82399, -17.42493,140.67588</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Report Contents:</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Details</td>
</tr>
<tr>
<td></td>
<td>Matters of NES</td>
</tr>
<tr>
<td></td>
<td>Other matters protected by the EPBC Act</td>
</tr>
<tr>
<td></td>
<td>Extra Information</td>
</tr>
<tr>
<td></td>
<td>Caveat</td>
</tr>
<tr>
<td></td>
<td>Acknowledgments</td>
</tr>
</tbody>
</table>

This map may contain data which are © Commonwealth of Australia (Geoscience Australia) © PSMA Australia Limited

### Summary

#### Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see [http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html](http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html).

**World Heritage Properties:** None

**National Heritage Places:** None

**Wetlands of International Significance:** (Ramsar Sites) None

**Commonwealth Marine Areas:** Relevant

**Threatened Ecological Communities:** None

**Threatened Species:** 15

**Migratory Species:** 51

#### Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the ‘environment’, these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at [http://www.environment.gov.au/heritage/index.html](http://www.environment.gov.au/heritage/index.html).
Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at [http://www.environment.gov.au/epbc/permits/index.html](http://www.environment.gov.au/epbc/permits/index.html).

### Commonwealth Lands:
None

### Commonwealth Heritage Places:
None

### Places on the RNE:
1

### Listed Marine Species:
90

### Whales and Other Cetaceans:
11

### Critical Habitats:
None

### Commonwealth Reserves:
None

### Extra Information
This part of the report provides information that may also be relevant to the area you have nominated.

### State and Territory Reserves:
None

### Other Commonwealth Reserves:
None

### Regional Forest Agreements:
None

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**Details**

**Matters of National Environmental Significance**

**Commonwealth Marine Areas** [Dataset Information]

Approval may be required for a proposed activity that is likely to have a significant impact on the environment in a Commonwealth Marine Area, when the action is outside the Commonwealth Marine Area, or the environment anywhere when the action is taken within the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

**EEZ and Territorial Sea**

**Threatened Species** [Dataset Information]

<table>
<thead>
<tr>
<th>Threatened Species</th>
<th>Status</th>
<th>Type of Presence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Birds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erythrotriorchis radiata Red Goshawk</td>
<td>Vulnerable</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Rostratula australis Australian Painted Snipe</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><strong>Mammals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balaenoptera musculus Blue Whale</td>
<td>Endangered</td>
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</tr>
<tr>
<td>Megaptera novaeangliae Humpback Whale</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Xeromys myoides Water Mouse, False Water Rat</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><strong>Reptiles</strong></td>
<td></td>
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</tr>
<tr>
<td>Caretta caretta Loggerhead Turtle</td>
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<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Chelonia mydas Green Turtle</td>
<td>Vulnerable</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth</td>
<td>Endangered</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Eretmochelys imbricata Hawksbill Turtle</td>
<td>Vulnerable</td>
<td>Species or species habitat likely to occur within area</td>
</tr>
<tr>
<td>Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle</td>
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<td>Species or species habitat likely to occur within area</td>
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<tr>
<td>Natator depressus Flatback Turtle</td>
<td>Vulnerable</td>
<td>Species or species habitat known to occur within area</td>
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<tr>
<td><strong>Sharks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pristis clavata Dwarf Sawfish, Queensland Sawfish</td>
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<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Pristis microdon Freshwater Sawfish</td>
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<tr>
<td>Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td>Rhincodon typus Whale Shark</td>
<td>Vulnerable</td>
<td>Species or species habitat may occur within area</td>
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<tr>
<td><strong>Migratory Species</strong> [Dataset Information]</td>
<td>Status</td>
<td>Type of Presence</td>
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Karumba EPBC Report 15 Nov 10.docx Page 3 of 12
<table>
<thead>
<tr>
<th>Migratory Terrestrial Species</th>
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<tbody>
<tr>
<td><strong>Birds</strong></td>
</tr>
<tr>
<td><em>Haliaeetus leucocephalus</em> White-bellied Sea-Eagle</td>
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<tr>
<td><em>Hirundapus caudacutus</em> White-throated Needletail</td>
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<tr>
<td><em>Hirundo rustica</em> Barn Swallow</td>
</tr>
<tr>
<td><em>Merops ornatus</em> Rainbow Bee-eater</td>
</tr>
<tr>
<td><em>Rhipidura rufifrons</em> Rufous Fantail</td>
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<tr>
<td><strong>Migratory Wetland Species</strong></td>
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<tr>
<td><em>Actitis hypoleucos</em> Common Sandpiper</td>
</tr>
<tr>
<td><em>Ardea alba</em> Great Egret, White Egret</td>
</tr>
<tr>
<td><em>Ardea ibis</em> Cattle Egret</td>
</tr>
<tr>
<td><em>Arenaria interpres</em> Ruddy Turnstone</td>
</tr>
<tr>
<td><em>Calidris acuminata</em> Sharp-tailed Sandpiper</td>
</tr>
<tr>
<td><em>Calidris alba</em></td>
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<tr>
<td><em>Calidris canutus</em> Red Knot, Knot</td>
</tr>
<tr>
<td><em>Calidris ferruginea</em> Curlew Sandpiper</td>
</tr>
<tr>
<td><em>Calidris ruficollis</em> Red-necked Stint</td>
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<tr>
<td><em>Charadrius leschenaultii</em> Greater Sand Plover, Large Sand Plover</td>
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<tr>
<td><em>Charadrius mongolus</em> Lesser Sand Plover, Mongolian Plover</td>
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<tr>
<td><em>Charadrius veredus</em> Oriental Plover, Oriental Pratincole</td>
</tr>
<tr>
<td><em>Glareola maldivarum</em> Oriental Pratincole</td>
</tr>
<tr>
<td><em>Grus antigone</em> Sarus Crane</td>
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<tr>
<td><em>Heteroscelus brevipes</em> Grey-tailed Tattler</td>
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<tr>
<td><em>Limicola falcinellus</em> Broad-billed Sandpiper</td>
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<tr>
<td><em>Limosa lapponica</em> Bar-tailed Godwit</td>
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<tr>
<td><em>Limosa limosa</em> Black-tailed Godwit</td>
</tr>
<tr>
<td><em>Numenius madagascariensis</em> Eastern Curlew</td>
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<tr>
<td><em>Numenius minutus</em> Little Curlew, Little Whimbrel</td>
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<tr>
<td><em>Numenius phaeopus</em> Whimbrel</td>
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<tr>
<td><em>Pluvialis fulva</em> Pacific Golden Plover</td>
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<tr>
<td><em>Pluvialis squatarola</em> Grey Plover</td>
</tr>
<tr>
<td><em>Rostratula benghalensis s. lat.</em> Painted Snipe</td>
</tr>
<tr>
<td><em>Tringa stagnatilis</em> Marsh Sandpiper, Little Greenshank</td>
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<tr>
<td><em>Xenus cinereus</em> Terek Sandpiper</td>
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<td><strong>Migratory Marine Birds</strong></td>
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<tr>
<td><em>Apus pacificus</em> Fork-tailed Swift</td>
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<td><em>Ardea alba</em> Great Egret, White Egret</td>
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<tr>
<td><em>Ardea ibis</em> Cattle Egret</td>
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<tr>
<td><em>Sterna albifrons</em> Little Tern</td>
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<tr>
<td><strong>Migratory Marine Species</strong></td>
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<tr>
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<tr>
<td><em>Balaenoptera musculus</em> Blue Whale</td>
</tr>
<tr>
<td>Common Name</td>
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<tr>
<td><strong>Dugong dugon</strong> Dugong</td>
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<tr>
<td><strong>Megaptera novaeanglia</strong> Humpback Whale</td>
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<tr>
<td><strong>Orcaella brevirostris</strong> Irrawaddy Dolphin</td>
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<tr>
<td><strong>Orcinus Orca</strong> Killer Whale, Orca</td>
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<td><strong>Sousa chinensis</strong> Indo-Pacific Humpback Dolphin</td>
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</tbody>
</table>

**Reptiles**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
<th>Type of Presence</th>
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<tbody>
<tr>
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<td>Species or species habitat likely to occur within area</td>
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<tr>
<td><strong>Chelonia mydas</strong> Green Turtle</td>
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<td>Migratory</td>
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<tr>
<td><strong>Crocodylus porosus</strong> Salt-water Crocodile, Estuarine Crocodile</td>
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<tr>
<td><strong>Dermochelys coriacea</strong> Leatherback Turtle, Leathery Turtle, Luth</td>
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<tr>
<td><strong>Eretmochelys imbricata</strong> Hawkshill Turtle</td>
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<td>Migratory</td>
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<tr>
<td><strong>Lepidochelys olivacea</strong> Olive Ridley Turtle, Pacific Ridley Turtle</td>
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**Sharks**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Status</th>
<th>Type of Presence</th>
</tr>
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<tbody>
<tr>
<td><strong>Rhincodon typus</strong> Whale Shark</td>
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**Other Matters Protected by the EPBC Act**

<table>
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<th>Scientific Name</th>
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<th>Type of Presence</th>
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<tbody>
<tr>
<td><strong>Actitis hypoleucos</strong> Common Sandpiper</td>
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<tr>
<td><strong>Anseranas semipalmata</strong> Magpie Goose</td>
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<tr>
<td><strong>Anous pacificus</strong> Fork-tailed Swift</td>
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<tr>
<td><strong>Ardea alba</strong> Great Egret, White Egret</td>
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<td>Listed</td>
<td>Species or species habitat likely to occur within area</td>
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<tr>
<td><strong>Ardea ibis</strong> Cattle Egret</td>
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<td>Species or species habitat may occur within area</td>
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<tr>
<td><strong>Arenaria interpres</strong> Ruddy Turnstone</td>
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<td>Listed</td>
<td>Roosting known to occur within area</td>
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<tr>
<td><strong>Charadrius acuminatus</strong> Sharp-tailed Sandpiper</td>
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<td>Roosting known to occur within area</td>
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<tr>
<td><strong>Calidris ferruginea</strong> Curlew Sandpiper</td>
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<td><strong>Calidris ruficollis</strong> Red-necked Stint</td>
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<td>Listed - overfly marine area</td>
<td>Roosting known to occur within area</td>
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<tr>
<td><strong>Charadrius mongolus</strong> Lesser Sand Plover, Mongolian Plover</td>
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<td>Roosting known to occur within area</td>
</tr>
<tr>
<td><strong>Charadrius veredus</strong> Oriental Plover, Oriental Dotterel</td>
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<td>Roosting may occur within area</td>
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<tr>
<td><strong>Gallinago megala</strong> Swinhoe's Snipe</td>
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<td><strong>Gallinago stenura</strong> Pin-tailed Snipe</td>
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<td>Roosting likely to occur within area</td>
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<tr>
<td><strong>Glareola maldivarum</strong> Oriental Pratincole</td>
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<tr>
<td><strong>Harryana leuconaster</strong> White-bellied Sea-Eagle</td>
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<td>Listed</td>
<td>Species or species habitat likely to occur within area</td>
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<tr>
<td><strong>Heteroscelus brevipes</strong> Grey-tailed Tattler</td>
<td></td>
<td>Listed</td>
<td>Roosting known to occur within area</td>
</tr>
<tr>
<td><strong>Himantopus himantopus</strong> Black-winged Stilt</td>
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<td>Species or species habitat may occur within area</td>
</tr>
<tr>
<td><strong>Himantopus hondurensis</strong> White-throated Needletail</td>
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<td>Species or species habitat may occur within area</td>
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<tr>
<td><strong>Hirundo rustica</strong> Barn Swallow</td>
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<tr>
<td><strong>Limicola falcinellus</strong> Broad-billed Sandpiper</td>
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<tr>
<td><strong>Limnodromus semipalmatus</strong> Asian Dowitcher</td>
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<td><strong>Limosa lapponica</strong> Bar-tailed Godwit</td>
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<td><strong>Limosa limosa</strong> Black-tailed Godwit</td>
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<tr>
<td><strong>Merops ornatus</strong> Rainbow Bee-eater</td>
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<td>Species or species habitat may occur within area</td>
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<td><strong>Numenius madagascariensis</strong> Eastern Curlew</td>
<td>Listed</td>
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<td></td>
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<tr>
<td><strong>Numenius minutus</strong> Little Curlew, Little Whimbrel</td>
<td>Listed - overfly marine area</td>
<td>Roosting known to occur within area</td>
<td></td>
</tr>
<tr>
<td><strong>Numenius phaeopus</strong> Whimbrel</td>
<td>Listed</td>
<td>Roosting known to occur within area</td>
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</tr>
<tr>
<td><strong>Pluvialis fulva</strong> Pacific Golden Plover</td>
<td>Listed</td>
<td>Roosting known to occur within area</td>
<td></td>
</tr>
<tr>
<td><strong>Pluvialis squatarola</strong> Grey Plover</td>
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<td>Roosting known to occur within area</td>
<td></td>
</tr>
<tr>
<td><strong>Recurvirostra novaehollandiae</strong> Red-necked Avocet</td>
<td>Listed - overfly marine area</td>
<td>Roosting known to occur within area</td>
<td></td>
</tr>
<tr>
<td><strong>Rhipidura rufifrons</strong> Rufous Fantail</td>
<td>Listed - overfly marine area</td>
<td>Species or species habitat may occur within area</td>
<td></td>
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<tr>
<td><strong>Rostratula benghalensis s. lat.</strong> Painted Snipe</td>
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<td><strong>Sterna albifrons</strong> Little Tern</td>
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<td>Species or species habitat may occur within area</td>
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<tr>
<td><strong>Stiltia isabella</strong> Australian Pratincole</td>
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<td>Roosting known to occur within area</td>
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<tr>
<td><strong>Tringa stagnatilis</strong> Marsh Sandpiper, Little Greenshank</td>
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</tr>
<tr>
<td><strong>Xenus cinereus</strong> Terek Sandpiper</td>
<td>Listed - overfly marine area</td>
<td>Roosting known to occur within area</td>
<td></td>
</tr>
</tbody>
</table>

**Mammals**

| **Dugong dugon** Dugong | Listed | Species or species habitat likely to occur within area |

**Ray-finned fishes**

| **Campichthys tricarinatus** Three-keel Pipefish | Listed | Species or species habitat may occur within area |
| **Choerichthys brachysoma** Pacific Short-bodied Pipefish, Short-bodied Pipefish | Listed | Species or species habitat may occur within area |
| **Choerichthys sturis** Pig-snouted Pipefish | Listed | Species or species habitat may occur within area |
| **Corvithys amplexus** Fijian Banded Pipefish, Brown-banded Pipefish | Listed | Species or species habitat may occur within area |
| **Corvothys flavofasciatus** Reticulate Pipefish, Yellow-bodied Pipefish, Network Pipefish | Listed | Species or species habitat may occur within area |
| **Doryrhamphus excisus** Bluesripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish | Listed | Species or species habitat may occur within area |
| **Doryrhamphus janssi** Cleaner Pipefish, Janss' Pipefish | Listed | Species or species habitat may occur within area |
| **Festucalex cinctus** Girdled Pipefish | Listed | Species or species habitat may occur within area |
| **Halicampus brocki** Brock's Pipefish | Listed | Species or species habitat may occur within area |
| **Halicampus grayi** Mud Pipefish, Gray's Pipefish | Listed | Species or species habitat may occur within area |
| **Halicampus spinirostris** Spiny-snout Pipefish | Listed | Species or species habitat may occur within area |
| **Haliichthys taeniophorus** Ribboned Pipehorse, Ribboned Seadragon | Listed | Species or species habitat may occur within area |
| **Hippichthys cyanospilos** Blue-speckled Pipefish, Blue-spotted Pipefish | Listed | Species or species habitat may occur within area |
| **Hippichthys penicillus** Beady Pipefish, Steep-nosed Pipefish | Listed | Species or species habitat may occur within area |
| **Hippocampus histrix** Spiny Seahorse, Thorny Seahorse | Listed | Species or species habitat may occur within area |
| **Hippocampus kuda** Spotted Seahorse, Yellow Seahorse | Listed | Species or species habitat may occur within area |
| **Hippocampus planifrons** Flat-face Seahorse | Listed | Species or species habitat may occur within area |
| **Hippocampus spinosissimus** Hedgehog Seahorse | Listed | Species or species habitat may occur within area |
| **Solegnathus hardwickii** Pallid Pipehorse, Hardwick's Pipehorse | Listed | Species or species habitat may occur within area |
| **Trachyrhamphus bicoarctatus** Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish | Listed | Species or species habitat may occur within area |
| **Trachyrhamphus longirostris** Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish | Listed | Species or species habitat may occur within area |

**Reptiles**

<p>| <strong>Acalyptophis peronii</strong> Horned Seasnake | Listed | Species or species habitat may occur within area |
| <strong>Aipysurus duboisii</strong> Dubois' Seasnake | Listed | Species or species habitat may occur within area |
| <strong>Aipysurus evidenzi</strong> Spine-tailed Seasnake | Listed | Species or species habitat may occur within area |
| <strong>Aipysurus laevis</strong> Olive Seasnake | Listed | Species or species habitat may occur within area |</p>
<table>
<thead>
<tr>
<th>Species Name</th>
<th>Status</th>
<th>Presence Description</th>
</tr>
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<td><em>Astrotia stokesii</em></td>
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</tr>
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<td><em>Crocodylus porosus</em></td>
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<td><em>Megaptera novaeangliae</em></td>
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Places on the RNE [Dataset Information]
Note that not all Indigenous sites may be listed.

Natural

Southern Gulf Plains QLD – Links to information below;
### Photographs:

![Image](image.jpg)

### List:

Register of the National Estate

### Class:

Natural

### Legal Status:

Registered (27/03/2001)

### Place ID:

18702

### Place File No:

4/07/281/0013

### Statement of Significance:

The Southern Gulf Plains area incorporates one of the largest, most diverse and least fragmented natural wetland aggregations in Australia. The area is a major shore and waterbird habitat. The area is geomorphologically significant as an excellent example, within an Australian context, of past, present and continuing processes associated with the development of a prograding coastline. The area represents one of the largest intact and functionally discrete natural wetland systems in Australia. Much of the area, particularly the tidal mudflats, are near pristine, remote from access and are not fragmented and as such have a very high wilderness quality. The area has a high diversity of wetlands. These include marine intertidal flats with occasional seagrass beds, bays and estuaries, saline mudflats, tidal and freshwater riverine environments, lagoons, swamps and seasonally flooded wetlands. These environments are characterised by variable water chemistry, ranging from fresh to hypersaline within a single season and widely fluctuating water levels. The Southern Gulf Plains is an area of major importance to many species of birds and aquatic animals by providing feeding, breeding and nesting areas. At times the area is estimated to support up to one third of all waders visiting Australia. The area supports a substantial proportion of the entire global population of the black tailed godwit (LIMOSA LIMOSA melanuroides) and is also habitat of international significance for the broad billed sand piper (LIMICOLA FALCINELLUS), great knot (CALIDRIS TENUIROSTRIS), lesser golden plover (PLUVIALIS DOMINICA), marsh sandpiper (TRINGA STAGNATILIS), Mongolian plover (CHARADRIUS MONGOLUS), terek sandpiper (XENUS CINEREUS), whimbrel (NUMENIUS PHAEOPUS) and red knot (CALIDRIS CANUTUS). In addition the area supports greater than 1% of the total Australian population of a further thirteen species of shorebird. The area is vital for the maintenance of the migration routes across Northern Australia for many species including; red knot (CALIDRIS CANUTUS), sanderling (CALIDRIS ALBA) and whimbrel (NUMENIUS PHAEOPUS). In addition, the area is an important wet season and
over wintering habitat for waterbirds migrating to and from south-eastern Australia and possibly New Zealand. These species include; grey teal (annas gibberifrons), sacred ibis (THRESKIORNIS MOLUCCA), glossy ibis (plegadis FALCINELLUS) and straw necked ibis (THRESKIORNIS spiniculus). The beach thick knee (ESACUS MAGNIOSTRIS) and the little tern (STERNA ALBIFRONNS SINENSIS), both of which are considered nationally vulnerable species, are also found within the area. The areas near the Flinders and Bynoe Rivers are important dry season refuges for the brolga (GRUS RUBICUNDUS) and saurus crane (GRUS ANTIGONE). In addition, the area provides refuge for moulting grey teal (annas gibberifrons), Pacific black duck (annas SUPERCILIOSA), pink eared duck (MALACORHYNCHUS MEMBRANACEUS) and Australasian shoveller (ANAS RHYNCHOTIS). Large breeding populations of barramundi (lates calcarifer), estuarine crocodile (CROCODYLUS POROSUS) and freshwater crocodile (CROCODYLUS JOHNSTONII) are found within the waterways of the area. The Southern Gulf Plains has been a focus for research on migratory waders for some time. The area has considerable potential for studying the processes of coastal accretion, the hydrology of tropical wetland systems and the ecology of many different species of birds.

**Official Values: Not Available**

**Description:**

The Southern Gulf Plains area incorporates a wide variety of land types including marine intertidal flats; deltas; beaches and foredunes; chenier plains; and low elevated black soil plains. Associated with many of these land types is an equally diverse array of wetland systems such as estuaries, tidal channels, rivers and streams, lakes, swamps and tidal saline mudflats. The wetlands are characterised by fluctuating water levels, strong tidal influences from the Gulf of Carpentaria, seasonal flooding by freshwater associated with monsoonal summer rains and surface runoff and the deposition of air-borne salts. Overall, the Southern Gulf Plains area represents a dynamic system of terrestrial and wetland environments that are associated with a prograding (actively accreting) coastline. Seven large and numerous small estuarine systems are found within the area. The major estuaries are associated with the Nicholson, Albert, Leichhardt, Flinders, Bynoe, Norman and Smithburne Rivers. These estuarine systems are typically fringed by mangrove forests that are continuous with a band of coastal mangroves. Nine species of mangrove have been recorded in the area namely club mangrove (AEGIALITIS ANNULATA), grey mangrove (AVICENNIA MARINA), blind your eye (EXCOECARIA AGALLOCHA), river mangrove (AEGICERAS CORNICULATUM), yellow mangrove (CERIOPS TAGAL), black mangrove (LUMNITZERA RACEMOSA), red mangrove (RHIZOPHORA STYLOSA) large leaved orange mangrove (BRUGUIERA EXARISTATA) and cedar mangrove (XYLOCARPUS AUSTRALASICUM). The mangrove communities also extend along the margins and levee banks of the tidal sections of rivers and streams. The mangroves, estuaries and tidal channels provide habitats for a number of waterbirds and aquatic animals. A breeding colony of a least 200 pairs of pied cormorant (PHALACROCORAX VARIUS) has been recorded 10km south-east of Gore Point. The Australian pelican (PELECANUS CONSPICILLATUS) also breeds within the area. Mangrove forests that fringe the Flinders and Bynoe Rivers are also used by waterbird breeding colonies on an irregular basis. Also found throughout the coastal systems are commercially viable prawn populations and breeding colonies of barramundi (lates calcarifer), estuarine crocodile (CROCODYLUS POROSUS) and freshwater crocodile (C JOHNSTONII). A narrow, discontinuous band of beaches and low foredunes occur along the coastline between the estuaries. Typically the sediments of these systems are comprised of unconsolidated sands and shell fragments. The dunes are vegetated by scattered coastal she oaks (CASUARINA EQUISETIFOLIA) and cottonwood (HIBISCUS TILIACEUS), with an understorey of trailing vines (eg IPOMOEA pes caprae) and SPINIFEX (SPINIFEX LONGIFOLIUS). Immediately behind the coastal systems is a chenier plain, which consists of a series of discontinuous secondary dunes resting on a muddy substrate and isolated from the beach dunes by a band of tidal mudflats. The chenier plains are the result of a prograding coastline, which has been moving out into the Gulf at a rate of 4m a year over the last 6,000 years. The mudflats are the most extensive of all the land types within the nominated area. They are subject to periodic inundation by high tides and are also seasonally flushed by localised rainfall and runoff from upland areas. The mudflats are mostly unvegetated, although patches of samphires (HALOSARCIA species) and salt tolerant grasses (SPOROBOLUS species) are scattered throughout. The mudflats are primary feeding the sand and mud banks along the river channels that cross the mudflats provide nesting habitats for many of these birds. The secondary dune systems extend behind the mudflats for up to 30km inland. The dune systems support open woodlands dominated by Moreton Bay ash (EUCALYPTUS TESSELLARIS) and screw pine (PANDANUS species). The swales between the dunes are seasonally flooded by freshwaters and become increasingly saline with the onset of the dry
season the aquatic plant communities vary according to current water levels and salinities but are usually fringed by tea trees (MELALEUCA species), sedges and grasses. The freshwater wetlands support brolga (GRUS RUBICUNDA), magpie goose (ANSERANAS SEMIPALMATA), black swan (CYGNUS ATRATUS), black duck (ANAS SUPERCILIOSA), grey teal (A Gibberifrons) and gargarone (A QUERQUEDULA). The upland sections of the Southern Gulf Plains area consist primarily of low elevated black soil plains which formed under backswamp conditions during a previous wetter climate. These plains are dissected by many stream channels and contain depressions associated with abandoned water courses. The hydrology of these plains is variable and is influenced by seasonal flooding and saline water carried inland by king tides and cyclonic surges. The vegetation communities of these areas are primarily grasslands dominated by SPOROBOLUS VIRGINICUS, ORYZA species and PSEUDORAPHIS species on slightly lower areas and XEROCHLOA, dicanchium, PANICUM and VETIVERIA species elsewhere. Sparse stands of trees on low rises are scattered across the plains and include gutta percha (exoceraria PARVI-FOLIA), beefwood (GREVILLEA STRIATA), PANDANUS species, box gum (EUCALYPTUS MICROTHECA) and broad leaved tea tree (MELALEUCA VIRIDIFLORA). The wetland systems of the low elevated plains are periodically inhabited by large concentrations of waterbirds such as grey teal (ANAS gibberifrons), black duck (A. SUPERCILIOSA) and wandering whistling ducks (DENDROCYGNA ARCUTA). Breeding populations of green pygmy goose (NETTAPUS PULCHELLUS), Australian grebe (TACHYBAPTUS NOVAEHOLLANDIAE) and white eyed duck (AYTHYA AUSTRALIS) have been recorded from these wetlands. During the dry season, the black soil plains are also used as feeding grounds by waders such as brolgas (GRUS RUBICUNDA) and saurus cranes (G ANTIGONE). The main human activities carried out in the coastal flats of the area are netting for barramundi in the major rivers and recreational fishing and crabbing which occurs primarily near Karumba and in the Bynoe and Flinders Rivers.

History: Not Available

Condition and Integrity:

The coastal saline flats are undisturbed and are virtually in a pristine condition. In 1991 dense stands of rubber vine (CRYPTOSTEGIA GRANDIFLORA) were observed along watercourses and secondary dune systems, particularly in the eastern section of the nomination. Small scale eradication programs are currently underway to prevent further spread of this pest. Other introduced species found within the area include ACACIA NILOTICA, PARKINSONIA ACULEATA and CALOTROPIS species, which occur in low densities throughout the area. The sub-coastal components of the Southern Gulf Plains are used primarily for pastoral activities. Cattle densities are generally low and there is little evidence of significant erosion, however, foliage cover of the bluegrass grasslands have been reduced substantially. During the dry season a concentration of cattle on permanent water occurs, resulting in localised reduction of vegetation cover, increased rate of siltation in lagoons and decreased regeneration of fringing vegetation. (1993/early 1994)

Location:

About 800,000ha, 3.5km north east of Burketown, comprising the area bounded by a line commencing at AMG point: 54KVG914148, then directly to the middle thread of the Smithburne River at AMG easting: (Zone 45K): 494600mE (approximate AMG point: 946148), then upstream via the middle thread of that river to AMG easting: 529600mE (approximate AMG point: WG296152), then directly south to the southern side of the track running east-west at approximate AMG point 296150, then east via the south side of that track to its intersection with a track running north-south at approximate AMG point: 310142, then via straight lines joining the following AMG points consecutively: 195095, 192968, 114695 and 022504, then directly to the right bank of the Bynoe River at AMG northing: 8041000mN (approximate AMG point: VF783410), then upstream via the right bank of that river to the causeway at AMG northing: 8024400mN (approximate AMG point: 814244), then generally westerly via the north side of the Burketown Normanton Road until it crosses Armstrong Creek (approximate AMG point: 690173), then directly to the eastern side of the north south track at Fork Lagoon Yard at AMG northing: 8016100mN (approximate AMG point: 122161), then generally northerly via the western side of that track to AMG northing: 8021700mN (approximate AMG point: 132217), then directly to the right bank of the Leichhardt River at AMG northing: 8034800mN (approximate AMG point: UF710348), then upstream via the right bank of that river to AMG northing: 8023400mN (approximate AMG point: 700234), then direct to AMG point: 500234, then direct to AMG point: 500040, then direct to the right bank of the Nicholson River at AMG easting: 336000mE (approximate AMG point: 360438), then upstream via the right bank of the Nicholson River to its divergence with Gin Arm Creek, then down stream via the left bank of Gin Arm Creek to AMG northing: 8053800mN (approximate AMG point: 264538), then direct to AMG point: 100682, then direct to AMG point: 153713, then direct to the left bank of Moonlight Creek at AMG easting: 306800mE (AMG point: 068839), then via the left bank of that creek to its mouth at approximate AMG point: 092880, then via straight lines joining the latter point and following AMG points...
produce indicative distribution maps.

imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to determine the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Bibliography:


-Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report. This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the migratory and marine provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
- Australian Bird and Bat Banding Scheme
- Australian National Wildlife Collection
- Natural history museums of Australia
- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia
- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra
- University of New England
- Other groups and individuals

ANUCli Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.
Appendix 2

Site Plans

Channel Alignment

Port of Karumba

Entrance Channel Maintenance Dredging
Appendix 3   Permit Copy
30th September 1996

Chief Executive Officer
Ports Corporation of Queensland
GPO Box 409
BRISBANE QLD 4001

Dear Sir

CHANNEL DREDGING AND MATERIAL RELOCATION AT KARUMBA

I am directed to inform you that in pursuance of the provisions of section 86 of the Harbours Act 1955, sanction has been given to the plan deposited for;

- an amendment to the sanction granted on the 24 June 1996 for the dredging of a channel and the rehandling and relocation of dredge spoil
- for the alteration of the dredge spoil offshore relocation site involving an approximate 500m westward shift of the central coordinates of the offshore relocation site.

in the areas at Karumba shown on the sanctioned plans and subject to the conditions contained within the letter of approval dated 24 June 1996.

A Copy of the sanctioned plan is returned herewith.

I wish to point out that the sanction or conditions do not constitute a ruling on structural safety and you must make your own arrangements to ensure adequacy of design and work.

The granting of this sanction pursuant to the Harbours Act does not remove the need to obtain any further approvals for this work which may be required pursuant to other legislation, both State and
Commonwealth. Applicants are advised to check with all relevant statutory authorities for such approvals as may be required.

Your attention is drawn to the provisions of the Native Title Act 1993 (Commonwealth) in so far as it may affect your right to construct these works on the subject land.

Yours faithfully

[Signature]

A SKEAT
(Acting) REGIONAL DIRECTOR
NORTHERN
Certificate of Registration

No: ENRE01369510

This registration certificate is issued by the administering authority and takes effect from 30 April 2010.

The anniversary day for the purposes of the Annual Return is 30 April each year.

This registration certificate is a requirement of section 73F of the Environmental Protection Act 1994 and authorises the registered operator to undertake the activities listed below at the following place, subject to the conditions set out in a development approval attached to the premises, or the relevant code of environmental compliance.

Registered Operator:-
Port of Brisbane Corporation
Locked Bag 1818
Port of Brisbane QLD 4181

Development Approval Number:-
SPDE00100610

Place:-
Port of Karumba

Registered Activity/ies: -
ERA 16 Extractive and screening activities Threshold 1(c) - dredging, in a year, more than 100000t to 1000000t of material

Mark Cavicchiolo
Delegate
Department of Environment and Resource Management
Administering authority
Environmental Protection Act 1994

30-APR-2010
This notice is issued by the Department of Environment and Resource Management pursuant to section 376 of the Sustainable Planning Act 2009 ("the Act").

Ports North
PO Box 594
CAIRNS QLD 4870

cc. Ports North
PO Box 594
CAIRNS QLD 4870
Your reference: 07-95-72 MCCP

Department of Transport & Main Roads
Maritime Safety Queensland
PO Box 1787
CAIRNS QLD 4870

Our reference: 274170

Re: Request to change a development approval

1. The Chief Executive, Department of Environment and Resource Management (DERM) as assessment manager received a request to change a development approval on 07-DEC-2010.

2. Details of the development approval for the original application

   Date original application made or referred to DERM: 22-MAR-2010
   Development approval applied for: Development Permit
   Aspect(s) of development:

   Operational work – For tidal works or work within a coastal management district
   Sustainable Planning Regulation 2009 - Schedule 3, Part 1, Table 4, item 5
   DERM ref. no: 274170
   Permit no: SPDC00281210

   Property/Location description: Port of Karumba
   Date of decision for the original application and development approval: 08-JUNE-2010
3. The decision for the request to change a development approval made on 07-DEC-2010 is to approve the request with conditions.

4. The name and address of each referral agency is as follows:

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<td>Advice Agency</td>
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<tr>
<td>Department of Transport &amp; Main Roads</td>
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<tr>
<td>Maritime Safety Queensland</td>
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<td>PO Box 1787</td>
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5. Approved plans and specifications

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<th>Document Name</th>
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<tr>
<td>KA-015-001 sheet 2 of 2</td>
<td>Karumba Channel Realignment</td>
<td>26/11/10</td>
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<tr>
<td>Figure 00814-EN-DAL-0003 Rev. A</td>
<td>Port of Karumba proposed channel realignment sediment physical characteristics</td>
<td>17/12/09</td>
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<td>Figure 00814-EN-DAL-0001 Rev. A</td>
<td>Sediment sampling and analysis plan Port of Karumba entrance channel maintenance dredging Sediment sampling sites</td>
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</table>
Peter Stock
A/Principal Environmental Officer
Environmental Services
Coastal and Riverine,
North Region
Chief Executive, Department of Environment and Resource Management

Enquiries:
Filiz Tansley
Department of Environment and Resource Management
ES - Reg Serv – Far Northern - Cairns
PO Box 937
CAIRNS QLD 4870
Phone: (07) 4222 5307
Fax: (07) 4222 5070
Email: filiz.tansley@derm.qld.gov.au

20-JAN-2011

Attachments
DERM permit number SPDC00281210 with conditions
Referral agency response
Approved plans and specifications
DERM Permit number: SPDC00281210

Date application received: 07-DEC-2010
Permit type: Development Permit
Date of decision: 20-JAN-2011

Decision: For a decision notice the application is approved subject to conditions, and the assessment manager's conditions are stated in this permit.

Relevant laws and policies: Coastal Protection and Management Act 1995 and any related statutory instruments and subordinate legislation

Jurisdiction(s): Sustainable Planning Regulation 2009 - Schedule 3, Part 1, Table 4, item 5

Development Description(s)

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<td>Tidal works or work within a coastal management district</td>
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<tr>
<td>Port of Karumba entrance channel</td>
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Reason(s) for inclusion of conditions

In accordance with section 289 of the Sustainable Planning Act 2009 the reasons for the inclusion of development conditions are:

The Department of Environment and Resource Management is assessment manager under the Sustainable Planning Act 2009 for coastal management under the Coastal Protection and Management Act 1995.

---

1 Permit includes licences, approvals, permits, authorisations, certificates, sanctions or equivalent/similar as required by legislation administered by the Department of Environment and Resource Management.
Peter Stock
A/Principal Environmental Officer
Environmental Services
Coastal and Riverine,
North Region
Chief Executive, Department of Environment and Resource Management

20-JAN-2011
CONDITIONS

PC1 All works are to be constructed in accordance with the attached approved drawings and specifications listed in the approved plans section in the notice attached to this development permit.

PC2 The chief executive administering the Coastal Protection and Management Act 1995 may order the works to be removed or modified, within a reasonable time, if the works have or are likely to have a significant effect on coastal management because the works:

(a) create a navigation hazard or other danger to the public; or
(b) cause erosion or land degradation; or
(c) are unstable or have not been constructed according to the approved plans.

Referral Agency conditions:
There are no conditions issued by the referral agencies for this permit

END OF CONDITIONS
11 January 2011

Adam Fletcher
Environment Manager
Ports Corporation Limited
PO Box 594
Cairns QLD 4870

Dear Adam

Lodgement of a development application pursuant to section 260 of the Sustainable Planning ACT 2009 Port of Karumba

Thank you for your letter dated 2nd December 2010 in relation to the above Development application.

I wish to advise Maritime Safety Queensland has no objections to the application for relocation of the Channel Boundary in the vicinity of No 10 Beacon

Please do not hesitate to contact our office should you have any further queries on the application.

Yours sincerely

Captain Alan Booth
Regional Harbour Master (Cairns)
Sustainable Planning Act 2009

DERM Permit number: SPDE00100610

This document replaces the document issued on 21-APR-2010

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Decision: For a decision notice the application is approved subject to conditions, and the assessment manager's conditions are stated in this permit

Relevant laws and policies: Environmental Protection Act 1994 and any related statutory instruments and subordinate legislation

Jurisdiction(s): Sustainable Planning Regulation 2009 - Schedule 3, Part 1, Table 2, item 1

Development Description(s)

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<tr>
<td>Port of Karumba</td>
<td>Port of Karumba entrance channel ERA 16-1(c) Dredging material &gt;100,000 – 1 million t/yr</td>
</tr>
</tbody>
</table>

Reason(s) for inclusion of conditions

In accordance with section 269 of the Sustainable Planning Act 2009, the reason(s) for inclusion of conditions stated in this permit required by the concurrence agency response for the application are as follows:

1) The Department of Environment and Resource Management is a concurrence agency under the Sustainable Planning Regulation 2009 for the purposes of the Environmental Protection Act 1994.

2) Any development conditions placed on this permit for an environmentally relevant activity are in accordance with section 73B of the Environmental Protection Act 1994.

1 Permit includes licences, approvals, permits, authorisations, certificates, sanctions or equivalent/similar as required by legislation administered by the Department of Environment and Resource Management.

Queensland Government
Mark Cavicchiolo
Principal Environmental Officer
Environmental Services
Coastal and Riverine,
North Region
Chief Executive, Department of Environment and Resource
Management

23-FEB-2011
CONDITIONS

Conditions for ERA 16 Extractive or screening activities Threshold 1(c) – Dredging material >100,000 – 1 million t/yr

Interest: General

Limitations of permit

G1 This development permit attaches to the part of the port area defined by the map in Attachment 1.

G2 This development permit authorises ERA 16 (dredging) that is for capital and maintenance work on lawful work as specified by the diagrams in Attachment 2.

G3 The port authority of the port area to which this permit attaches must maintain direction of any operator carrying out an activity authorised by this permit.

Prevent environmental harm

G4 The operator must ensure that environmental harm is not caused by this ERA except where specifically permitted by a condition of this development permit.

Maintenance of measures, plant and equipment

G5 The operator must:
   (a) install all measures, plant and equipment necessary to ensure compliance with the conditions of this development permit
   (b) maintain and calibrate such measures, plant and equipment in an efficient condition and keep records of the maintenance
   (c) operate such measures, plant and equipment in an efficient manner.

Integrated environmental management system (IEMS)

G6 The operator must implement an integrated environmental management system (IEMS) from (the commencement of this ERA or specified date). The IEMS must identify all causes of environmental harm, including but not limited to the actual and potential release of any contaminants, the nature of the environmental harm and the actions that will be taken to prevent environmental harm being caused. The IEMS must be made available to the Administering Authority when requested.

The IEMS must achieve the following outcomes:
   (a) material intended to be dredged under this permit is tested and analysed in accordance with the latest version of the National Assessment Guidelines for Dredging 2009
   (b) significant and sensitive receptors (including for example wetland and ecosystem features) in the port area are identified and mapped
   (c) environmental aspects and potential impacts are identified
   (d) control measures that minimise the potential for environmental harm are in place
   (e) contingency plans and emergency procedures are in place
   (f) organisational structures, accountability and responsibility is recorded
   (g) arrangements for effective communication are documented and undertaken
   (h) all contaminant releases are monitored
   (i) staff are trained and aware of the requirements of this permit
   (j) appropriate records are kept
   (k) reviews of environmental performance and continual improvement are undertaken periodically.

G7 The IEMS must not be implemented or amended in a way that contravenes any condition of this development permit.
Monitoring Plan for 2011 and subsequent dredging programs

G8 The operator must implement a monitoring plan that complies with the latest version of the Administering Authority’s Water Quality Sampling Manual from the commencement of this ERA.

The monitoring plan must achieve the following outcomes:
(a) long-term ecological impacts associated with dredging operations are monitored
(b) compliance with the conditions of this development permit is monitored
(c) operations are adjusted in response to monitoring results to ensure compliance with development permit conditions.

G9 The monitoring plan must include (but not be limited to) the following:
(a) a description of the dredge equipment to be used, including the discharge points for turbid waters
(b) a plan for the lawful disposal of the dredged material
(c) a list of environmental values located within and adjacent to the dredge operation
(d) the methods for collection and analysis of the samples (including specific areas to be monitored, when monitoring is to be undertaken and duration of monitoring)
(e) the methods of analysing the data and responding to the results.

Records

G10 The operator must maintain a record of sites where dredging is carried out (specifying the boundaries of the dredged area by GPS coordinates) and the volume of material removed from each site (to the nearest tonne), and submit these records to the port authority.

G11 The port authority must maintain a record of all documents or information provided under condition G11 and all monitoring results required by this permit.

G12 All records required by this permit must be kept for five years and be made available to the administering authority upon request.

Complaint response

G13 The port authority must record the following details for all complaints received and provide to the administering authority upon request:
(a) time, date, name and contact details of the complainant
(b) reasons for the complaint
(c) details of investigations undertaken by the port authority
(d) conclusions formed
(e) actions taken to resolve the complaint.

Notification

G14 Any incident of environmental harm (including a reasonable suspicion that environmental harm has or is likely to have occurred) outside the lawful work as specified in condition G2 must be reported as soon as practicable to the relevant DERM regional office.

Interest: Air Nuisance

A1 The release of airborne contaminants from the activity must not cause environmental nuisance.

Interest: Noise Nuisance

N1 Noise from the activity must not cause environmental nuisance.

Interest: Water

Release of contaminants

W1 Contaminants must not be directly or indirectly released to waters other than wastewater released from the discharge point during the loading and unloading of dredge spoil.
W2 In carrying out the ERA, the release of contaminants (including any release caused by extraction of material from the bed of waters) must:
(a) only occur within the permitted areas specified in condition G2
(b) not have any properties which are capable of causing environmental harm
(c) not produce any slick or other visible evidence of oil or grease, nor contain visible floating oil, grease, scum, litter or other objectionable matter
(d) be carried out taking all practical measures necessary to minimise the concentration of suspended solids released during the loading and pump-out of the vessel.

Equipment

W3 Any dredging must be conducted using equipment that is in survey and registered and, in relation to environmental performance, is equal to or better than the following equipment:
(a) Trailing Suction Hopper Dredge that is equipped, as a minimum, with:
   (i) below keel discharge of tail waters via an anti-turbidity control valve
   (ii) on-board systems for determining solids to water ratio or density of dredged material
   (iii) electronic positioning and depth control system for defining the location and depth of dredging activities
   (iv) dredge heads and depth control capable of, and where appropriate, fitted with fauna exclusion devices (e.g. turtle deflectors).
(b) Cutter Suction Dredge that is equipped, as a minimum, with:
   (i) electronic positioning and depth control system for defining the location and depth of dredging activities
   (ii) continuous delivery connection (e.g. floating or submerged pipeline) to an approved placement site
   (iii) a system or process to ensure the delivery system integrity is maintained at all times
   (iv) systems for determining solids to water ratio or density of dredged material during operations.
(c) Grab Dredge that is equipped, as a minimum, with:
   (i) electronic positioning system for defining the location and depth of dredging activities.

Placement of dredge material

W4 Dredging must not start until provision has been made to lawfully place or dispose of the dredge material. Evidence of applicable approvals must be made available to the administering authority when requested.

Placement of dredge material at sea

W5 Material dredged under this permit must not be placed at sea except at a place authorised under an authority, licence or other permit issued by either or both the Commonwealth or Queensland governments to receive the dredged material.

Monitoring for 2010 dredging program

W6 Monitoring must be undertaken and records kept of receiving water quality potentially impacted by the dredging operations for the quality characteristics and not less frequently than specified in Table 1 - Receiving water release limits. All determinations must be made in accordance with methods prescribed in the latest edition of the Department of Environment and Resource Management's Water Quality Sampling Manual.
### Table 1 – Receiving water release limits

<table>
<thead>
<tr>
<th>Quality characteristics</th>
<th>Monitoring point</th>
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<th>Release limit</th>
<th>Monitoring frequency</th>
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<tr>
<td></td>
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<td></td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Turbidity</td>
<td>W1&lt;sup&gt;1,W2&lt;/sup&gt;</td>
<td>NTU</td>
<td>-</td>
<td>Either: background plus 25% or 62NTU, whichever is the greater value, for a duration of no more than 72 hours</td>
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<tr>
<td></td>
<td>W3&lt;sup&gt;2&lt;/sup&gt;  (background)</td>
<td>NTU</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<sup>1</sup> W1 - The edge of the seagrass beds at Alligator Point
<sup>2</sup> W2 - The edge of the seagrass beds at Alligator Point, no closer than 100m from W1.
<sup>3</sup> W3 - Background: at least 100m up-current of the dredging operations, at a site experiencing similar wind, wave and tidal conditions as W1 and W2. Sampling must be undertaken within 1 hour of sampling from W1 and W2.

### Notes:

- **W7** If the receiving water release limit in Table 1 is exceeded at either W1 or W2, dredging operations must be amended to achieve compliance with the limit.
- **W8** Monitoring results must be made available to the administering authority upon request.
- **W9** Monitoring must be done by a competent person in accordance with methods set out in the latest version of the administering authority's water quality sampling manual.

---

**END OF CONDITIONS**
Definitions

Words and phrases used throughout this guideline are defined below. Where a definition for a term used in this guideline is sought and the term is not defined within this guideline, the definitions provided in the relevant legislation must be used.

dredging includes extraction of mud, sand, coral, ballast, shingle, gravel, clay, earth and other material from the bed of Queensland tidal and non-tidal waters. Dredging does not include the banks of a waterway.

lawful work means work in accordance with a development permit. For the purposes of this guideline and model conditions, lawful work is limited to the following work:
   (i) berth pockets, and approach and departure aprons
   (ii) navigation channels
   (iii) swing basins.

integrated environmental management system for an environmentally relevant activity or activities, means a system for the management of the environmental impacts of the carrying out of the activity or activities.

maintenance work on lawful work means maintaining works in accordance with the development approval. Examples of maintenance work include excavation of material for repair or maintenance of the approved dredge basin. Examples of work not considered to be maintenance work include work to extend the boundaries of an approved dredge basin in any dimension (including depth) or any new dredging not covered by a development approval.

operator means any of the following:
   (i) a person having the benefit of this development permit
   (ii) the holder of a registration certificate for this development permit
   (iii) anyone undertaking the activity to which this development permit relates (Note: it is an offence to carry out work under a development permit without a relevant registration certificate).

port area means as defined in section 267 of the Transport Infrastructure Act 1994

port authority means as defined in schedule 2 of the Transport Infrastructure (Ports) Regulation 2005
25th January 2011

Adam Fletcher
Environment Manager
Ports Corporation Limited
PO Box 594
Cairns QLD 4870

Dear Adam,

Lodgement of a request to change an existing development approval SPDE00100610 pursuant to section 260 of the Sustainable Planning ACT 2009 Port of Karumba.

Thankyou for your letter dated 14th January 2011, received in this office 17th January 2011 in relation to the above request for change to an existing development approval.

I wish to advise Maritime Safety Queensland has no objections to amend condition G2, being replacement of diagram in Appendix 2 with a new drawing. The new drawing specifies a further realignment of a portion of existing approved shipping channel design as per drawings specification, to minimise requirements for maintenance dredging of that portion.

Please do not hesitate to contact our office should you have any further queries on the application.

Yours sincerely,

[Signature]

[Department of Transport and Main Roads]
Maritime Safety Queensland
Marina Operations (Cairns)
Floor 1 Tingle Street
64-66 Tingle Street Portsmith Queensland 4870
PO Box 1787 Cairns Queensland 4870
Appendix 4

2009 Karumba Sediment Analysis Plan (SAP) Report

Extract (excludes Laboratory Reports)

Port of Karumba

Entrance Channel Maintenance Dredging
Sediment Characterisation Report
Port of Karumba Entrance Channel Maintenance Dredging, 2009

30 November 2009
Disclaimer

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EXECUTIVE SUMMARY

WorleyParsons was commissioned by Far North Queensland Ports Corporation Limited (FNQPC) to undertake analysis and reporting for sediments to be dredged as part of routine maintenance dredging within the Entrance Channel to the Port of Karumba. Biennial maintenance dredging is required within the Entrance Channel to maintain a navigable depth of -3.4m LAT for vessels entering/leaving the Port. Between 395,000m³ and 613,000m³ may be required to be dredged from the Entrance Channel on a biennial basis. For the 2010 maintenance dredging campaign it is expected that an additional 100,000m³, ie 613,000m³, will be required due to the influence of tropical cyclone Charlotte which passed through the area in January 2009 mobilising large amounts of sediment. Maintenance material is disposed of at sea in the approved spoil ground located approximately 1.5km west of the outermost extent of the Entrance Channel. Sampling was completed in accordance with the approved SAP.

Minor capital dredging is also currently being considered to optimise the position of the channel in the kink area and take advantage of the deeper channel bathymetry to reduce future maintenance dredging volumes. Requirements for sampling in this area were carried out in accordance with the approved SAP which DEWHA assessed as meeting the sampling requirements of the channel alignment under consideration.

A total of 11 sites were sampled for chemical analysis within the Entrance Channel and a further 45 sites were sampled for physical characterisation on the southern bank of the Entrance Channel in the area being considered for channel realignment. The chemical analysis sites were consistent with those sampled in previous sampling programs to provide spatial and temporal consistency. Samples for chemical analysis were collected using a piston corer where possible and where necessary, due to the nature of the sediments, a stainless steel van-Veen grab sampler was used. All samples for physical characterisation only were sampled using the van-Veen grab sampler.

Samples collected for chemical analysis were placed in a stainless steel mixing bowl and homogenised before being placed in laboratory supplied sample jars. Collected samples were transported under refrigerated conditions to the primary analytical laboratory (ALS) and secondary analytical laboratory (AAA) within required holding times. Samples were analysed for metals, tributyltin and particle size distribution.

Sediment particle size distribution showed a trend of decreasing sand content moving offshore. This trend appeared to be correlated with metal contaminant concentration which increased moving offshore. The indication is that metal contaminants appear to be bound to the silt and clay fractions of the sediment.

Chemical analysis of sediments within the Entrance Channel maintenance dredging area identify that all contaminants are below respective NAGD screening levels. In addition, power analysis confirmed that the sample program was sufficient to make a statistically valid comparison of results with the NAGD screening levels.
Comparison of results with previous testing indicates that results are comparable in concentration level and trend. That is, although not as distinct, contaminant levels in previous years have also shown a general trend of increasing in concentration moving offshore.

Overall, results have shown that according to the NAGD, maintenance material within the Entrance Channel is suitable for unconfined placement at sea in the approved spoil ground.
1. INTRODUCTION

1.1 Background

Far North Queensland Ports Corporation Limited (FNQPC) took over management for the Port of Karumba from Ports Corporation Queensland (PCQ) in July 2009. The Port of Karumba is accessed by an Entrance Channel that extends from the mouth of the Norman River seaward. FNQPC proposes to undertake maintenance dredging of the Entrance Channel to maintain a navigable depth of -3.4m LAT for vessels entering/leaving the Port. Routine maintenance dredging of the entrance channel is required approximately every two years to remove accumulated sediments and maintain navigable depths. Recent dredging history indicates that between 395,000m$^3$ and 513,000m$^3$ may be required to be dredged in any one typical maintenance dredging campaign. However, due to additional siltation resulting from tropical cyclone Charlotte in January 2009 up to an additional 100,000m$^3$ would be required in the 2010 campaign to restore full navigable dredge depth.

Minor capital dredging is also currently being considered to optimise the position of the channel in the kink area and take advantage of the deeper channel bathymetry to reduce future maintenance dredging volumes.

Activities at the Port are dominated by MMG Century (formerly OzMinerals) who commenced exporting zinc concentrate through the Port in December 1999. Zinc slurry is piped approximately 300 km from the mine to the Port, dewatered, and loaded onto a 5,000 tonne transfer vessel, the Wunna, for the 40 km journey to export ships that anchor in deep water in the Gulf of Carpentaria. Other facilities in the Port provide for general cargo, fuel and the export of live cattle.

1.2 Sediment Sampling and Analysis Plan

A Sediment Sampling and Analysis Plan (SAP) was developed and submitted to the Department of Environment, Water, Heritage and the Arts (DEWHA) in September 2009. Following a request for further information from DEWHA the SAP was resubmitted and approved in October 2009. The SAP was developed in accordance with the National Assessment Guidelines for Dredging (NAGD) and provided the proposed plan for the sampling and analysis of sediments within the Entrance Channel.

The minor capital dredging which is under consideration was also addressed in the approved SAP, to which DEWHA stated that the amended SAP 'meets the requirements for the channel realignment as marked on the supplementary information'. Hence, sampling associated with this consideration was completed in accordance with the approved SAP.

This sediment characterisation report has been completed in accordance with the approved SAP, with variations detailed as required.
1.3 Project Objectives

WorleyParsons was commissioned by FNQPC to characterise sediments proposed for maintenance dredging in accordance with the approved SAP and the National Assessment Guidelines for Dredging (NAGD). The objectives of this project are to:

- Undertake the sediment sampling and analysis program according to the SAP study methods;
- Test and analyse for a range of physical and chemical properties; and
- Provide a comparison of contaminant concentrations against the NAGD.

1.4 Previous Studies

Detailed sediment quality investigations have been completed in 2002 and 2004. Conclusions from these investigations identified that sediments within the Entrance Channel were compliant with the relevant adopted guidelines and hence suitable for unconfined ocean disposal at the approved spoil ground.
2. METHODS

2.1 Sampling Protocols

The field sampling program was conducted between 30 October and 2 November, 2009. Field sampling for chemical analysis prior to dredging was completed for a total of 11 sites within the Entrance Channel (Table 2-1). A further 45 sites were physically characterised on the southern bank of the Entrance Channel in support of proposed channel alignment changes (Table 2-2). Sampling locations were sited using a Garmin Map 76 CSx with an accuracy of ±5m. Sampling was conducted within 10m of the established location coordinates.

A map showing all sampling locations is provided in Figure 2-1.

Table 2-1: GPS location of sites for chemical analysis within the Entrance Channel (UTM - MGA 54, GDA 84)

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Table 2-2: GPS location of sites for physical characterisation on the southern bank of the Entrance Channel (UTM - MGA S4, GDA 94)

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</tr>
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<td>B14</td>
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</tr>
<tr>
<td>B15</td>
<td>0473130</td>
<td>8071580</td>
</tr>
</tbody>
</table>
2.1.1 Sample Collection

Samples for chemical analysis were collected using a boat deployed piston corer. The corer was constructed of stainless steel, and had an internal barrel length of 1.0m and internal diameter of 60mm. The corer was lowered over the side of the vessel to the seabed using extension rods. The corer was used to collect a sediment core to 1m of depth, or until refusal was met. Once a sediment core had been collected, the piston corer was retrieved to the surface and extruded manually into a stainless steel mixing bowl for sample processing and containment. At each location between three and five cores were taken to obtain the necessary sample volume for chemical analysis.

Where sediments were not able to be retained within the piston corer upon retrieval (ie loose sands), a stainless steel van-Veen Grab Sampler was used to collect surface sediments. This required the grab sampler being lowered over the side of the boat until it reached the seabed. Upon retrieval the grab closed, retaining a sample from the surface of the seabed. Once onboard the vessel, the grab sampler was emptied into a stainless steel mixing bowl for sample logging, processing and containment. At each location 10 or more grabs were taken to obtain the necessary sample volume for chemical analysis.

Sediment at sites which underwent physical characterisation only was also collected using a stainless steel van-Veen Grab Sampler. Methods for deployments and retrieval were as per those described above. Sediments were also emptied into stainless steel mixing bowls for physical characterisation. Between one and five grabs were taken at each site to obtain sufficient material to physically characterise sediments.

2.1.2 Sample Processing

Sediment sample material designated for chemical analysis was homogenised in a large stainless steel mixing bowl using powderless gloved hands. Samples were then placed in sample containers with zero headspace and stored in chilled eskies before being consigned under chain-of-custody documentation to the analytical laboratories, Australian Laboratory Services (ALS), Ecotox Services Australia, and Advanced Analytical Australia. Following receipt at the laboratories samples were stored under refrigerated conditions prior to analysis. The jars for chemical analysis were solvent washed, acid rinsed glass jars with Teflon lined lids, provided by the analytical laboratories.

A description of each site was recorded detailing the following information:

- Name of client;
- Sampling date;
- General location of sample collection;
- Sampling location number and sample identifiers assigned;
- Name of the sample collector;
Type of sample used;
- Weather conditions at the time of sampling;
- Sea state at time of sampling;
- General comments (e.g. wind speed, level of shipping traffic etc);
- GPS location;
- Time of sampling;
- Water depth at each sampling location; and
- Photograph of each sediment sample.

A sediment log of each sample was recorded on a field data sheet, providing a description of the composition of each sample, including the following information:

- Colour;
- Field texture;
- Observed sand grain size;
- Plasticity;
- Moisture content of sample (e.g. wet, moist, dry);
- % stones;
- Presence of shell/shell grit and organic matter; and
- Odour (e.g. Marine, sulphurous).

2.1.3 Variations from the Approved SAP

As indicted in Section 2.1.1, some sites were unable to be sampled using the piston core method outlined in the approved SAP. Piston coring was attempted at each site, however due to the nature of the sediments this method was unsuccessful at seven of the 11 sites. At each of these sites the piston core reached refusal at a maximum of 40cm. The coarse sandy nature of the sediments meant that material was not able to be contained within the piston core and hence the van-Veen grab sample was used to obtain a sample.

The approved SAP identified, based on previous sampling, sediments within the top 1m are homogenous and hence composting of a 1m core was allowed. Based on this assessment, it is considered that samples collected using the van-Veen grab sampler, ie surface layer only, are representative of the full depth of material required to be dredged.
2.2 Analysis Protocol

2.2.1 Sediment Laboratory Analysis

Sediment analysis was completed by two National Association of Testing Authorities (NATA) accredited laboratories:

- Australian Laboratory Services (ALS); and
- Advanced Analytical Australia (AAA).

ALS provided primary laboratory services while AAA provided secondary laboratory services on split field triplicate samples. In the event that toxicity testing was required, hold material was also sent to Ecotox Services Australia for appropriate storage.

Table 2-3 provides a summary of the contaminant analyses completed for each sediment sample collected. Contaminant analysis was determined based on the approved SAP and included:

- Particle Size Distribution (PSD);
- Moisture Content;
- Total Organic Carbon (TOC);
- Trace Metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn); and
- Tributyltin (TBT).

Table 2-3: Sediment contaminant analysis undertaken at each sampling location

<table>
<thead>
<tr>
<th>Site</th>
<th>PSD</th>
<th>Moisture Content</th>
<th>TOC</th>
<th>Metals</th>
<th>TBT</th>
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<td>PSD</td>
<td>Moisture Content</td>
<td>TOC</td>
<td>Metals</td>
<td>TBT</td>
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<tr>
<td>------</td>
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<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
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</tbody>
</table>

### 2.2.2 Data Analysis

Contaminant levels for sediments are compared against screening levels listed in Table 2 of Appendix A of the NAGD to assess whether the material is suitable for sea disposal or if further testing is required (e.g., elutriate, bioavailability and/or direct toxicity assessment).

Assessment against screening levels involves the comparison of mean contaminant concentrations at the upper 95% confidence level (95% UCL) of the mean. For the purposes of calculating normalised values (i.e., organics) and 95% UCLs, values below detection limits were set to one-half of the laboratory detection limit (LOR) in accordance with NAGD recommendations. Results for organic parameters are normalised to 1% TOC where the recorded value is within the range of 0.2 – 10%. If TOC values are outside this range, then the highest or lowest of the 0.2 – 10% range is adopted as appropriate. Organic contaminants below detection limits were not normalised to 1% TOC in 95% UCL calculations.

The methods used to calculate the 95% UCLs were based on those required in Appendix A of the NAGD (PS8, Comparison of Data to Screening Levels). Normality of datasets was determined using Shapiro-Wilk's test and quantile-quantile plots in ProUCL Version 4 (4.00.02) developed by the US EPA. Datasets were determined as being normal, log-normal or neither in their distributions. Normal datasets were analysed using the 1-tailed student's UCL. Log-normal datasets were analysed using non-parametric jackknife analysis as recommended in the NAGD. Similarly, datasets that were neither normal nor log-normally distributed were analysed using non-parametric jackknife analysis.

Outcomes regarding the tests are presented in Table 3-2. Under the NAGD, if the 95% UCL values for all substances are below relevant screening levels, it is considered unlikely that sediment contaminants will have adverse effects on organisms living in or on that sediment. The sediment is therefore considered non-toxic and there are no chemical obstacles to unconfined sea disposal.
2.3 Quality Control

2.3.1 Quality Control – Field Sampling

Quality Control during sampling was ensured by:

- Using suitably qualified environmental staff and support personnel experienced in sediment sampling via piston core and grab sample, field supervision and sediment logging;
- Storing samples in appropriately cleaned, pre-treated and labelled sample containers that were provided by the analytical laboratory;
- Keeping samples cool in eskies containing bags of ice immediately after sampling, and stored with bags of ice until being transported to the laboratory in eskies containing ice-packs;
- Transportation of samples to the laboratories under chain of custody documentation;
- Blind labelling all field QC triplicate (split and replicate samples) samples with QC sample numbers that do not relate to the sampling location names; and
- Decontaminating all sampling equipment, including mixing bowls etc. between samples via a decontamination procedure involving washing with ambient sea water and a laboratory grade detergent (Decon 90), and successive rinsing with deionised water.

2.3.2 Quality Control – Laboratory Analysis

The laboratories used for sediment sample analysis are NATA accredited for the methods used and are experienced in the analysis of marine sediments.

Quality control procedures for contaminant assessment were used from sampling through to completion of laboratory analysis, including:

- Chain of Custody documentation;
- Field and intra-laboratory QC protocols; and
- Inter-laboratory analyses.

One field split triplicate was taken at site 6 and two field replicate triplicates were taken, one at site 12 and one at site 20.

Laboratory QC procedures were conducted in accordance with the requirements of Appendix F of the NAGD. These requirements included analysis of laboratory blank, certified reference materials, replicate and spiked samples.

A validation of the analytical analysis was undertaken in accordance with Appendix A of the NAGD to confirm that the data quality was suitable for undertaking an assessment to characterise material
proposed for dredging and disposal. Laboratory data validation included assessment of results for laboratory blanks, standards, surrogate and matrix spikes and duplicate samples.

Field data validation included calculation of relative standard deviation (RSD) for field split and replicate triplicate samples respectively, and comparison against laboratory and NAGD criteria.

Sediment samples were submitted to the laboratories as a single batch.
3. RESULTS

3.1 Sediment Physical Characteristics

Sediments were physically characterised in the field at each sampling location. In addition, samples were also collected from each location for analysis of particle size distribution. A graphical summary of PSD results is presented in Figure 3-1. Field log data summaries and photographs are provided in Appendix A and laboratory PSD analysis is provided in Appendix B.

![Graphical summary of particle size distribution analysis at each site within the Entrance Channel.](image)

Figure 3-1: Graphical summary of particle size distribution analysis at each site within the Entrance Channel.

Figure 3-1 identifies that there is a trend for decreasing clay and silt content and increasing sand content from offshore to inshore. Results of the PSD analysis identifies that sediments within the Entrance Channel are dominated by sands (mean 85.64%) (Table 3-1). The five most inshore sites (14 to 22) are relatively consistent in particle size distribution being dominated (83% - 92%) by sand, as are the three outer most sites (2 – 6) which are dominated (75% - 81%) by clay and silt fractions.
Table 3-1: Statistical summary of particle size distribution within the Entrance Channel

<table>
<thead>
<tr>
<th></th>
<th>Percent Gravel (&gt; 2 mm)</th>
<th>Percent Sand (0.06 - 2.00mm)</th>
<th>Percent Silt (2 - 60μm)</th>
<th>Percent Clay (&lt;2μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Samples</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Mean</td>
<td>3.36</td>
<td>65.84</td>
<td>9.18</td>
<td>21.82</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>3.80</td>
<td>30.27</td>
<td>10.71</td>
<td>21.38</td>
</tr>
<tr>
<td>Minimum</td>
<td>0</td>
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<td>1</td>
<td>3</td>
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<tr>
<td>Maximum</td>
<td>11</td>
<td>92</td>
<td>27</td>
<td>54</td>
</tr>
</tbody>
</table>

3.2 Sediment Chemical Results

Laboratory results obtained for the Entrance Channel are summarised in Figure 3-2 and Table 3-2. Primary laboratory analytical reports are provided in Appendix C and secondary laboratory analytical reports are provided in Appendix D. Results are compared against the screening concentrations listed in Appendix A Table 2 of the NAGD (Commonwealth of Australia, 2009).

METALS

- Arsenic was detected in eight of the 11 sites below NAGD screening levels. The three most inshore sites had no detection of arsenic. Arsenic showed a trend of increasing in concentration moving offshore, refer Figure 3-2;
- Cadmium was below detection levels at all sites;
- Chromium, lead, and zinc were above detection limits in all samples, but below respective NAGD screening levels. Each of these metals show a general trend of increasing concentration moving offshore, refer Figure 3-2;
- Copper was above detection limits at nine of the 11 sites and nickel was above detection limits at 10 of the 11 sites. All detections were below the respective NAGD screening levels. Both metals show a general trend of increasing concentration moving offshore, refer Figure 3-2;
- Mercury was below detection limits in all but two sites. Detections were below the NAGD screening level.


Figure 3-2: Detected metal concentrations (As, Cr, Cu, Pb, Ni, Zn) within Entrance Channel sediments.

Figure 3-3 demonstrates a strong relationship between particle size and metal contaminant concentration. The indication is that metals are bound within the silt and clay fractions of the sediment.
Figure 3-3: Relationship between particle size distribution and metal concentration for sediments within the Entrance Channel

**Tributyltin**

Tributyltin was below detection limits in all samples analysed.

### 3.3 Southern Bank Physical Characterisation

FNQPC are proposing to amend the alignment of the Entrance Channel between sites 10 and 12 in response to the natural movements of sediments within the area. It is anticipated that by altering the channel in this area the amount of maintenance material being dredged from the area can be reduced. As such, physical characterisation of the sediments in the proposed realignment area was completed to assist FNQPC in determining general benthic characteristics.

Field log sheets are included in Appendix A. Overall, field characterisation identified that sediments closest to the existing channel are predominantly silty sands with some clay nodules. Moving outwards from the existing channel sediments tend to be dominated by clays, some with a small sand/silt content. No seagrass was identified within this area.
3.4 Power Analysis

Power analysis was completed on the data set to determine the minimum number of samples required to make a statistically valid comparison of dredged sediments against the NAGD screening levels. The results of this analysis are reported in Table 3-2. Metals only were tested, as TBT was below detection levels. For all metals the statistical power is very high (1.0) and the number of samples required to make a statistically valid comparison against the NAGD screening level is two for all elements except nickel, which is three. This analysis confirms that the sample program (11 locations) was sufficient to determine the contaminant status of maintenance material within the Entrance Channel, and that valid conclusions regarding the contaminant status can be made.

3.5 Suitability of Maintenance Dredging Materials for Unconfined Placement at Sea

Table 3-2 presents the 95% UCL of the mean for sediments within the Entrance Channel. All contaminants analysed were below respective NAGD screening levels as were the 95% UCLs of the mean. As such, according to the NAGD assessment framework there are no chemical impediments to unconfined placement of maintenance material at sea.
<table>
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<th>Sample Date</th>
<th>NAGD Screening Level</th>
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<th>2/11/09</th>
<th>2/11/09</th>
<th>2/11/09</th>
<th>2/11/09</th>
<th>2/11/09</th>
<th>31/10/09</th>
<th>31/10/09</th>
<th>31/10/09</th>
<th>31/10/09</th>
<th>31/10/09</th>
<th>31/10/09</th>
<th>Mean/Geomean</th>
<th>Std Dev</th>
<th>95% UCL</th>
<th>Normal (N)</th>
<th>Log-Normal (L)</th>
<th>Neither (X)</th>
<th>Power at alpha = 0.05</th>
<th>No. samples required for Power of 0.8</th>
<th>No. samples taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Content (dried @ 103°C)</td>
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<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
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<td>-</td>
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<tr>
<td>Total Organic Carbon</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.00</td>
<td>2</td>
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</tr>
</tbody>
</table>
4. DATA VALIDATION

This section examines the validity of the analytical data obtained in the study. It provides the scientific confidence in the actual results presented.

4.1 Laboratory Accuracy and Precision

The primary laboratory (ALS) and secondary laboratory (AAA) incorporated a range of QA/QC methods to ensure accuracy of data. Laboratory QA/QC reports are included in laboratory reports in Appendix C (ALS) and Appendix D (AAA). Discussion of these is presented below.

4.1.1 Laboratory Blanks

Laboratory blanks are samples undertaken by the laboratory during sample analysis to assist in identifying any cross contamination of samples during laboratory preparation, extraction, or analysis. Analysis of laboratory blank samples should result in a concentration not exceeding the detection limit for a particular contaminant. An assessment of laboratory blank samples reported by ALS and AAA demonstrates concentrations below the detection limit for all parameters, so cross-contamination does not appear to have occurred.

4.1.2 Laboratory Duplicates

The precision of analysis performed by the laboratory is determined by the calculation of the relative percent difference (RPD). The RPD is calculated based on a comparison of an intra-laboratory split of the sample material with results representing the percent difference between the two sample concentrations for a specific contaminant. While NAGDC states that the RPD should be within ±35%, both primary and secondary laboratories prefer to use a sliding scale to account for greater analytical uncertainty for contaminant concentrations nearer to the detection limit. The primary laboratory (ALS) uses the following protocol to assess laboratory duplicates:

- Results <10 times LOR: no limits;
- Results between 10 and 20 times LOR: 0% - 50%; and
- Results >20 time LOR: 0% - 20%.

The laboratory RPDs for the secondary laboratory (AAA) have been assessed using the following protocol:

- Results <10 times LOR: no limits; and
- Results >10 times LOR: 0% - 50%

Results from the primary laboratory indicate that all contaminants conform with the adopted protocols, so the level of precision for laboratory analysis is considered acceptable.
Laboratory duplicates for metals from the secondary laboratory were not assessed. Results of laboratory duplicates for TBT are within the adopted criteria.

4.1.3 Surrogate Spikes

Surrogate spikes are compounds similar in composition to the target analyte but are not likely to be present within the environment. Samples are spiked with the surrogate material and a calculation of the percent recovery of the spiked amount against the returned concentration is performed. The percent recovery result provides an indication of the ability of the laboratory to extract a specified contaminant type from the sample matrix. Typically surrogate spikes are performed only on organic compounds. NAGD states that recovery limits of 75% - 125% are generally acceptable.

Assessment of surrogate spike recoveries from the primary laboratory and secondary laboratory for tributyltin identify that all surrogate spikes conform to the NAGD criteria. Surrogate spikes were not completed for metal analysis.

4.1.4 Matrix Spikes

Matrix spikes are undertaken by the laboratory to identify the amount of interference from the sediment matrix on contaminant recovery. Samples collected from the field are split from the base sample and spiked with a known contaminant concentration. The percent recovery of the contaminant is then calculated.

The accuracy of the data is determined through analysis of spiked samples. NAGD recommends that “Recovery Rates [for matrix spiked samples] should be within the limits specified for the analysis method (typically 75-125%)”.

The primary laboratory (ALS) adopts a recovery rate of 70% to 130% for metals and 20% to 130% for tributyltin. According to this criteria, all matrix spike results are compliant. Matrix spike results are also compliant with the NAGD criteria.

The secondary laboratory (AAA) adopts the following criteria:
- Trace elements: 70% - 130%;
- Organic analyses: 50% - 150%;
- SVOC & speciated phenols: 10% - 140%;
- Surrogates: 10% - 140%

Results of matrix spikes from AAA identified that dibutyltin and tributyltin were non-compliant with the NAGD criteria, however all matrix spikes were compliant with AAAs own criteria as detailed above.

4.1.5 Field Split Triplicate and Replicate Triplicate Analysis
Table 4-1 provides a summary of field split triplicate and replicate triplicate samples, identifying any samples which exceed the NAGD RSD criteria. Results for the various analyses are discussed below.

**FIELD SPLIT TRIPlicate SAMPLE ANALYSES**

Field split triplicates are samples that are split from the original sample with two of the samples submitted to the primary laboratory and the third sample submitted to the secondary laboratory for analysis. Contaminant concentrations are compared between the split samples through calculation of the Relative Standard Deviation (RSD). The RSD value provides an indication of the accuracy of laboratory analysis between samples. One field split triplicate was collected.

Field split triplicate samples are collected to identify variation associated with sub sample handling. The NAGD states that RSDs for field split samples should be within ±50%. Assessment of the field split triplicate sample identified that all contaminants are within the 50% criteria value. Table 4-1 provides the results of split triplicate analyses.

Based on RSD data analysis for the field split triplicate sample, sub-sample handling was undertaken effectively to a standard that ensured sample contaminant concentrations were representative of sampled sediments.

**FIELD REPLICATE TRIPlicate ANALYSES**

Two field replicate triplicate samples (i.e. three separate samples collected in the field at a given sampling location) were collected to test for sediment homogeneity. Contaminant results were compared through calculation of the Relative Standard Deviation (RSD). According to NAGD:

> "Field replicates (that is, two separate samples taken at the same location) should agree within an RPD (or for three samples at the one location, the relative standard deviation, RSD) of ±50%, although they may not always do so where the sediments are very inhomogeneous or greatly differing in grain size."

All RSD results for the replicate triplicate samples were compliant with the NAGD criteria, indicating that sediments within the dredge area are relatively homogenous.
### Table 4-1: Field replicate triplicate and split triplicate results

<table>
<thead>
<tr>
<th>Sample</th>
<th>Date Sampled</th>
<th>Moisture Content</th>
<th>Arsenic</th>
<th>Chromium</th>
<th>Copper</th>
<th>Lead</th>
<th>Nickel</th>
<th>Zinc</th>
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<td></td>
<td></td>
<td>Units</td>
<td>%</td>
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<td>mg/kg</td>
<td>mg/kg</td>
<td>mg/kg</td>
<td>mg/kg</td>
<td>%</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>6</td>
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<td>12.2</td>
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<td><strong>RSD</strong></td>
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<td><strong>7.69%</strong></td>
<td><strong>7.45%</strong></td>
<td><strong>7.26%</strong></td>
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<td>ND</td>
<td>8.65</td>
<td>5.59%</td>
<td>2.17%</td>
<td>ND</td>
</tr>
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</table>

### 4.2 Holding Times

Samples were kept chilled whilst in the field (using eskes and bags of ice), during storage (kept in refrigeration) and during delivery (using eskes and ice packs), and stored under refrigeration at the laboratories. All contaminant analyses were undertaken within required holding times by the primary laboratory (ALS) and the secondary laboratory (AAA).
5. CONCLUSIONS

Chemical analysis of sediments within the Entrance Channel maintenance dredging area identify that all contaminants are below respective NAGD screening levels. In addition, power analysis confirmed that the sample program was sufficient to make a statistically valid comparison of results against the NAGD screening levels.

In January 2009 tropical cyclone Charlotte mobilised large amounts of sediments, possibly causing the considerable amount sand deposition within the Entrance Channel, particularly inshore of the sand bank located to the north of site 14 and 16. Inshore sites were identified as having a much higher sand content than those offshore, which corresponded with a decrease in metal contaminant concentration. A strong relationship between metals concentrations and clay/silt distribution reflects the natural binding of metals within the silt and clay fractions of the sediments. Clays and silts maintain a high surface area, compared to sand particles, and due to their surface chemistry are more likely to adsorb organics and heavy metals (ANZEC/ARMCANZ, 2000).

Comparison of results with previous testing indicates that results are comparable in concentration level and trend. That is, although not as distinct, contaminant levels in previous years have also shown a general trend of increasing in concentration moving offshore, again, related to particle size distribution.

Results have shown that according to the NAGD, maintenance material within the Entrance Channel is suitable for unconfined placement at sea in the approved spoil ground.
6. REFERENCES


Appendix 5

CSIRO Advice about Prawn Season and Dredge Window

Port of Karumba

Entrance Channel Maintenance Dredging
Dear Mr Fletcher,

I refer to your correspondence dated December 8th, 2009 in which the FNQPC is planning to submit an application for a 10 year sea-dumping permit with DEWHA. A component of the application will be a Long Term Management Plan (LTMP) for maintenance dredging at the Port of Karumba.

As advice to the TACC, I have provided information on the timing of a ‘dredging window’ for dredging in the navigation channel of the Norman River. It is worth noting that previously the Management of the Northern Prawn Fishery has supported a dredging window from May 1st to September 30th, as appropriate depending on the year.

You have asked for comment; a summary letter for inclusion in the LTMP and Application:

- Status of understanding of prawn recruitment processes in the southern Gulf;
- Any comment on influences of past dredging activity in prawn recruitment movements;
- Triggers or mechanisms by which the existing ‘dredging window’ may be adjusted;
- Comment on the forecast date of completion of juvenile prawn emigration and possible timing for dredging in early 2010;
- Any other relevant comments.

**Status of understanding of prawn recruitment processes in the southern Gulf**

The biology of banana prawns in the southern Gulf of Carpentaria is well understood. The period from October to January is a critical time window for the nearshore spawning and inshore advection to estuarine nursery habitats of the postlarvae of the banana prawn (*Penaeus merguiensis*) in the south east Gulf of Carpentaria. December to April is a critical time window for the emigration of large juvenile and sub-adult banana prawns from the nursery habitats to the offshore fishing grounds.

I summarised their estuarine recruitment and emigration processes and timing in a letter to Mr Craig at Ports Corporation Queensland (PCQ) in June 2006. I include the letter for your interest.

I can inform you that CSIRO and Griffith University currently have a project sampling the estuarine prawn community, water quality and productivity indicators in the Norman River estuary. The first year of the sampling has been completed (these data have not been published). However, I can confirm that the abundance of postlarval and juvenile prawns that are resident in the estuary from October to March 2008/09, and their subsequent emigration, matches the timing described in the research conducted in the 1970’s and 1980’s in this region.

Moreover since 2003, CSIRO has conducted surveys of the nearshore area and fishing grounds offshore from the Norman River in February each year and good catches of sub-adult banana prawns are made. These prawns are recent emigrants from the estuary and inshore habitats.

**Any comment on influences of past dredging activity in prawn recruitment movements**

No scientific research has been undertaken on the effect that dredging (and elevated turbidity over a significant area) might have on prawn larvae and postlarvae entering the Norman River. Likewise, no scientific research has been undertaken on the effect that the disposal of spoil in the offshore dumping ground might have on sub-adult prawns in the shallow offshore areas adjacent to the estuary. It must be stated that past dredging activity has been undertaken outside the period October to April, so likely effects of dredging on prawn recruitment would have been avoided.

As previously stated to PCQ, there is a significant risk that clogging and elevated turbidity during October to December may interrupts a critical ecological process that supports the inshore recruitment.
of banana prawns. Dredging during the advection of larval and postlarval prawns may increase the mortality of these animals and reduce the subsequent fishery catch. There is a risk that the disposal of spoil before May each year may impact the population of newly-emigrated prawns that are moving offshore to deeper waters.

Furthermore in 2006, expert members of the Northern Prawn Resource Assessment Group were of the strong opinion that dredging during October to April (inclusive) should be avoided to reduce risk to the critical inshore stages in the life history of the banana prawns.

Triggers or mechanisms by which the existing ‘dredging window’ may be adjusted
The window for prawn spawning, larval advection and postlarval recruitment to the Norman River estuary is from October to January, during the late dry season. This process is reasonably consistent from year to year, but may be affected by early rainfall in December or January. Therefore there is no flexibility to allow dredging from October to January.

Triggers that may change the seasonal emigration behaviour of juvenile banana prawns are limited to major environmental perturbations, principally rainfall and flooding. Juvenile banana prawns emigrate from estuaries in large numbers during river flooding when salinity levels drop dramatically. Both small and large juvenile banana prawns are intolerant of freshwater, and their growth and survival decreases at salinities below about 20%. In tank experiments, no banana prawns kept at 5% salinity and ≥ 30°C survived after 65 days.

Significant rainfall occurs usually from January to April; possibly in December. Significant flooding during this period causes the estuarine stage of the banana prawn to leave the estuary for offshore habitats. This aspect of banana prawn ecology provides some flexibility in regard to the ‘dredging window’ in the March/April period each year. Flexibility of the dredging window is dependent on environmental cues at the time. In years of significant flooding when the Norman River runs fresh, it may be possible to dredge in April. In 2008 this was the case. PCQ requested to be able to dredge in April 2008. By chance that year, significant rainfall had occurred and the Norman River had major flood-water inputs. As well, the Northern Prawn Fishery (NPF) opened on March 26th so fishing activity was well underway by April. Members of the Northern Prawn Resource Assessment Group made an assessment that 2008 was a year when dredging could occur in April. I include the letter for your interest. However, they were adamant that April-dredging was suitable for 2008 only and could not be considered in subsequent years without assessment of environmental parameters for the year in question.

Comment on the forecast date of completion of juvenile prawn emigration and possible timing for dredging in early 2010
It is impossible to forecast the ‘completion of juvenile prawn emigration’ in 2010. Our data show effective emigration can occur up to May in any year. The timing of dredging should be planned post April 30th 2010. The caveat on this date would be significant and consistent rainfall and measurable river flooding in January-March 2010. Consultation with NPF Management to adjust the date would be highly desirable and is recommended.

You may like to note that our current estuary sampling in the Norman River continues through to March 2010. So in the event of a significant flood (as in 2009), CSIRO could provide real-time advice on the possibility of bringing forward the date for beginning dredging.

Yours sincerely,

Rob Kenyon
CSIRO Marine and Atmospheric Research

References
9th June 2006

Mr Sean Craig,
Ports Corporation Queensland,
GPO Box 409
Brisbane, 4001.

Dear Mr. Craig,

CSIRO Marine and Atmospheric Research (CMAR) has been involved with the Technical Advisory Committees (TACs) for the Norman (Karumba) and Mission (Weipa) Rivers for over 10 years, often considering port-access dredging programs. CMAR’s involvement with the TACs has been to advise on issues relating to fisheries and habitats (mostly the Northern Prawn Fishery) and how activities that support local port infrastructure might interact with fishery and ecosystem processes. Recently, CMAR was asked to provide an opinion on the suitability of the month of October to conduct dredging in the access channel for the Port of Karumba (the Norman River).

CMAR reiterated that the period from October to January is a critical time window for the nearshore spawning and inshore advection of the larvae and postlarvae of key prawn species that support a multi-million dollar fishery in the Gulf of Carpentaria; the Northern Prawn Fishery. The postlarval prawns move from offshore pelagic habitat to estuarine nursery habitats. December to April is a critical time for emigration from the nursery habitats, and recruitment to the offshore fishery, of the large juveniles and sub-adults of the same species. No scientific research has been undertaken on the effect that dredging and the disposal of spoil (and elevated turbidity over a significant area) might have on prawn larvae and postlarvae in the vicinity of the Norman River. However, the Norman River is a key nursery habitat for banana prawns (Penaeus merguiensis). As our past advice stated, there remains a significant risk that dredging and elevated turbidity during October may interrupt a critical ecological process that supports the inshore recruitment of key fishery species. Dredging during the advection of larval and postlarval prawns may increase the mortality of these animals and reduce the subsequent fishery catch.

Furthermore, on June 1st and 2nd 2006, the Resource Assessment Group (a sub-committee) of the Northern Prawn Fishery Management Advisory Committee met at the CSIRO Cleveland laboratories and discussed the proposed October dredging. Members of the Resource Assessment Group were of the strong opinion that dredging during the early stage in the life history of the banana prawns should be avoided. They do not support a dredging scheme that extends beyond September 30 (the historical end of the dredging time-window for ports in the Gulf of Carpentaria).

It should be noted that the Northern Prawn Fishery is experiencing significant economic hardship at the moment. The price that the fishers receive for their target species has slumped by 30-40% over that last 4-5 years, while the price of fuel has increased by much the same amount. Any activity that might reduce the recruitment of juveniles to their nursery habitats or the subsequent catch will have a significant economic impact on the fishery and should be avoided. The situation is critical for some Gulf of Carpentaria fishers.

Below, I have included a short summary of the ecological processes that contribute to the successful recruitment of banana prawns to estuarine habitats and their subsequent offshore migration to the fishery. The summary should assist in understanding the interaction of dredging with the fishery.

Yours sincerely,

Rob Kenyon.
A short summary of the biology that underpins the prawn fishery and its interaction with dredging activity.

Historically, dredging in the port entrance of the Norman River at Karumba has been undertaken from April to 30th September. This time window was based on advice from CSIRO that the critical annual window for the inshore recruitment of postlarval and small juvenile banana prawns was October to March/April each year (Staples and Vance, 1985; Staples and Vance, 1987), followed by the emigration of large juveniles and sub-adults during December to April (Staples and Vance, 1986). Although the timing of cohorts of recruiting prawns varies by month from year to year (Staples and Vance, 1965; Staples and Vance, 1967; Vance et al., 1996), the period from October to December each year is critical to support the prawn stocks available on the Northern Prawn Fishery the following April/May (Crocos and Kerr, 1993). The banana prawn stock is an annual stock and individuals in the population have grown to a size that is large enough to be fished after about 6 months (Ye et al., 2006). The annual fishery opens about early- to mid-April and closes late-May to mid-June (Perdrew and Garvey, 2003). Thus, the prawns that support the fishery are about 6-8 months old and have recruited to inshore nursery habitats the previous October to December.

Although banana prawns spawn and recruit inshore at other times of the year; the September to December nearshore spawning and October to December inshore recruitment initiate the critical pulse of reproduction and growth of the prawn stocks for the subsequent fishery (Crocos and Kerr, 1983; Staples and Vance, 1986; van der Velde et al., in prep). Hence, October to December is a critical period for the inshore advection and settlement of larval and postlarval banana prawns, from the nearshore pelagic environment to the mouth of, and within, the Norman River.

Furthermore, not all prawn spawning is "effective spawning". To be effective, eggs (and subsequent larvae) must be released within an "envelope" of nearshore water from which they can access the estuary (Rothlisberg et al., 1996; Condie et al., 1999). Larvae move inshore through a combination of diel vertical migration in the water column (active at night) and subsequent tidally-cued migration (active in the water column on the flood tide, inactive on the substrate on the ebb tide) (Staples and Vance, 1985; Rothlisberg et al., 1995; Vance and Pendrey, 2001). The tidally cued activity, in particular, ensures that the larvae move inshore towards the estuary over the 3-4 weeks that they are pelagic animals (Dall et al., 1990; Vance and Pendrey, 2001). Once within an area where regular tidal streams produce a net inshore movement of the active larvae, the probability of them reaching the estuarine environment greatly increases. In effect, they are "advected" inshore on each flood tide. Successful advection is critically dependent on the hydrodynamic processes in the locality (Rothlisberg et al., 1996; Condie et al., 1999).

The nearshore region from which the prawn larvae can access the currents and tidal streams that move them inshore is called the "advective envelope" and defines the zone of "effective spawning", adjacent to inshore nursery habitats. It is a limited geographic area in which spawning must take place. If spawned outside this envelope, 2-3 week old postlarvae cannot access estuarine benthic habitats at a time when they transform from pelagic to benthic animals. Offshore from the advective envelope, larvae and postlarvae are lost to predation and demise in the open gulf (Rothlisberg et al., 1996).

As the postlarval prawns approach the mouth of the rivers, they cue to the flood tides. They are active early on each flood tide (spring tides enhance their activity and abundance) (Staples and Vance, 1985; Rothlisberg et al., 1996) and the animals that reach the estuary on each flood tide likely come from within a few kilometres offshore from the mouth of the estuary (Rothlisberg et al., 1995, 1996). At some estuaries, recruitment occurs from within a few hundred of metres of the estuary (Rothlisberg et al., 1995). The exact location and extent of this region have not been studied for the Norman River. Thus, dredging immediately offshore from the mouth of the Norman River would be most deleterious. The Ports Corporation documents (and our knowledge of the location of the channel) show that the dredging program will be in this vicinity, although the linear nature of dredging along the entrance channel may limit the effect of the dredge, given the breadth and geography of the area adjacent to the river mouth.

Were the decision made to allow dredging during October 2006, the effects of dredging may be ameliorated by dredging only on the ebb tide; in particular on the 1st and 2nd thirds of the ebb tide. Those benthic animals in the immediate vicinity of the dredge would still be impacted. However, the turbidity plume and disturbed water-body on the flood tide probably has a more extensive deleterious effect on active animals in the water column. The highly turbid water may disperse before the flood-tide active period of the banana prawn larvae.

In the area where intertidal and shallow banks restrict the inshore movement of postlarvae to a narrow channel of flood-tide waters, an active dredge potential would be to limit the numbers of postlarvae to similar extent as turbid plumes. This locality in the navigation channel would be inshore of Beacons 9 and 10; within and inshore of the "dog-leg" in the channel. Thus, completing the dredging in the nearshore sections of the channel prior to October would reduce the impact on prawn immigration. If the dredge operations were limited to the offshore-most sector of the channel in October (in the vicinity of Beacons 1-6), the dredge would be active in an area where (presumably) larvae and postlarvae are most dispersed. Offshore, the deeper water (~2.5 m) adjacent to the area of the dredged channel was more extensive and the density of larvae in this area should be more diffuse.

Bibliography (not all papers are cited, all provide background)


Van der Velde, T.D., Crocos, P.J., Evans, F. (In prep) Seasonal, spatial, and interannual variability in the reproductive dynamics of the banana prawn, *Peneaus merguiensis* de Man, in Albatross Bay, Gulf of Carpentaria, Australia. Marine and Freshwater Research, 00:00-00.

Ms. Nicola Rae,
Environmental Coordinator
Ports Corporation Queensland,
GPO Box 409
Brisbane, 4001.

Dear Ms. Rae,

CSIRO Marine and Atmospheric Research (CMAR) has been involved with the Technical Advisory Committees (TACs) for the Norman (Karumba) and Embley/Mission (Weipa) Rivers for over 10 years; advising on how activities that support local port infrastructure might interact with fishery and ecosystem processes. Recently, CMAR was asked to provide an opinion on the suitability of the month of April to conduct maintenance dredging in the access channel for the Port of Karumba (the Norman River).

CMAR reiterates that December to April is a critical time for emigration of juvenile banana prawns (Penaeus merguiensis) from the nursery habitats to recruit to the offshore fishery. The estuary of the Norman River is a key nursery habitat for banana prawns and dredging the entrance channel and dumping the spoil does impact the inshore phase of the banana prawn, and hence the fishery. The time window was based on advice from CSIRO that the inshore recruitment of postlarval banana prawns occurred from October to March each year (Staples and Vance, 1985; Staples and Vance, 1987), followed by the emigration of juveniles during December to April (Staples and Vance, 1986). The major cue for the emigration of juvenile prawns is a decline in salinity in the estuary caused by significant rainfall in the catchment (Staples and Vance, 1986).

During 2008 there has been early and continuing flood-rainfall in the catchments of many SE Gulf of Carpentaria rivers. Consequently, emigration cues for banana prawns likely have been triggered in December and January causing the prawns to move from the estuary to offshore. Considering this and other factors, the Northern Prawn Management Advisory Committee has decided to open the fishery on March 24th 2008 (i.e. the first season or banana prawn season 2008).

Furthermore, over the last few days I have consulted with the Resource Assessment Group (a sub-committee) of the Northern Prawn Management Advisory Committee on the proposed April maintenance dredging. Members of the Resource Assessment Group were of the opinion that dredging during April 2008 would be acceptable as the prawns that will contribute to this years catch will be established in offshore waters by April.

It should be noted that the suitability of April for dredging is confined to 2008 only and would need to be reassessed in the future. Historical data have shown that in years of late or minimal rainfall, emigration of banana prawns through the nearshore area including the entrance channel to the Norman River continues to occur during April (Staples and Vance, 1986).

In summary, I can relay to you that considering aspects of juvenile banana prawn biology, CMAR and stakeholders in the Northern Prawn Fishery do not see a significant negative impact of dredging in the entrance channel of the Norman River during April 2008. I reiterate that this acceptance of dredging in April is confined to 2008 only and would need to be reconsidered at any future time.

Yours sincerely,

Rob Kenyon,
CSIRO Marine and Atmospheric Research.
Bibliography


Appendix 6

Minutes of Technical Advisory Consultative Committee (TACC) Meeting

Port of Karumba

Entrance Channel Maintenance Dredging
MINUTES OF MEETING

Meeting: Karumba TACC  Date: 14 April 2010
Called by: GM-Operations Michael Barnett  Held at: Ports North Executive Meeting Room
Attendees: DERM-Mark Cavicchiolo  Apologies: DERM - Filiz Tansley
DEEDI-Michael Rasheed  MSQ- Bevis Hayward
MSQ-Nathan Best  NG-NRM – Riki Gunn/Noeline Gross
MMG Century Ltd - Alejandro de Bary

Meeting Commenced at 0920 am

Ross Byers joined the meeting by phone at 0950, and introduced acting environmental co-ordinator Alex de Bary for remainder of meeting.

Previous Minutes- Action Items – 2008 Karumba TACC chaired by Ports Corporation QLD

MB noted action items from that meeting had been confirmed as completed by Ports Corporation QLD, including;
- Placement of community notification in advance of the 2008 campaign, also noted Ports North will do the same for 2010 campaign.
- Circulation of PCQ presentation on dredge campaign was provided by PCQ to Zinifex.

Discussion:

TACC structure - representation

MC raised question of if Local Council was involved AF noted not in recent meetings. MC noted they have been at meeting - suggested they would be good future inclusion.
MC and MR reiterated need for local community input
AF advised Riki Gunn, Project Co-ordinator of Ghost Nets Program- NG-NRM has declined further involvement in TACC, and passed on the information to CEO Noeline Gross for another representative, possibly Olwyn Crimp. Confirmation to be sought by AF.
MB note about community represented at Port Advisory Group – noted community concern about closure to fishery, and life of MMG operations beyond the five years.
MR queried involvement of other reps involvement with the TACC over period back to capital campaigns and noted attendance by a broad cross-section of community and agencies, monitoring programs addressed concerns, and general reduction of interaction by some sections of community in recent times. Noted that commercial fishing interest had been represented by Claudine Ward.
Agenda Items

Dredging Schedule – Michael Barnett

2009 Bed Levelling Campaign – due to excess siltation as a result of the 2009 floods, approximately 780,000m³ of spoil in channel.

MB comment that SAP was completed in 2009, reported to DEWHA, and commenced process for obtaining sea dumping permit, and permanent approval for channel re-alignment. Noted the development for guidelines for 10 year permits by DEWHA, and that yesterday in Ports North meeting with DEWHA that a one year permit issue based on the draft LTMMP was to be made, and that permit will be issued to take into account views of DERM and DEEDI and any issues they have with the Plan, and then Ports North will reapply shortly thereafter for long term permit, using same document. 23 April will be last date Ports North is able to contract the dredge for this year’s campaign.

2010 campaign, was 780,000m³ of spoil in channel with estimated cost to remove of $9million, so looked at option to re-align the channel. Comment that by moving the channel to deeper water many have questioned why hadn’t it been done before. Quite extensive dredging to keep channel at beacon 10 clear, represents a negative capital dredging. Ports North completed bed levelling works to achieve -3.4m, channel declared depth is -3.6m. Alteration to channel configuration and has identified a reduction on dredging requirement, to a volume of 450,000m³ in 2010 campaign.

MC question; how much of a reduction is the volume? MB response was 780,000m³ and now is 320,000m³ so more than half the amount. A considerable reduction in volume. Discussion with MMG and Port of Brisbane will move to an annual campaign, so a smaller volume to be removed on an annual basis. Presents a higher cost to MMG due to recurring costs, but a reduction in risk of loss of depth in channel.

MR comment – has not had time to look at document, started yesterday – endeavoured to do that by end of week, pass on to planning and assessment group

- possible concern to be confirmed with Phil Hales – should check with Phil Hales to determine if self assessable code may not apply to the alteration to channel alignment.

- Discussion of Channel alignment – channel is 60m wide, moved 30m to the south. MR comments that the proposed change won’t have impact on marine plants as they have not been found there or at spoil ground. MC note that the present application (state level approval) should be inclusive of that area. AF response that Worley Parsons did permit application and benthic survey as part of 2009 SAP- noted no marine plants/algae etc and application was a Coastal Works application.

- MR question on if a benthic survey of spoil ground had been completed in recent times – not suggesting one needs to be done, but that if the channel realignment did trigger a need for additional marine plant approval not covered by the self assessable code, then a reapplication may be needed if it was suspected marine plants were on the spoil ground. MR confirmed it would be significantly unlikely that marine plants would occur in the realigned channel section and spoil ground. To be double checked with DEEDI planning and assessment section.
– **AF** queried the applicable code would be MP02 SAC for maintaining existing lawful structures, **MR** suggested checking with planning and assessment team.

**Action** – **AF** to contact Phil Hales at DEEDI to confirm state coastal works application status in regard to interaction with SAC Marine Plants

**Permit Application and LT MMP Summary**

**AF** noted LT MMP and application drafting commenced by Ports North in September 2009, with third party review of drafts by technical reviewer with Worley Parsons, Application was lodged on 28 January, Assessment comments received on 23 March, with the updated version of the application and LT MMP distributed to the TACC on 1 April.

**AF** outlined the structure of the LT MMP and identified key sections of that which should be of interest to the TACC, noting the discussion on disposal needs, volumes and options, that ocean disposal still remains preferred option, the summary of existing environment and outcomes of past monitoring programs, management structure and reporting section.

Ross and Alex join conference - brief reintroduction of attendees and MB update on meeting status for Alex.

**Summary of 2009 SAP** - Material is clean, nil concern re any specific contaminants. MC query on last SAP data set, was it 2004, **AF** confirmed 2009 was the most recent, and that it was a pristine area with minimal contaminant inputs that a 5 year validity of data should hold.

**Key areas;**

- disposal options page 28 qualitative assessment of risk across each option and costs
- historical dredge volumes – initially was planned to be a biennial campaign schedule, but revised to be smaller regular volumes/impacts each year, rather than larger more periodic events.
- Section 9 Potential Impacts to receiving environment - page 151
- Monitoring Programs
  - Reactive water quality monitoring program, derived ambient trigger value for NTU – summarised that there has not been a significant turbidity/water quality issue with past campaigns.
  - Seagrass- summarised that program has been in place, no significant declines of seagrass due to dredging had been identified.

**MR** comment that initial read of document doesn’t represent well why the seagrass monitoring program is in place in terms of the dredging program – seagrass is key receiving environment at risk due to dredging, role of TACC in past has been to review what is the current health of seagrass, are there any issues that may make them less resilient to dredging, is there a requirement for any additional mitigation actions – rather than using them to look for any immediate impact of dredging. Allows answers to questions of its current health; is it robust, resilient; is dredging going to have an impact – that is how DEEDI would see it going forward. On that basis water quality assessments are in part designed to protect the key habitat (seagrass) so need some measure of those actions – that is why seagrass is used – as well as looking at seagrass for other broad issues. Consider seagrass status prior to dredging via the TACC and provide an assurance that measures to be taken in forth coming dredge campaign will be effective, rather than as a tool to measure dredging impact – it can be, but major use is to assess the key receiving environment. In past has been big flood events, seagrass may have declined to point where it could be vulnerable to dredging, or from ports
perspective which could be blamed for the decline. Have done interim reconnaissance surveys to check after wet season etc. Section is not inaccurate, but needs to reflect that climate variation makes seagrass more vulnerable and susceptible to possible impacts from dredging- however the risk is low, program has demonstrated that – consequences are extremely high both from an environment and Port community perception, and also if seagrass gets to that state don’t want DEWHA or others saying to stop dredging due to declines that may not be due to dredging.

MR noted that there a lot of emphasis on program not being good for measuring impact of dredging on seagrass, but that is not the way program was set up – was designed to answer; how healthy is receiving environment ? is it resilient? can it cope? what mitigation measures are needed?

MC concern of not having turbidity monitoring, good arguments that support not having a routine program to some extent, for example levels of turbidity depends on conditions at time of year, tide, wind etc and monitoring indicates that to date elevated turbidity near seagrass has not been an issue. There is that perception that if turbidity monitoring was stopped, then we cannot answer any queries from the public as to whether or not the dredging is impacting on the seagrass beds. If monitoring is conducted, then at least we are in a position to advise.

MB comment no intention to not do monitoring – note that Brisbane doesn’t overflow, as it can’t fill hopper to capacity due to draft constraints in Karumba channel. Discussion with DEWHA was that in 2011 and 2018 were to do more extensive monitoring, but review comments back from DEHWA that Ports North would bring that forward to 2010, but as it is only going to being a one year, that we would revert to do the detailed work in 2011. Seagrass as an excellent tool for monitoring the place – except case that dredging is only one activity.

MC – now that DERM has to authorise port authority dredging under a Development Approval for an Environmentally Relevant Activity (ERA), things have changed quiet a lot as to how DERM approaches dredging and TACC meetings – previous regime that TACC decides on a program basis that for a specific campaign these were the requirements - when a DA is issued it is for ever so they need to think very carefully if they need to include water quality limits like turbidity- and there would be a need to have monitoring in place to gauge compliance with the water quality limits. It is a very unique position to be in for licensing of port authority dredging – so have to think about conditions that are a key part of the development approval. Mindful that the DA to be issued should not be inconsistent with what is talked about at TACC meetings, the DA needs to reflect similar requirements and can’t have it conflict with what is discussed/agreed at TACC –MR comment that turbidity monitoring was initially extensive works done with capital program, then thru subsequent maintenance works – included flyovers, and were discussed a lot back then as to what to continue to going forward – fly over had shown that plume did migrate over seagrass banks periodically but usually only for a small time – TACC was comfortable – so what are the key things to look at? – so fly over method was put aside – reactive program was then considered, and concerns raised again so Ports Corporation Queensland said they would do vessel based program to provide that assurance.

MC comment that thru TACC there is flexibility to do that, where as that if a DA has no monitoring requirements, how would DERM answer queries if there is a problem identified by interest groups e.g. commercial fishers?
MB comment that although ERA is issued, TACC meetings will occur, and even if a long term permit is issued it is a living document and there are more than the state level DA conditions in place such as the DEWHA approval. The DA isn’t the only way that monitoring will be required. Noted that if something came up the document is a living document and can be updated. MC noted that it is all about impacts of turbidity on seagrass and that if DEEDI was comfortable to not require conditions in the DA, that DERM would also be comfortable with that. MR emphasised that the risk due to maintenance is low, it is not a 4 month capital program for example, but that there are a whole range of impacts outside the ports control that may make seagrass susceptible to dredging and risk gets elevated. Agreement that is why we are doing the seagrass monitoring. MB comment that DEWHA have requirements under NAGD and water quality requirements that there are controls. MC concern of the” what if?”that there are concerns re perceptions if a problem does come up and DERM minister’s office is asked if they are compliant with their permit conditions, then we are not in a position to provide that information if monitoring hasn’t been undertaken. MR comment that a fall back response could be provided such that relevant monitoring programs such as seagrass monitoring were in place, seagrass was healthy, no issues had been identified etc in light of 15 years data or alternatively yes, something is in play, and they had identified a concern.

MR comment that there are other approaches that could be considered – other than detailed work while dredge is in operation – have approach of doing longer term monitoring of turbidity at seagrass areas for background conditions which integrate what has happen in months prior to dredging etc. DEEDI are getting to know more about what conditions seagrass need. This approach has two benefits, firstly for example prior to dredging that a statement can be made about period where seagrass has only had its minimum light requirements, say for example, two months, there is a concern for the forth coming campaign etc, or, they have had lots of light, flourishing, no problems proceed to dredge. Secondly, if loggers where in right place they would pick up plumes from dredging in potential impact environment and allow differentiation of dredge vs natural fluctuations in light – worth considering. Light loggers in use by DEEDI for other projects are relatively inexpensive – 3 month download period – worthy considering. MB comment that through discussion with Worley Parsons, what opportunities are there for longer term turbidity monitoring and that is what Ports North intend to discuss with DEWHA in terms for beyond 2011. MR comment that whole question of why are we monitoring turbidity if it is to protect seagrass – we are better to monitoring light, and the relationship is not always linear or is a poor relationship – so why not just monitor PAR that seagrasses are responding to. There may be other reasons that DEWHA may have for doing turbidity, but for terms of protecting seagrass or their condition, light is the key factor.

MB comment that there shouldn’t be any difference between each of the departments that the science should be the same across the board. MR note that it is becoming a more common philosophy around Australia and world that turbidity isn’t the best way to monitor.

MC query as to what type of way to condition those requirements – MB note that there would be a need to correlate observed light with seagrass growth. MR note that it would strengthen the discriminatory ability to differentiate have the light meters at the meadows. MB note that there is something other than the DA that requires us to do it, that the compliance is required by something else and that DERM have the ability to have input via TACC etc.

MR comment – specifically for next campaign – has a concern due to flood last year was bound to have impact on seagrass, they monitored last year in October and that there is evidence of seedling germination,
low cover, and that it has come back, there is a seed bank – good story, but just recently there is again wet weather and flooding potential they have taken another hit - what condition are they in in lead up to the next may campaign – something to consider that they may be in poor state, to be influenced by dredging, and then surveyed again latter in year in October, may identify a decline – need to be careful. Is there an opportunity to do a pre dredge recon – for ports sake to be in a position to comment on.

**MR** comment that the six to eight week campaign may present an increased risk to seagrass, given the reduction in biomass/covered surveyed at end of 2009, and the subsequent flood of early 2010, may have reduced resilience to a long dredge campaign. Noted consequence would be high, but probability would be low- however potential of impacts of dredging to be inferred as the cause of declines lends support for a brief fly over survey prior to dredging.

**Action MR** to confirm need/ logistics of pre dredge survey and advise Ports North for consideration.

**MC** request that some form of hand held program be conducted for this year, that a condition has for example requirements to comply with an 80th percentile trigger level plus 25%. If such a trigger limit was put into place, it is not a rigid limit, but is a trigger value consistent with what has been done in past for other types of dredging operations; non-compliance triggers management actions such as moving to other parts of channel. **MC** overviewed the past staged approach that had been taken in past, such as if plume detected for greater than a given number of days dredging is moved to just outgoing tides etc. **MC** comment that a flexible approach like that could be considered for the conditions.

**MC** query on duration of campaign – noted a two week resilience to turbidity, however an eight week campaign adds a bit more risk MB noted campaign would be less than 24hrs/day operations due to tide constraints. **MC** and **MR** discussion that Karumba site can be very turbid naturally and would need to have an ambient site plus another plus a certain NTU. **MR** note that this similar discussion was similar to what had been done by PCQ – that a staged approach was implemented for past vessel based water quality monitoring, such as if levels were above trigger for greater than 4 days, move to another section of channel – or call phone hook up with management review team to determine is there a need to place any restrictions or controls.

**MB** statement that question of which way is plume going out to sea or up channel needs to be considered and that monitoring would not be conducted for the full 8 weeks.

**MC** not saying that there are set on a set level, but leaning toward a flexible concept of a “limit plus” approach. There is opportunity to amend the DA if required, but not be modified easily unless there is a very good reason or evidence of environmental harm.

**AF** summarised discussion that here was support for an annual requirement for water quality monitoring framework being leaned toward by DERM –not extensive as planned in 2011, but **MC** noted it prudent to have a program in place. **MR** note that if seagrass was healthy, there would be less concern, but **MC** note that it would be prudent to have a program in place. **MR** comment that if turbidity monitoring is desirable, then a staged approach should be implemented – how far is plume extending, and focus on when dredge is in vicinity of seagrass beds. **MB** note that dredge ops is constrained by tide and draft
MR note that plan shown in document does not have full baseline seagrass extent mapped – therefore LTMMMP needs updated figure.

MC query on particle size – AF confirmed that fine material in close and sand in outer sections of channel.

AF concluded that we work to a similar style reactive water quality monitoring program as has been done in past three campaign with a view to implement detailed or alternate methodology in future year – MR support that for LT permit that it is a good chance to address the longer term water quality program.

Other sections of ongoing monitoring – implement sediment quality in 2014, seagrass done in 2009 and is most up to date survey – draft report complete and MR advice that it could be made available to TACC reps if required. Marine pests nil reports by relevant agencies, next detailed benthic survey work intended to implement methodology in appendices for spoil ground in 2014 and 2019 – detailed look at benthic condition to check impact at and adjacent to site in radiating design.

LTMMMP Stakeholder Review Comments;

Any comments invited by MB – clarified that it would be in regard to one year permit;

Nathan – nil

Mark – one issue re water quality monitoring - supply any comments by end of week

Michael – to provide by Friday, and Monday at latest

AF noted that detailed comment for ten year permit required within 3-4 weeks and MB reiterated that for DEWHA to keep ball rolling on the long term permit issue that comments from TACC reps on the plan be provided within that timeframe.

Have comments from CSIRO – comfortable with approach in regard to dredge window, outside times of highest risk. Refer email circulated by Rob on 13 April.

Alex; confirmed that their response would be provided by Friday for one year permit

Next meeting

– when we are ready to address the ten year permit – to be soon rather than latter, perhaps a month. MR query re here or Karumba? MB advice that there will be opportunity for community input to the process.

Meeting end 1045 hrs

Conclusions and Action Items;

1) AF to confirm future representation from Northern Gulf Natural Resource Management Group.

2) All noted the need to provide comment on one year permit issue, to address DEWHA’s request for TACC input to permit issue for 2010 campaign.
3) Detailed comment on LTMMMP for longer term permit from TACC reps due within 3-4 weeks

4) AF to contact Phil Hales at DEEDI to confirm state coastal works application status in regard to interaction with SAC Marine Plants

5) Support by DEEDI and DERM for implementation during the 2010 campaign of a reactive water quality monitoring program, annual seagrass monitoring, and management approach similar to former campaigns
Appendix 7

LTMMMP Sediment Sampling and Analysis Plan

Port of Karumba

Entrance Channel Maintenance Dredging
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1. INTRODUCTION

1.1. Background

The Port of Karumba is located within the Norman River in the southeast corner of the Gulf of Carpentaria. The port facilities are situated approximately 6km upstream of the entrance channel at the mouth of the Norman River. The entrance channel to the port extends approximately 9.5km northwest from the mouth of the river (refer to Figure 1).

Broad intertidal sand flats extend for distances of 3 – 10km from the shoreline to shallow subtidal areas on both sides of the mouth of the Norman River, through which the Entrance Channel traverses. The intertidal and subtidal zones remain turbid throughout the year and sediments within these areas are highly mobile, making up the majority of the maintenance material within the Entrance Channel.

The Port of Karumba has been servicing the remote Gulf communities since the late 1800’s. In 1996 the current entrance channel to the port was developed to provide reliable access to the Port. This channel was developed over two capital dredging campaigns (1996 and 1998) and has been maintained on a biennial basis ever since.

Far North Queensland Ports Corporation Limited (FNQPC), trading as Ports North, which took over port management from Ports Corporation Queensland (PCQ) in July 2009, is proposing to continue the program of dredging the Entrance Channel approximately every two years from 2010 to maintain navigable depth of -3.4m LAT for vessels entering/leaving the Port.

Activities at the Port are dominated by MMG Century (formerly OzMinerals) who commenced exporting zinc concentrate through the Port in December 1999. Zinc slurry is piped approximately 300 km from the mine to the Port, dewatered, and loaded onto a 5,000 tonne transfer vessel, the Wunma, for the 40 km journey to export ships that anchor in deep water in the Gulf of Carpentaria. Other facilities in the Port provide for general cargo, fuel and the export of live cattle.

Ports North sought approval of this SAP for maintenance dredging of the Entrance Channel by the Department of Sustainability, Environment, Water, Population and Communities, (DSEWPaC) for inclusion in the Long Term Management and Monitoring Plan (LTMMP) for Maintenance Dredging and Disposal: Port of Karumba Entrance Channel 2013-2022.

It is noted that that MMG Century is responsible for any maintenance of the berths at the Port and hence these areas do not form a part of this SAP.
Figure 1 Ports Limits, Entrance Channel and Spoil Ground Locations

1.2. Objectives of the SAP

The aim of this SAP is to develop a set of procedures that will provide a statistically valid representation of the physical and chemical contaminant properties of sediments to be dredged and to provide an assessment of the likely contaminant impacts of sea disposal of the dredged sediment.

The specific objectives of the SAP are to:

- Provide a brief summary of the dredging operations relevant to the SAP;
- Provide a summary of the catchment and land-use activities with the potential to impact on dredge material quality;
- Identify a contaminants list for testing of sediments, based on potential contaminant sources and results of previous testing;
- Identify the number of samples required to provide an adequate representation of the mean and upper 95% confidence interval for contaminant substances;
- Develop protocols for the collection and handling of sediment samples for analyses;
- Identify the types of analysis to be performed on sediment samples;
- Outline quality assurance and quality control (QA / QC) procedures for collection, handling and laboratory analysis of samples;
- Describe statistical techniques to determine the status of potential contaminants within dredged material; and
• Prescribe a reporting framework for all data, results and conclusions which address the requirements of Ports North and the DSEWPaC.

1.3. Description of the Proposed Dredging

The Port of Karumba is accessed by an Entrance Channel that extends from the mouth of the Norman River seaward. Ports North proposes to undertake maintenance dredging of the Entrance Channel to maintain declared depths. Routine maintenance dredging of the entrance channel is required approximately every two years to remove accumulated sediments and maintain navigable depths.

Recent dredging history (refer Section 2.1) indicates that between 269,899 m\(^3\) and 525,000 m\(^3\) may be required to be dredged in any one typical maintenance dredging campaign. While it is not possible to predict actual volumes to be dredged in subsequent campaigns, a maximum historic maintenance dredge volume of 525,000 m\(^3\) would be a conservative estimate. Hence an estimated annual requirement of 500,000 m\(^3\) is considered appropriate, resulting in an estimated dredging and disposal need of 3,600,000 m\(^3\) over the ten year period.

Dredging would be undertaken using the trailing suction hopper dredge *TSHD ‘Brisbane’* or similar vessel. The material would be placed at the approved Port of Karumba spoil ground, which has been used for all prior dredging campaigns (capital and maintenance). The spoil ground is located approximately 1.5km west of the seaward end of the entrance channel (refer Figure 1). Due to natural shallow depths within the spoil ground closest to the coast, no spoil will be placed within the south-eastern quadrant. Spoil will be distributed evenly over the remainder of the spoil ground.

Table 1 Estimated dredge volumes over 10 year long term Sea Dump Permit

<table>
<thead>
<tr>
<th>Operational case</th>
<th>Wet Load (m(^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum of maintenance dredging</td>
<td>5 x 600,000</td>
</tr>
<tr>
<td>Or</td>
<td>10 x 300,000</td>
</tr>
<tr>
<td>Emergency dredging – allowance for an additional maintenance dredging volume twice within 10 year sea dumping permit period</td>
<td>2 x 300,000</td>
</tr>
<tr>
<td><strong>Total requirement for 10 year permit period</strong></td>
<td><strong>3,600,000</strong></td>
</tr>
</tbody>
</table>
2. COMPILATION AND REVIEW OF EXISTING INFORMATION

2.1. History of the Dredge Area and the Catchment

Karumba is situated on the Norman River in the southeast corner of the Gulf of Carpentaria. The catchment of the Norman River is approximately 50,000 km² of largely undeveloped land. The major land uses in the area are pastoral farming, mining and conservation areas. As such, the estuarine area of the Norman River remains largely un-impacted by upstream land uses. Karumba town is a base for commercial fishing in the Gulf of Carpentaria, in particular the inshore net fishery and the Northern Prawn Fishery.

The Port of Karumba has been servicing the remote Gulf communities since the late 1800’s. In 1996 the current entrance channel to the port was developed and extends for a distance of approximately 9.5km offshore. This channel was developed over two capital dredging campaigns (1996 and 1998) and has been maintained on a biennial basis since (Table 2). Dredge material from each of these campaigns has been placed in the Port of Karumba’s approved spoil ground.

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume m³</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>1,004,000</td>
<td>Capital</td>
</tr>
<tr>
<td>2000</td>
<td>454,000</td>
<td>Maintenance</td>
</tr>
<tr>
<td>2002</td>
<td>513,000</td>
<td>Maintenance</td>
</tr>
<tr>
<td>2004</td>
<td>395,000</td>
<td>Maintenance</td>
</tr>
<tr>
<td>2006</td>
<td>399,000</td>
<td>Maintenance</td>
</tr>
<tr>
<td>2008</td>
<td>466,200</td>
<td>Maintenance</td>
</tr>
<tr>
<td>2010</td>
<td>544,200</td>
<td>Maintenance</td>
</tr>
<tr>
<td>2011</td>
<td>269,889</td>
<td>Maintenance</td>
</tr>
</tbody>
</table>

2.1.1. Sources and History of Contamination

The Entrance Channel is used solely for the passage of ships (i.e. no loading/ unloading of ships occurs in the channel) to and from the Port berths which are located approximately 6km upstream from the mouth of the Norman River. As such there are no direct sources of potential contamination into the Entrance Channel. Any anthropogenic contaminants found in Entrance Channel sediments would likely originate from upstream sources in the catchment such as the Port or surrounding land use. The major activities at the port, with respect to potential contaminant input, are a lead and zinc concentrate export operations and refueling of commercial and recreational vessels.

Marine sediment testing for maintenance dredging has been undertaken at the port area within the Norman River and has indicated that no increase in heavy metals concentrations has occurred since the commencement of concentrate exports. Testing within the Entrance Channel has also shown previously that all potential contaminants are below relevant screening level guidelines.

Minor spills of zinc concentrate into the Norman River, approximately 8km upstream of the
Entrance Channel have been reported during operations by MMG at the site in the past years. Investigation by the State EPA (DEHP) and the company was consequently completed within the vicinity of the spill, and the results of which concluded that those minor incident would have had negligible impact on the Entrance Channel sediments on the basis that:

- Chemical, bioavailability and toxicity testing of affected sediments in the vicinity of the spill site conclusively demonstrated the suitability of the material for ocean disposal;
- The channel and proposed dredging site is located approximately 8km from the spill site;
- The incidents some time ago whereby any concentrations would have been thoroughly dispersed; and
- The entrance channel has been dredged since the spill incident.

Consequently it is proposed that those results from the 2004 and 2009 (discussed in Section 2.1.2 below) sediment quality assessment remains representative of sediments to be dredged from within the Entrance Channel.

2.1.2. History and Results of Sediment Quality Investigations

Detailed sediment quality investigations have been completed by GHD in 2002 and 2004 and by WorleyParsons in 2009. Despite 2004 data being outside the stipulated NAGD five year currency period, it is provided here as background information as it is considered good quality data on the basis that:

- data met NODGDM (and NAGD) quality requirements at the time; and
- there has been no significant changes or major developments within the catchment area that have the potential to considerably alter the contaminant status of the Entrance Channel sediments.

As such, 2009 and 2004 results are summarised and provided below, with commentary also provided regarding 2002 sediment data.

Physical Characteristics

The 2002 and 2004 SAP’s did not require the physical characterization of the maintenance material. Consequently, particle size distribution was not analysed in the 2002 and 2004 sediment characterization study reports (GHD, 2002; GHD, 2004).

However, Entrance Channel sediments were characterized during the preparation of the Karumba dredging environmental impact assessment (EIA) (Dames & Moore and WBM, 1996). In the EIS, it was reported that principal sedimentation would be due to the lateral inflow of fine silty sediments mobilized from the surrounding shallow sub tidal regions by wave action. Fluvial material transported downstream from the Norman River catchment was expected to comprise only a minor component of the material, as is the lateral inflow of coarser material from the intertidal banks.

Physical characterization of the sediments was completed as part of the 2009 SAP implementation, Figure 2. The results identify that sediments within the Entrance Channel have a clear trend, moving from sand dominated sediments inshore, to silt and clay dominated sediments with distance from the shore. Field observations also confirmed the results of Munksgaard and Parry (2002) that identified a lens of fine sand a few centimetres thick over silt and clay dominated sediments.
In 2004, sediment samples from 22 sites along the Entrance Channel for trace metals, organotins, and PAHs. Samples were taken from up to three horizons (0-0.5m; 0.5-1.0m; and >1.0m) and submitted for analyses. This was consistent with 2002 sampling and analysis requirements.

The results for chemical testing for sediments within the entrance channel from 2004 are summarized in Table 3 and as follows:

- There were no detectable concentrations of Tributyltin (TBT) above PQL;
- Concentrations of all metals were below the relevant screening levels in all samples. 95%UCL of the means for metals were well below screening levels; and
- There were no detectable concentrations of PAHs above respective PQLs.

Note that the 95%UCL results for metals in Table 3 actually reflect more conservative 97.5%UCLs as the 95%UCL undertaken appears to have been a two-tailed UCL analysis rather than a one-tailed UCL analysis. Further, replicate data were included in the 95%UCL data calculation.

### Table 3  2004 results of metals in entrance channel sediments

<table>
<thead>
<tr>
<th>Sample</th>
<th>Units</th>
<th>NAGD Screening Level</th>
<th>Mean</th>
<th>SD</th>
<th>95%UCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>mg/kg</td>
<td>20</td>
<td>3.87</td>
<td>3.25</td>
<td>4.98</td>
</tr>
<tr>
<td>Cadmium</td>
<td>mg/kg</td>
<td>1.5</td>
<td>0.06</td>
<td>0.03</td>
<td>0.07</td>
</tr>
<tr>
<td>Chromium</td>
<td>mg/kg</td>
<td>80</td>
<td>13.23</td>
<td>7.26</td>
<td>15.71</td>
</tr>
<tr>
<td>Copper</td>
<td>mg/kg</td>
<td>65</td>
<td>7.2</td>
<td>5.00</td>
<td>8.9</td>
</tr>
<tr>
<td>Mercury</td>
<td>mg/kg</td>
<td>0.15</td>
<td>&lt;0.1</td>
<td></td>
<td>&lt;1</td>
</tr>
<tr>
<td>Manganese</td>
<td>mg/kg</td>
<td>-</td>
<td>356.90</td>
<td>258.18</td>
<td>445</td>
</tr>
<tr>
<td>Nickel</td>
<td>mg/kg</td>
<td>21</td>
<td>7.2</td>
<td>1.58</td>
<td>8.579</td>
</tr>
<tr>
<td>Lead</td>
<td>mg/kg</td>
<td>50</td>
<td>8.023</td>
<td>4.63</td>
<td>10.21</td>
</tr>
<tr>
<td>Zinc</td>
<td>mg/kg</td>
<td>200</td>
<td>20.9</td>
<td>12.14</td>
<td>24.23</td>
</tr>
</tbody>
</table>
Based on these results, the material was considered clean under the NODGDM and suitable for unconfined ocean disposal. These results were generally consistent with sampling that occurred in 2002 and with sampling conducted by Munksgaard & Parry (2002).

Note that the 2002 sediment study (GHD, 2002) reported that the PAH fluorene was marginally above the NODGDM screening level of 19ug/kg in four samples and above screening in five samples when normalized to 1%TOC. Re-testing of these samples and other samples (43 in total) did not result in any detection, so it is apparent that laboratory error may have been the cause. Nevertheless, elutriate and toxicity testing was undertaken. Elutriate analysis returned values below detection. Acute toxicity testing, using the 48-hour Sydney Rock Oyster larval abnormality test, identified that the sediments were not toxic to the test organisms.

2009

In 2009, sediment samples from 11 sites along the Entrance Channel for trace metals, and four sites for organotins. Samples were collected via a 1m piston core and composited or, where sediment was not able to be retained within the piston corer, a surface sample was collected via van-Veen grab sampler. Sampling was undertaken in accordance with the approved SAP which was modified from previous sampling undertaken in 2004.

The results for chemical testing for sediments within the entrance channel from 2009 are summarized in Table 4 and as follows:

- There were no detectable concentrations of Tributyltin (TBT) above PQL; and
- Concentrations of all metals were below respective screening levels in all samples. 95%UCL of the means for all metals were well below screening levels.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Units</th>
<th>NAGD Screening Level</th>
<th>Mean</th>
<th>SD</th>
<th>95%UCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>mg/kg</td>
<td>20</td>
<td>1.67</td>
<td>2.15</td>
<td>3.67</td>
</tr>
<tr>
<td>Cadmium</td>
<td>mg/kg</td>
<td>1.5</td>
<td>&lt;0.1</td>
<td>-</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Chromium</td>
<td>mg/kg</td>
<td>80</td>
<td>8.56</td>
<td>10.3</td>
<td>17.65</td>
</tr>
<tr>
<td>Copper</td>
<td>mg/kg</td>
<td>65</td>
<td>2.8</td>
<td>4.74</td>
<td>13.6</td>
</tr>
<tr>
<td>Mercury</td>
<td>mg/kg</td>
<td>0.15</td>
<td>0.009</td>
<td>0.011</td>
<td>0.014</td>
</tr>
<tr>
<td>Nickel</td>
<td>mg/kg</td>
<td>21</td>
<td>3.12</td>
<td>4.66</td>
<td>7.58</td>
</tr>
<tr>
<td>Lead</td>
<td>mg/kg</td>
<td>50</td>
<td>5.16</td>
<td>6.33</td>
<td>10.86</td>
</tr>
<tr>
<td>Zinc</td>
<td>mg/kg</td>
<td>200</td>
<td>9.33</td>
<td>13.9</td>
<td>22.35</td>
</tr>
</tbody>
</table>

Based on these results, the material was considered clean under the NAGD and suitable for unconfined ocean disposal. These results were consistent with sampling that occurred in 2004, as discussed above, and with sampling conducted by Munksgaard & Parry (2002).
2.2. Dredge Areas, Volumes and Potential Contamination Classifications

As detailed in Section 1.3, recent maintenance dredge volumes undertaken every two years have ranged between 269,889 m³ and 525,000 m³ per campaign. A conservative estimate of the maximum volume of 3,000,000 m³ of routine maintenance dredging (plus allowance for 600,000 m³ Emergency Dredging) may be required during a ten-year Sea Dumping Permit period.

Past sediment survey of port sediments indicate that the sediments are suitable for unconfined placement at sea, with all contaminants being below NAGD screening levels for the analytes tested. Taking into consideration the results of past sediment analysis, limited potential contaminant input sources and the remote nature of the site, sediments within the Entrance Channel dredge area are classified as ‘probably clean’. Under the NAGD, this classification allows for the required number of sampling sites outlined in Table 6 of the NAGD to be halved.

2.3. Contaminants List

Appendix A of the NAGD requires that a contaminants list is to be developed and should include:

- Toxic substances known, from previous investigations, to occur in dredge area sediments at levels greater than one-tenth of the Screening Levels, or
- Based on historical review, substances potentially present at such levels in the sediments to be dredged.

It is noted in relation to the first point, that levels one-tenth of screening levels may be lower than the NAGD PQL. Previously in the NODGDM, contaminants of concern largely related to contaminants above PQL. Consequently, our interpretation of the first point relates to substances greater than one-tenth the screening level or the PQL if the PQL is higher than one-tenth the screening level.

Based on review of previous sediment testing results (2002, 2004 and 2009) and potential sources of contaminant substances to the Entrance Channel, the contaminants list in Table 5 has been compiled. Apart from the contaminants listed in Table 5 the following additional analyses are proposed to provide information regarding physical characteristics and for normalisation of organic substances:

- Particle size distribution (to 2µm);
- Total Organic Carbon (where organotins are tested for); and
- Moisture Content.

The suite of chemical and physical analyses would be performed on each sample composited at each sampling location, as described in Section 3.2.
Table 5 Contaminants list qualification review

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Included or Excluded</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>Include</td>
<td>Exceeds one-tenth screening level</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Include</td>
<td>Where detected, detection level &gt;PQL and not less than one-tenth screening level</td>
</tr>
<tr>
<td>Chromium</td>
<td>Include</td>
<td>Exceeds one-tenth screening level</td>
</tr>
<tr>
<td>Copper</td>
<td>Include</td>
<td>Exceeds one-tenth screening level</td>
</tr>
<tr>
<td>Mercury</td>
<td>Include</td>
<td>Not detected but detection level &gt;PQL and detection level not less than one-tenth of the screening level</td>
</tr>
<tr>
<td>Nickel</td>
<td>Include</td>
<td>Exceeds one-tenth screening level</td>
</tr>
<tr>
<td>Lead</td>
<td>Include</td>
<td>Exceeds one-tenth screening level</td>
</tr>
<tr>
<td>Zinc</td>
<td>Include</td>
<td>Exceeds one-tenth screening level</td>
</tr>
<tr>
<td>Organotins</td>
<td>Include</td>
<td>Below PQLs but may be present at levels exceeding one-tenth screening level. Propose initial sampling of fewer sites (4) and sampling of hold samples from other locations if detections above PQL occur.</td>
</tr>
<tr>
<td>Total PAH</td>
<td>Excluded</td>
<td>Not detected, or where detected re testing and wider testing of hold samples confirmed it as a false positive (i.e. for some samples in 2004), with no further detections.</td>
</tr>
<tr>
<td>Total TPH's</td>
<td>Excluded</td>
<td>Not tested previously but any fuel loading at the Port of Karumba is at least 6kms upstream from the entrance channel. No significant pillages known to have occurred at the port. Any spillages in the river would be minor and diluted prior to exit from the mouth of the Norman River.</td>
</tr>
<tr>
<td>Organochlorine</td>
<td>Excluded</td>
<td>Not tested previously but no significant known or historic sources within the catchment. Not of relevance to offshore entrance channel sediments.</td>
</tr>
<tr>
<td>Pesticides</td>
<td>Excluded</td>
<td>Not tested previously but no significant known or historic sources within the catchment. Not of relevance to offshore entrance channel sediments.</td>
</tr>
<tr>
<td>PCB’s</td>
<td>Excluded</td>
<td>No known current or historic contamination sources of PCB’s (e.g. transformer and capacitor oils, hydraulic and heat exchange fluids, and lubricating and cutting oils) in the catchment. Not of relevance to offshore entrance channel sediments.</td>
</tr>
<tr>
<td>Radionuclides</td>
<td>Excluded</td>
<td>No known or historic sources of radionuclides in the catchment (e.g. no heavy sands mining or stockpiling). Not of relevance to offshore entrance channel sediments.</td>
</tr>
</tbody>
</table>

2.4. Consideration of Environmental Factors

Environmental factors that may potentially affect contamination in the sediments include hydrological conditions, particularly cyclones and flooding events which may have an impact on particle size. Aside from lead and zinc loading operations at the port (6km upstream) there are no other significant potential sources of contamination that may directly affect the entrance channel. Other contamination that may potentially be found within the entrance channel sediments would likely have originated from upstream sources.

There are a number of environmental considerations that may limit or hinder sampling.

- Hazardous sea creatures: Diving methods of sediment sampling are not proposed because of the presence of crocodiles, sharks and marine stingers, which present a significant risk to personal safety for any divers entering the water;
- Remoteness of the location: The remoteness of the location makes re-sampling for any reason (e.g. for the collection of samples for bioavailability and/or direct toxicity testing) a costly exercise and logistically difficult, particularly where it involves remobilising equipment. Additional material is to be collected and stored under appropriate conditions at the analytical laboratories for Phase 3 and Phase 4 testing. Back-up sampling...
equipment (piston corer and extension rods) will be taken to site to mitigate sampling equipment loss or failure during collection;

- Seasonal weather conditions: The area experiences a tropical monsoonal climate with a pronounced wet season from November to March and generally dry conditions for the remainder of the year. The cyclone season typically extends from December to April. Not only do these weather conditions affect sea conditions, but many roads and services are cut off during the wet season making sampling difficult. Sampling therefore is to occur during the dry season (April to October); and

- Tidal conditions: Tides typically occur once per day, with a spring tidal range of 4.7m. Hence the best time to undertake sampling is during neap tides to minimise water depth and current flow.

3. SAMPLING AND ANALYSIS OF SEDIMENTS

3.1. Rationale

The sampling and analysis of sediments proposed below complies with the requirements for large capital dredging projects in Appendix D of the NAGD.

3.2. Sampling Locations and Horizons

The number of sampling locations within the dredge area is based upon the requirements in Appendix A of the NAGD and refined according to power analysis completed on the results of previous sediment sampling. On the basis of the conservative maximum dredge volumes plus estimated additional dredging required following extraordinary siltation from a tropical cyclone, 31 sample sites would be required when using the nominated equation to linearly extend NAGD Table 6. However, sample site numbers can be halved in case of having good quality data, as discussed above, making 16 sampling locations. Alternatively, in consultation with the Determining Authority, the NAGD permits the use of Power Analysis to determine the number of sample locations.

Statistical power analysis calculates the number of samples required to achieve acceptable statistical power to make a valid comparison against the NAGD screening levels. The NAGD refers to ANZECC/ARAMCANZ (2000: Section A5.1.10) in relation to power analysis. It suggests that a Type I error rate of 5% (i.e. \( \alpha = 0.05 \)) is conventional and Type II error rate of 20% (i.e. \( \beta = 0.2 \), whereby power = 1-\( \beta \) = 0.8) is acceptable.

A review of the 2009 dataset (metals only as TBT were all below the PQL) to calculate the power of the previous data has been undertaken. The purpose of this power analysis was to identify the required number of samples to achieve a statistically rigorous comparison against NAGD screening levels.

Analysis of power and required sample size was undertaken using the power analysis software “G Power version 3.0.10” (Faul et al., 2007) and specifically assessed using the calculation routine to assess the difference from a constant. The software was developed by the Institute for Experimental Psychology, University of Dusseldorf, Germany.

Specifically, the one-sample t test was used to determine whether the populations mean \( \mu \) (at the 95% UCL in this case) equals some specified value \( \mu_0 \) (Screening Level). The t-test analysis assumes a normal distribution of data. Where datasets were log-normally distributed, the screening level and data were log-transformed to enable use of the t-test. Where data did not have a discernible distribution, it was assumed that they approximated a normal distribution for the purposes of the analysis. It was considered better to include them in the power analysis and determination of sample size than leave them out.
A one-sided ("one tailed") test was used in the calculation as we are only concerned with detecting whether a contaminant concentration is above the screening level.

The null and alternate hypothesis of the one-tailed t-test state: $H_0 : \mu - \mu_0 = 0$ and $H_1 : \mu - \mu_0 > 0$

The effect size index $'d'$ used in the calculations is defined as: $d = (\mu - \mu_0)/\sigma$

where $\sigma$ denotes the (unknown) standard deviation in the population. Thus, if $\mu$ and $\mu_0$ deviate by one standard deviation then $d = 1$.

The $\alpha$ error probability used in the calculations was the conventional 0.05.

Results for power $(1 - \beta)$ and corresponding sample size required to make a statistically valid comparison to the Screening Level are provided in Table 6. The power of the analysis performed was very high, with all results being above 0.99. Based on this power analysis assessment, a maximum of three samples are required to achieve a power of 0.8 with an alpha of 0.05 (Table 6). Note that power analysis identifies the number of samples required to make a valid comparison against the NAGD screening levels and is independent of the volume of potentially contaminated material used to identify the number of sample locations in Table 6 of the NAGD. Consequently, any discrepancies with anticipated dredge volumes and actual dredge volumes are irrelevant from a sample location number perspective.

Table 6 Summary of Power Analysis completed on 2009 dataset

<table>
<thead>
<tr>
<th>Sample</th>
<th>Distribution</th>
<th>NAGD Screening Level (mg/kg)</th>
<th>Mean</th>
<th>SD</th>
<th>95% UCL</th>
<th>Power (alpha = 0.05)</th>
<th>Sample Number Required (0.05, 0.2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>Log-normal</td>
<td>20</td>
<td>1.67</td>
<td>2.15</td>
<td>3.67</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Not detected at any site</td>
<td>1.5</td>
<td>&lt;0.1</td>
<td>-</td>
<td>&lt;0.1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Chromium</td>
<td>Log-normal</td>
<td>80</td>
<td>8.56</td>
<td>10.30</td>
<td>17.65</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Copper</td>
<td>Log-normal</td>
<td>65</td>
<td>2.8</td>
<td>4.74</td>
<td>13.6</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Mercury</td>
<td>No discernible distribution</td>
<td>0.15</td>
<td>0.009</td>
<td>0.011</td>
<td>0.014</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Nickel</td>
<td>No discernible distribution</td>
<td>21</td>
<td>3.12</td>
<td>4.66</td>
<td>7.58</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Lead</td>
<td>No discernible distribution</td>
<td>50</td>
<td>5.16</td>
<td>6.33</td>
<td>10.86</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Zinc</td>
<td>No discernible distribution</td>
<td>200</td>
<td>9.33</td>
<td>0.011</td>
<td>0.014</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

The reason for so few samples being required is due to the 95% UCLs being well below the respective Screening Levels and the contaminants being relatively uniform between samples.

While the power analysis identifies that statistically a maximum of three samples are required, the remoteness of the port requires that collection of samples for Phase 3 and Phase 4 is undertaken at the same time as Phase 2 (screening level) sampling to eliminate the need to remobilize in the event that further analyses are required. As such the requirements for Phase 3 and Phase 4 sampling have been taken into consideration when determining the required number of locations to be sampled. According to Table 7 of the NAGD, 11 sample locations would need to be sampled and analyzed for Phase 3 and Phase 4 assessments. The NAGD does not stipulate options for reducing the number of sampling location for Phase 3 and Phase 4 assessments and therefore the number of sampling locations required should also be 11 for the Phase 2 sampling.

Based on the above assessments and the NAGD requirements it is therefore proposed that the
number of sampling locations be reduced from 31 to 11, as summarized in Table 7 below. The 11 locations proposed to be surveyed would be those sampled in the 2009 sampling survey, which were based on alternating sites within the 22 locations previously surveyed along the Entrance Channel length in the 2004 sediment sampling program (refer to Figure 4 for 2004 sampling sites and Figure 5 for 2009, 2014 and 2019 sampling sites). Note that organotins are proposed to be tested in only four sites initially because they were below PQL in previous surveys. Should there be detections above PQL, then hold sample material will be analyzed. The coordinates for the 11 sampling sites are provided in Table 7. This approach, rather than random site selection from a sampling grid would provide spatial consistency and allow for temporal comparison for common sampling locations.

Table 7 Establishment of sample site numbers for sediment characterization

<table>
<thead>
<tr>
<th>Dredge Area</th>
<th>Conservative Dredge Volume of Potentially Contaminated Dredge Material (m³)</th>
<th>NAGD Table 6 - Sample Location Number</th>
<th>Allowance for Good Quality Data - Sample Location Number</th>
<th>NAGD Table 7 – Sample Location Number</th>
<th>Power Analysis - Sample Location Number</th>
<th>Proposed Sample Location Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance Channel</td>
<td>613,000</td>
<td>31</td>
<td>16</td>
<td>11</td>
<td>3</td>
<td>11</td>
</tr>
</tbody>
</table>

The NAGD requires sampling over the entire depth of the maintenance dredging, with separate sample horizons being taken every 0.5m. The Entrance Channel to the Port runs through broad intertidal sand flats that extend for distances of 3 – 10km from the shoreline to shallow sub-tidal areas on both sides of the mouth of the Norman River. These intertidal and sub-tidal zones remain turbid throughout the year and sediments within these areas are highly mobile, particularly with heavy seasonal rainfall and frequent cyclone activity which cause relatively frequent extremes sediment transport, coastal wave actions and currents (cited in Munksgaard and Parry, 2002). The Karumba dredging environmental impact assessment (EIA) (Dames & Moore, 1996) reported that the principal source of sedimentation within the channel would be due to the lateral inflow of fine silty sediments mobilized from the surrounding shallow sub-tidal regions by wave action. Fluvial material transported downstream from the Norman River is considered to comprise only a minor component as is the lateral inflow of coarser material from the intertidal banks.

Pooled results from the 2002 and 2004 sediment sampling surveys show that contaminants within each sample horizon are relatively similar, as shown in Figure 3. From these results, and consideration of the nature of sediment movement within the area and the lack of potential contaminant sources, it is proposed that compositing horizons from a 1m core length will provide an acceptable assessment of maintenance material quality with no benefits being realized through the separation of horizons, as indicated in Figure 3. This methodology was undertaken in 2009.
Figure 3 Contaminant levels from 2002 and 2004 from each sampling horizon. ([Mean ± standard deviation) contaminant levels from pooled 2002 and 2004 sampling programs from each sampling horizon].

Note: Mercury excluded as there were no detections.
Figure 4 Location of sampling sites - even numbers only tested in 2004 study
Figure 5 Location of sampling sites - even numbers only tested in 2009 study
3.3. Proposed Sediment Quality Attributes for Analysis

3.3.1. Sediment Characterization

For sediment characterization, the suite of contaminants proposed to be tested include those identified in the contaminants list (refer to Section 2.3) as well as physical characteristics. To reiterate, sediment samples will be analyzed for:

- Arsenic (As);
- Cadmium (Cd);
- Chromium (Cr);
- Copper (Cu);
- Mercury (Hg);
- Nickel (Ni);
- Lead (Pb);
- Zinc (Zn);
- Total organic carbon (TOC) (initially four sites, then remaining sites if TBT detections occur above PQL);
- Organotins (initially four sites, then remaining sites if TBT detections occur above PQL);
- Particle Size Distribution (PSD).

3.3.2. Phase 3 – Elutriate and Bioavailability Analysis

Based on previous sampling, it is not expected that 95% UCLs of the mean would be above screening levels. Any exceedance would likely relate to a trace metal. Due to the remote nature of the study area, to minimize the need to recollect material for Phase 3 elutriate and bioavailability testing, hold samples will be taken for each sample location and stored appropriately at the laboratory in the instance that further testing is required.

If elutriate and bioavailability (i.e. dilute acid extraction for metals) testing is required, hold samples from each sampling location (total of 11) would be analyzed. Eleven sample locations is the number of locations required for phase 3 testing according to Table 7 in Appendix D of the NAGD for the given volume of dredging.

3.3.3. Phase 4 – Toxicity Analysis

As for Phase 3 analyses, previous results do not indicate that toxicity testing will be required. However again, to eliminate the need to recollect material for Phase 4 toxicity testing, hold samples will be taken for each sample location and stored appropriately at the laboratory in the instance that further testing may be required.

If toxicity testing is required, hold samples from each sample location (total of 11) would be analysed. Eleven sample locations is the number of locations required for phase 4 testing according to Table 7 in Appendix D of the NAGD for the given volume of dredging.

3.4. Frequency of Sampling

It is proposed that two sampling surveys would be undertaken during the period of the Long Term Management Plan. These would occur in 2014 and 2019 in order to comply with NAGD currency of data requirements of 5 years. Sampling frequency and requirements would be reviewed in the event of a potential new contaminant source was identified, a major incident that caused contamination or the contaminant status of the sediment changes significantly as detected through the 2014 or 2019 sampling events.
3.5. Sample Collection Methods and Sampling Horizons

3.5.1. Standard Operating Procedures

Samples would be collected at each sampling location using boat deployed piston corer with extension rods. The piston corer is stainless steel with a barrel length of 1.0m and internal diameter of 60mm. The corer will be lowered over the side of the vessel to the bed using extension rods.

All working areas of the vessel will be thoroughly checked, cleaned and prepared for sediment sampling activities prior to each days sampling. Any potential sources of contamination (e.g. galvanised or oily surfaces) will be cleaned, covered and secured to avoid accidental contamination of any sample.

Field data sheets will be completed in the field (one for each sampling location) to document both collection details and sediment description for later compilation onto a standardised core description log. A copy of the proposed field collection form is provided in Appendix. Photographs will be taken of samples obtained at each sampling location.

Sample handling onboard the vessel will include sample homogenisation and containment for dispatch to analytical laboratories under chain of custody documentation. Samples will be homogenised in large stainless steel mixing bowls using gloved hands (powerless latex or nitrile gloves). New gloves will be used for each sample to avoid potential cross-contamination.

Samples for the analysis will be stored in containers provided by the laboratory for the analyses requested. A list of sampling containers to be used is provided in Table 8. Sample containers will be appropriately labelled and stored either in refrigerators or in eskies with ice packs, without delay. Samples will remain in refrigerated condition until dispatched to the analytical testing laboratory, where they will be maintained at 4°C or otherwise deemed appropriate for the preservation of samples by the laboratory. Hold material for toxicity testing will be nitrogen sparged and stored under refrigerated conditions.

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Containers per Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Suite</td>
<td>1 x 500ml solvent washed glass jar with Teflon lined lid</td>
</tr>
<tr>
<td>Particle Size</td>
<td>1 x zip lock bag to hold a minimum of 500g sample</td>
</tr>
<tr>
<td>Elutriate and DAE</td>
<td>1 x 500ml solvent washed glass jar with Teflon lined lid</td>
</tr>
<tr>
<td>Elutriate water (sea water)</td>
<td>2 x 10L seawater in clean polyethene carboy (1.5 L per sample)</td>
</tr>
<tr>
<td>Toxicity</td>
<td>1 x 3L sample (zip lock bag)</td>
</tr>
</tbody>
</table>

3.5.2. Hold Samples

Hold samples (duplicate split taken from the homogenised sample material) will be taken at each site and stored appropriately, with enough quantity, in the event that material may be required for Phase 3 (elutriate and bioavailability) and Phase 4 (toxicity) analysis.

3.6. Contingency Plan

Weather forecasts will be reviewed prior to mobilisation to the field with field work rescheduled if conditions are likely to significantly disrupt sample collection. If significant weather conditions arise during sample collection, weather forecasts will be reviewed and sample collection will be either temporarily suspended on site, or the team will be demobilised and scheduled for remobilisation.
The potential for contingency due to gear failure will be minimised through properly maintained piston coring equipment and the provision of a spare corer and extension rods. Sampling during the dry season will minimise the risk of adverse weather that can occur during the wet season.

### 3.7. Laboratory Analysis for Contaminants

Table 9 provides summary details regarding the laboratory method information for the suite of total tests to be undertaken on sediment samples.

#### Table 9 Analytical method information for sediments

<table>
<thead>
<tr>
<th>Activity/Test</th>
<th>Method Reference</th>
<th>Method Summary</th>
<th>Practical Quantitation Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Content</td>
<td>Gravimetric</td>
<td>Oven dry overnight, measure weight</td>
<td>0.1%</td>
</tr>
<tr>
<td>Particle Size Distribution</td>
<td>Sieve and hydrometer</td>
<td>Sieve and hydrometer</td>
<td>To 2um</td>
</tr>
<tr>
<td>Total Organic Carbon</td>
<td>Handbook of Soil &amp; Water</td>
<td>Dilute acid treatment, high temperature dry combustion, infrared detection</td>
<td>0.01%</td>
</tr>
<tr>
<td>Organotins</td>
<td>In-house (Abalos et al 1997, Atlaar 1996)</td>
<td>Acidified solvent extraction, ethylation, derivatisation, GC/MS (EI mode)</td>
<td>0.5 ug Sn/kg</td>
</tr>
<tr>
<td>Trace Metals</td>
<td>USEPA 3050/200.7 ICP/AES</td>
<td>Nitric/ hydrochloric acid digestion, CV/AAS</td>
<td>0.01 mg/kg</td>
</tr>
<tr>
<td>Mercury</td>
<td>USEPA 3050/7471A CVAAS</td>
<td>Nitric/ hydrochloric acid digestion, CV/AAS</td>
<td>0.01 mg/kg</td>
</tr>
</tbody>
</table>

Laboratory analyses for Phase 3 and Phase 4 analyses are described in Section 3.11

### 3.8. Summary of Sampling and Analysis

A total of 11 sampling locations are proposed for sampling within the entrance channel maintenance dredging area. A summary of the proposed sampling scheme is presented in Table 10. The table also includes those samples to be analyzed for field quality control/quality assurance purposes.
Table 10 Proposed sample locations and analyses

<table>
<thead>
<tr>
<th>Dredge Area</th>
<th>Sample Location</th>
<th>Coordinates (WGS 84)</th>
<th>Moisture Content</th>
<th>PSD</th>
<th>Metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn)</th>
<th>Organotins</th>
<th>Total Organic Carbon</th>
<th>Hold (Elutriate, DAE/Porewater)</th>
<th>Hold (Toxicity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entrance Channel</td>
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<td></td>
<td></td>
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<tr>
<td>2</td>
<td></td>
<td>17°25'24.1S 140°42'52.4E</td>
<td></td>
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<td>22</td>
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<td>17°27'06.7S 140°47'39.4E</td>
<td></td>
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</tr>
</tbody>
</table>

Normal Samples
Replicate Triplicate
Split Triplicate

Note: Due to TBT being below PQLs in previous sampling, it is proposed to undertake analyses on 4 of the 11 sample, with testing of remaining samples if initial concentrations are returned above PQLs.
3.9. Laboratory Analysis

All laboratories used for analyses will be NATA accredited for the methods used and will be experienced in the analysis of marine sediments.

3.10. Sampling and Analysis Quality Control

3.10.1. Quality Control – Field Sampling

- Quality Control during sampling will be ensured by:
- Using suitably qualified environmental staff experienced in sediment sampling, field supervision and sediment logging;
- Using a surveyed vessel which is thoroughly inspected and washed down;
- Containing samples in appropriately cleaned, pre-treated and labelled sample containers;
- Keeping samples cool (4°C) after sampling and during transport where they would be stored in eskies with pre-frozen ice bricks;
- Transportation of samples under chain of custody documentation;
- Generating additional QC samples in accordance with the NAGD (refer Section 3.10.2 below);
- ‘Blind labelling’ all field QC split and replicate triplicate samples in the field with QC field numbers which do not relate to the sampling location names; and
- Decontaminating all sampling equipment, including mixing bowls etc., between sampling locations via a decontamination procedure involving a wash with ambient sea water and a laboratory grade detergent, and successive rinsing with deionised water.

3.10.2. Quality Control - Analysis

NAGD (Appendix F) specifies that field quality control samples should include (per batch of 20 or fewer):

- In cases where volatile substances such as some chlorinated organics are being determined, one container (trip) blank filled with inert material, for example chromatographic sand;
- On 10 per cent of locations, one field triplicate (that is three separate samples taken at the same location) to determine the variability of the sediment physical and chemical characteristics;
- On five percent of location, samples should be thoroughly mixed then split into three container to assess laboratory variation, with one of the three samples sent to a second (reference) laboratory for analyses; and
- One sample that has been analysed in a previous batch (if more than one batch is sent) to determine the analytical variation between batches.

In consideration of this, the following QA / QC protocol has been developed:

- No trip blanks will be taken and analysed as volatile organic carbon compounds, such as
chlorinated hydrocarbons and BTEX, are not being assessed;

- The field samples proposed to be taken for quality control analysis are indicated in Table 10, and comply with the ten percent and five percent criteria for replicate triplicate and split triplicate samples respectively;

- All samples will be sent to the laboratories as a single batch.

The analytical laboratory will need to comply with the laboratory and quality assurance procedures specified in Appendix F of the NAGD, which require:

The laboratory quality assurance program should include the following quality control samples to be analysed in each batch (10-20 samples). This is in addition to its own internal procedures to ensure analytical procedures are conducted properly and produce reliable results:

- One laboratory blank sample;

- For metals, one Standard reference Material (SRM), that is a sample of certified composition such as MESS-1 or BCSS-1, or BEST-1 (for mercury), or a suitable internal laboratory standard calibrated against an SRM. The laboratory should be a ground sediment sample, not a liquid sample, to test both the recovery of the extraction procedure and the analysis;

- For organics, one sample spiked with the parameters being determined (or a surrogate spike for certain organics) at a concentration within the linear range of the method being employed – this will determine whether the recovery rate of the analytical method is adequate or not (that is, that all the chemicals present in the sample are actually being found in the analysis); and

- One replicate sample to determine the precision of the analysis; the standard deviation and coefficient of variation should be documented.

A validation of the analytical data obtained will be undertaken in accordance with Appendix F of the NAGD. This analysis will confirm that the analysis undertaken is of suitable quality to make an assessment of dredge material for suitability for sea disposal. This validation will include a consideration of results for blanks, standards and spikes, and replicate and duplicate samples. Relative standard deviations between quality control replicate triplicate and split triplicate samples will be compared against relevant criteria.

### 3.11. Analysis of Results

#### 3.11.1. Sediment Analysis for Total Sediment Concentrations

Total contaminant concentrations in sediments will be compared against the Screening Levels listed in Appendix A, Table 2 of the NAGD to assess whether the material is suitable for unconfined placement at sea or if further testing is required. Comparison against guideline levels involves the comparison of mean contaminant concentrations at the upper 95% confidence level (95%UCL) of the mean. For the purposes of calculation of 95% UCLs, values below detection limit will be set to one-half of the laboratory detection limit (LOR) in accordance with NAGD recommendations. Results above detection for organic parameters (organotins and total PAHs) are normalised to 1% TOC (total organic carbon) where the recorded value for TOC is within the range of 0.2 – 10%. If TOC values are outside this range, then the highest or lowest of the 0.2 – 10% range is adopted as appropriate. Means, standard deviation and 95% UCLs will be provided within the results summary table.

The methods proposed to be used to calculate the 95% UCLs are based on the methods...
recommended in Appendix A of the NAGD (P58, Comparison of Data to Screening Levels). Normality of datasets will be determined using Shapiro-Wilks test in ProUCL Version 4 (4.00.02) developed by the US EPA. Datasets will be determined as being either normal, log-normal or other in their distributions. Normal datasets will be analysed using the 1-tailed student’s t 95%UCL. Log-normal datasets will be analysed using non-parametric jackknife analysis as recommended in the NAGD. Similarly, datasets that were neither normal nor log-normally distributed will be analysed using non-parametric jackknife analysis. The H-Lands UCL will not be used for the analysis of log-normal data as this method is only appropriate for datasets of more than 30 samples, which is significantly more than the number of samples to be taken.

Under the NAGD, if the 95% UCL values for all substances are below relevant screening levels, it is considered unlikely that sediment contaminants will have adverse effects on organisms living in or on that sediment. The sediment is therefore considered non-toxic and there are no chemical obstacles to unconfined placement at sea in the approved spoil ground.

3.11.2. Phase 3 – Elutriate Analysis

If required, elutriate analyses will be undertaken using sediments prepared in a 1:4 suspension of Port of Karumba spoil ground seawater.

The elutriate concentrations at the 95th percentile for the relevant dredge area will be compared with the relevant toxicant trigger level in the ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, following the procedures outlined in Appendix A of the NAGD (Commonwealth of Australia, 2009). Allowance will be made for dilution at the spoil ground when comparing elutriate concentrations against guideline values.

3.11.3. Phase 3 – Bio-Availability Analysis

If required, dilute acid extraction (DAE) results for metals will be analysed similar to total sediments with the difference being that metal will be extracted using a weak acid (1M HCl). Analysis of results will be as indicated in 3.11.1 for total metal contaminants.

For organic contaminants, collected sediment samples would be pressure squeezed or centrifuged to provide the chemical laboratory with porewater for chemical analysis. The 95th percentile of porewater concentrations would be compared with the relevant trigger level in the ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, following the procedures outlined in Appendix A of the NAGD (Commonwealth of Australia, 2009).

3.11.4. Phase 4 – Toxicity Testing

If required, toxicity testing will be undertaken using the following tests, as recommended by Ecotox Services Australasia:

- 10-day acute whole sediment toxicity test using the juvenile amphipod Melita plumulosa (based on the amphipod sediment test method of USEPA 1994 and PSEP 1995 adapted for use with M. plumulosa by CSIRO);
- The 48-hour larval abnormality test (sublethal) using the rock oyster Saccostrea commercialis (based on APHA method 8610C and PSEP 1995, modified for use with S. commercialis by Krassoi 1996). Tests to be conducted using pore waters; and
- The 72-hour larval development test (sublethal) using the sea urchin Heliocidaris tuberculata with sediment pore water (based on APHA method 8810D, PSEP 1996 and Simon and Laginestra 1997).

It should be noted that advances in toxicity testing may arise during the term of this SAP and any such method changes are to be proposed to DSEWPac for approval prior to implementation.
3.11.5. Reporting

A report containing the following information will be prepared at the conclusion of the sampling and analysis program:

- Executive Summary;
- Introduction and description of the study area;
- Details of the sampling methodology including any deviation from the approved SAP;
- A figure showing the sampling locations;
- Descriptions of the core samples, based upon the photographs and core logs;
- Descriptions of any observations or anomalies during sampling and/or analysis;
- Table of laboratories used and the analytical methods employed;
- Quality Assurance Procedures and Results;
- Summary table of results for each parameter analyzed;
- Comparison and interpretation of the results as indicated in Section 3.11;
- Conclusions;
- Recommendations; and
- Appendices containing all laboratory reports and Quality Assurance and Quality Control analyses.
4. REFERENCES


5. FORMS

Appendix A - Field Collection Data Sheets
# Port of Karumba SAP - Sediment Quality Assessment

<table>
<thead>
<tr>
<th>CLIENT:</th>
<th>Ports North</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE OF CORING:</td>
<td></td>
</tr>
<tr>
<td>TIME OF CORING:</td>
<td></td>
</tr>
</tbody>
</table>

## Collection Details

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>General location of core of sampling location</td>
<td></td>
</tr>
<tr>
<td>Site/location number</td>
<td></td>
</tr>
<tr>
<td>Sample Id.s assigned</td>
<td></td>
</tr>
<tr>
<td>Easting/Longitude of core location (from onboard GPS)</td>
<td></td>
</tr>
<tr>
<td>Northing/Latitude of core location (from onboard GPS)</td>
<td></td>
</tr>
<tr>
<td>Water depth at core location</td>
<td></td>
</tr>
<tr>
<td>Sample collector</td>
<td></td>
</tr>
<tr>
<td>Type of core sampler</td>
<td></td>
</tr>
<tr>
<td>Sea state at time of coring</td>
<td></td>
</tr>
<tr>
<td>Conditions (e.g. weather, sea state, wind speed, level of shipping traffic)</td>
<td></td>
</tr>
<tr>
<td>General Comments</td>
<td></td>
</tr>
</tbody>
</table>
# Port of Karumba SAP - Sediment Description Field Sheet

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Date / Sample Time</th>
<th>Depth retained</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Strata Change (m)</th>
<th>Colour* (refer AS1726)</th>
<th>Field texture**</th>
<th>Moist.</th>
<th>Consistency</th>
<th>Sand grain size</th>
<th>Plasticity</th>
<th>% stones</th>
<th>Shell/grit and/or biota</th>
<th>Odour</th>
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* Colour: black, white, grey, red, brown, orange, yellow, green, blue. Pale, dark, mottled. *e.g. grey mottled red-brown clay.*

**Field Texture: clay, silt, sand, gravel, etc
Appendix 8  International Maritime Organisation Reporting Template
Sea Dumping Permit International Reporting Requirements

Please fill in this form and return it by email only to the Department of Sustainability, Environment, Water, Population and Communities by 31 January each year. This information is required for Australia’s International reporting obligations under the London Protocol. Email: portsandmarine@environment.gov.au

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Appendix 9  Spoil Ground Benthic Infauna Survey Method
Port of Karumba  LTMMP

Spoil Ground Benthic Infauna Survey Method

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Spoil Ground Benthic Infauna Survey Method

1. Scope

In order to test the desired hypothesis, a survey design is necessary that can detect changes at the ocean disposal site itself, as well changes emanating from disposal at the site that manifest themselves outside the site.

For the Ports of Bundaberg Mackay, and Cairns, WorleyParsons designed the monitoring programs to better assess the impacts from deposition of material at the spoil ground on areas outside the spoil ground. The rationale of the design was the detection of impacts both within the spoil ground, and along a gradient extending from the spoil ground in the direction of the prevailing currents. A second transect, which was not in a direction where prevailing current conditions are likely to transport material from the spoil ground to adjacent areas provided a reference.

This modified survey design was approved by the Commonwealth environment agency for the purpose of the Port of Bundaberg meeting monitoring conditions set out in that Sea Dumping Permit. It was also approved for monitoring at Cairns Port by Great Barrier Reef Marine Park Authority. The design has now been demonstrated three times to provide a rigorous assessment of changes to benthic communities both within and adjacent to the spoil ground.

For the Port of Karumba, the location of the ocean disposal site is influenced by the regular tide generated and long term coastal circulation. Preliminary assessment of the hydrodynamics of the ocean disposal site was completed during the EIA phase of environmental assessments prior to 1996 capital dredging campaign. Due to inshore shelf dynamics, and the large confined southern Gulf of Carpentaria location, a single tide cycle per day influences the ocean disposal site and has a significant effect on direction of general long term trend of current at the ocean disposal site. In the process of verification of the hydrodynamic modelling for the channel and disposal site, work by Nielsen (1997) through use of drogue tracking and model calibration identified a generally north to south movement at the ocean disposal site under the tide and current pattern prevailing during the month of July to August when sampling occurred. Subsequent to this work further investigations and monitoring were completed by PCQ during actual dredging campaigns. Further literature review is required to confirm this information and shall determine the final proposed axis alignment to be utilised in the implementation of the 2014 and 2019 surveys.

2. Methods

The proposed spatial pattern of sampling for Port of Karumba is to be undertaken is as follows:

- Five survey locations extending in direction parallel to general prevailing current direction from the edge of the spoil ground with one site per location and three replicate grab samples per site. The sites are positioned 50m, 200m, 500m, 1km and 2km from edge of the spoil ground. These locations represent the zone of putative impact. Consideration will be made to include additional sites at a distance greater than 2kms where suitable comparable parameters (bathymetry, orientation, current
and profile) are present to assist in determining if spoil placement management responses have been effective.

- Five survey locations extending in a perpendicular direction to general prevailing current from the edge of the spoil ground with one site per location and three replicate grab samples per site. The sites are positioned 50m, 200m, 500m, 1km and 2km from edge of the spoil ground. These locations represent reference locations. Separate control locations are not proposed as recent experience in Cairns, Bundaberg and Mackay Ports have identified that such separate areas have proven to be too different to be effective as reference areas. This has been considered by determining authorities and approved within their sampling designs.

- Five survey locations within the ocean disposal site – one in the centre and one each to the north, south, east and west of the site approximately two-thirds toward the boundary. Three replicates grab samples per location will be taken.

A single grab sample per site (i.e. 15 samples in total) will be taken to characterise sediment granulometry to 75 µm.

The chosen distances for survey locations projecting from the spoil ground are based on those used for the Ports of Bundaberg and Cairns. The chosen axes for the survey locations are based on existing knowledge of the prevailing wind and current directions, and also remove any significant depth variation across the area to be surveyed. The maximum distance surveyed from the edge of the spoil ground along the two survey axes is two kilometres. This distance from the edge of the spoil ground was chosen based on 1) consideration of hydrodynamics; and 2) consideration of the scale of turbid plumes found at other spoil grounds such as Bundaberg and Cairns.

A van Veen grab and a sieve with mesh of 0.5 mm is proposed to be used because of the high percentage of fines in the spoil ground and surrounding sediments (80-90%). The sled is not proposed to be used for characterising the epibenthic assemblage in general as the epibenthic habitat is open muddy substrate, high turbidity results in poor video footage, and the previous survey results were dominated by benthic infauna rather than epifauna. However the sled is proposed to be deployed at all five survey locations within the ocean disposal site to determine the presence of introduced marine pests in much the same manner as sled tows were undertaken in the outer channel and inner port during pre-dredging sediment surveys. The proposed transect length is 100m. Any retained mussel material or tube worms (calcareous) from the sled tows will be sent to the Queensland Museum for identification for the target introduced marine pest species of Asian Green Mussel, Asian Bag Mussel and Caribbean Tubeworm. A similar level of taxonomic analysis as that used by Neil et al. (2003) is proposed to be used for infauna identification in the modified survey program.

3. Laboratory Analyses

Laboratory analysis of the macrobenthic infauna will be conducted by an experienced invertebrate taxonomist.

Upon arrival in the laboratory each sample will be processed by washing the samples in freshwater on a 0.5 mm mesh sieve to remove formaldehyde. The macrobenthic infauna will be removed from the sediment using a dissecting microscope, identified to the lowest practical taxonomic level, counted and stored in 70% ethanol. This level of taxonomic
identification is consistent with what has been undertaken previously and consistent with a large number of peer reviewed studies that advocate groupings above species to assess environmental impacts. Using species or even genera for benthic invertebrates generally leads to introducing significant amounts of “noise” into the dataset which masks trends important for monitoring and assessment.

A representative collection of benthic invertebrates will be collated during the identification process to provide a reference for the current and future surveys will be stored by Ports North.

4. Statistical Analyses

Statistical analyses will involve both univariate and multivariate statistics and will allow for where relevant, comparisons with previous studies will provide a temporal comparison. Spatial variation of the following parameters will be assessed: total abundance, species (taxa) richness, species (taxa) diversity and evenness.

Total Abundance

Density (or abundance) as a measure of the total number of individuals collected at each sampling location.

Species (Taxa) Richness

Richness is the measure of the number of species present at each sampling location. In the current study, species are represented the lowest practical taxonomic units and as such it is convention to refer to it as taxonomic richness.

Species (Taxa) Diversity

Species (taxa) diversity will be calculated using the Shannon Diversity Index which is a measure of the number of organisms in each taxa present at each sampling location. The formula to calculate this index is presented below.

\[ H' = - \sum_{i=1}^{s} \frac{n_i}{n} \ln \frac{n_i}{n} \]

Where: \( s \) = the number of taxa; and \( n \) = the number of individuals per taxa

Functionally Analyses

Previous methods of analysis for assessing potential impacts at the Port of Karumba spoil ground have not considered impacts on different functional groups of macrobenthic invertebrates (e.g. deposit feeders, filter feeders, scavengers). For this study we propose to analyse the ratio of the functional groups at the spoil ground and across the survey locations that extend from it.

Evenness

Evenness is another measure of community structure and is based on measuring the number of each taxa present at each sampling location. This index is a modification of the Shannon Diversity Index. The formula to calculate evenness is presented below.
Multivariate methods use both the identity and the abundance of every taxa to describe each sampling location, and make comparisons between the structure of the macrobenthic infauna assemblage at different times and different locations. The software package Primer 6, designed specifically for marine ecological studies, will be used to undertake the following multivariate analyses: ordination using non-metric multidimensional scaling (nMDS), cluster analysis (if necessary pending the output of the nMDS), and analysis of similarities (ANOSIM). Multivariate statistics will provide greater insight into changes in the structure of the assemblage than either univariate (parametric or non-parametric) or descriptive statistics. Conclusions drawn from multivariate statistics are not as strongly dependent on the number of replicates as those from univariate measures. In previous analyses undertaken at the Bundaberg and Cairns spoil grounds, randomly choosing three of the four replicates to analyse led to the same conclusions being drawn as analysing all four replicates.

**Ordination**

Ordination methods such as nMDS force a multidimensional data set into a reduced number of dimensions. In lay terms, it allows for a visually representation of how survey locations differ taking into consideration the abundance of all species present. The closer the symbols in each plot are to one another, the more similar the overall macrobenthic infauna assemblage. A hypothetical example of output showing how a macrobenthic infauna assemblage at a spoil ground differs from that of reference locations is described in Figure 9-1.

Data will be square-root transformed prior to generating a Bray-Curtis similarity index. The transformation is generally required to reduce the dominance of certain infauna taxa that might have otherwise overly influence the statistical assessment.

Stress is a measure of the success of the nMDS ordination method in reducing the high dimensional data to a lower dimensional plot (Clarke, 1993). provides a guideline for the goodness-of-fit for nMDS ordination for a range of stress levels.

\[
J' = \frac{H'}{\log S}
\]

where: \( s \) = the number of taxa; and \( H' \) = the Shannon Diversity Index
Table 9-1 Guide to interpreting stress values from nMDS

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<td>Excellent representation with no prospect of misinterpretation.</td>
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<tr>
<td>&lt;0.1</td>
<td>Good ordination with no real prospect of a misleading interpretation.</td>
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<tr>
<td>&lt;0.2</td>
<td>Still gives a potentially useful 2-dimensional picture. Cross-check conclusions against alternative technique (e.g. cluster analysis).</td>
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<tr>
<td>&lt;0.3</td>
<td>Ordination should be treated with a great deal of scepticism. Indicates points are close to being arbitrarily placed in the 2-dimensional ordination space.</td>
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Note: Green triangles are sites within spoil ground. Dark blue triangles are sites along northern axis. Light blue squares are sites along eastern axis. The closer symbols are to each other, the more similar they are to each other.

Figure 9-1 Hypothetical example of nMDS output

Cluster Analysis

Should the stress level of the nMDS be between 0.2 and 0.3, cluster analysis will be undertaken. The output from the cluster analysis is analogous to a “family tree” where the closer together the branches of the tree, the more similar the samples. Cluster analysis is based on the same dataset as the nMDS and it provides another method of visualising the similarities of the macrobenthic infaunal assemblage between survey times and locations. It
is proposed to use if necessary a hierarchical cluster method based on the Bray Curtis similarity measure and square root transformation.

**Analysis of Similarity (ANOSIM)**

ANOSIM (ANalysis Of SIMilarities) will be used to test for significant differences in community structure between factors (e.g. sites) and is analogous to Analysis of Variance tests (ANOVA) for univariate analyses. ANOSIM is a non-parametric permutation procedure applied to the (rank) similarity matrix underlying the ordination or classification of samples (Clarke and Warwick, 2001). The resulting ‘R’ statistic is a comparative measure of the degree of separation of sites although main interest usually centres on whether it is significantly different from zero. The Global R statistic is based on the difference of mean ranks between sites and within sites and usually falls within 0 to 1. R equals 1 only if all replicates within sites (or sampling periods) are more similar to each other than any replicates from different sites (or sampling periods). R is approximately zero if the similarities between and within sites (or sampling periods) are the same on average. The significance level provided in ANOSIM relates to the null hypothesis (Ho) that “there is no difference between the factor being analysed”, with factors being sampling site or sampling date.

In addition to a Global R value, ANOSIM, also produces pair-wise R values, measuring how separate groups are, on a scale of 0 (indistinguishable) to 1 (all similarities within groups are less than any similarity between groups) gives an interpretable number for the difference between groups. We interpreted R-values >0.75 as well separated; R>0.5 as overlapping, but clearly different and R<0.25 as barely separable at all, in accordance with the PRIMER-manual (Clarke & Gorley, 2001).

### 5. Discussion and Interpretation

All trends evident from the results will be appropriately discussed and interpreted, with particular focus on determining any impacts from the placement of spoil at the approved offshore spoil ground.

Information gained through the above methods on biological characteristics shall be interpreted against data gathered on physical (grain size) and hydrographic data to evaluate long term temporal variability, inclusive of changes to sea bed types or bed topography.

### 6. Reporting

Findings of the survey shall be complied to form a specific survey report for circulation to DSEWPaC and to inform the TACC.
Appendix 10

Port of Karumba LTMMP

Environmental Management Plan for a Trailing Suction Hopper Dredge (TSHD) Dredging Campaign

Template for Inclusion in Long Term Management and Monitoring Plan (LTMMP)
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1 Scope

As a sub-ordinate document to the approved Long Term Management and Monitoring Plan (LTMMP), this Environmental Management Plan (EMP) shall form the template to which appointed contractors shall follow, or in the scenario where the dredging contractor has their own EMP, be the approved benchmark to which Ports North will determine if it meets and exceeds the following management arrangements.

Conditions of the dredging contract will include a requirement for the Contractor to follow the approved EMP, the LTMMP and any corresponding Approval conditions (including Sea Dumping Permit and State approvals).

Figure 1. Document Map - Linkages between LTMMP and EMP’s

2 Introduction

Ports North engages the services of a dredging contractor for dredging and drag barring works to periodically maintain the entrance channel at Port of Karumba.

This Environmental Management Plan (EMP) forms the operational control document for a typical Trailing Suction Hopper Dredge (TSHD) while undertaking the dredging works and is intended to ensure all site specific environmental issues that are the responsibility of the dredging contractor engaged by Ports North, under the contract arrangements, are adequately addressed. Approval conditions have also been considered as part of the development of this EMP. The EMP forms part of the Karumba LTMMP which is a component of the Ports North’s Environmental Management System to ensure the environmental management practices for dredging are conducted in an environmentally sound manner.

In developing the EMP, consideration has been given to the environmental Aspects and Impacts to ensure all impacting processes are addressed through clearly defined management actions, mitigation measures and performance indicators.
This EMP is developed for a typical modern TSHD such as the vessel “Brisbane” that is owned and operated by Port of Brisbane Pty Ltd which has conducted most recent maintenance dredging campaigns at the Port of Karumba, and is engaged under a long term contract for dredging services to the northern Queensland Ports for maintenance dredging. This vessel was designed to meet the need for dredging in some of the shallow coastal Port’s including Karumba, Weipa and Cairns and includes several design specifications which ensure a high level of environmental and dredging performance.

A typical maintenance dredging campaign at the Port of Karumba is of an approximate duration of 4-6 weeks.

### 3 Description of Dredging Plant

#### 3.1 TSHD

A typical Trailer Suction Hopper Dredge (TSHD) can operate 24 hours per day to ensure a continuity of activity and maximise efficiency of the campaign.

Requirement for dredging activity is determined by comparison of required or design depths of a site with pre-dredging hydrographic survey. Specialised vessels independent of the dredge undertake all survey work.

The hydrographic survey information is digitally uploaded to the TSHD on-board computer system allowing the dredge master to display the depth information for a site with dredge target areas clearly highlighted.

The vessel can operate in either automatic, where onboard computers control vessel dredge systems, or manual mode for dredging operations. Further, the onboard computers will assist the positioning of the vessel by displaying a differentially corrected GPS position of the vessel track against intended dredge areas. Dredge Pipe Operator and Dredge Manager are present on the bridge during all operations regardless of dredging mode, and all vessel movements are directed by the Dredge Manager.

The vessel extracts material by lowering two suction heads (one on either side of the vessel) to the seafloor whilst steaming slowly ahead. Large pumps onboard then draw water through the heads entraining sediments from the seafloor in a similar fashion to a household vacuum cleaner, depositing a mixture of water and sediments into the vessel’s central hopper.

The dredge heads are not fitted with any mechanical agitation equipment and rely solely on the suction head provided by the onboard pumps. Whilst the vessel has the ability to pump high-pressure water to the dredge head to agitate sediments, this is generally not required unless operating in compacted sands.

The concentration of sediments delivered to the hopper is dependant on a number of factors, such as sediment type and dredging conditions, but is generally in the order of 10-30% solids. That is, 70-90% of the material pumped to the hopper is water and must be discharged to achieve effective loading.

A best practice TSHD will include a central column weir to control water discharge. This weir may consist of rings stacked vertically. The position of the rings and hence the depth to which water in the hopper must be before overflowing to discharge, is controlled automatically by
the draft of the vessel. This controls the residence time of the water in the hopper, providing maximum time for suspended material to settle and reducing discharge suspended sediment concentration and turbidity.

Discharge from the weir is through the bottom of the vessels hull below the keel on the centreline. As such, discharge of waters during dredging is 4-6m below the water’s surface, depositing sediments near the bed and further reducing settlement time and dispersion of turbidity plume.

The effective capacity of the hopper is dependant upon the type of material being dredged. While the volume of the hopper is 2900m³, effective capacities range from 2100 m³ for sands, to 2900 m³ for fine silts.

This variation in effective hopper capacity is due to both the maximum load carrying capacity of the vessel and the differences in settling time for the material dredged. Material with a high silt content (<0.075mm) takes a relatively long time to settle from suspension in the water. As the hopper residence time is reduced, insufficient material settles in the hopper per cubic metre dredged to make the works economically viable.

Hopper residence time is the time taken for water pumped to the hopper to flow out the discharge weir. As the hopper fills with sediment, the residence time, and hence the potential for settling of suspended sediment decreases. A compensation point is reached as the load curve (a plot of sediment load verses total dredging time) asymptotes. That is, the amount of material retained in the hopper per unit of dredging time decreases.

Once the hopper has reached optimum capacity for the type of material being dredged, the vessel steams to the relocation site. The material may be bottom dumped (as is generally undertaken for placement at sea) by opening large valves in the floor of the hopper to allow the material to fall out though the hull.

Alternately, the material can be pumped out via a bow discharge pipe (generally used for on-shore placement). A floating pipeline is connected to the bow coupling and material within the hopper agitated with high-pressure water jets to achieve the correct consistency for pumping. Material is then delivered via the pipeline to detention basins on-shore.

### 3.2 Bed Levelling - Sweep Bar

The process of bed levelling is typically used in conjunction with and after the final transit of the *TSHD* in a given sector of the dredge area to achieve a smooth final channel bottom profile.

The Sweep Bar (or commonly known as a bed leveller) is a specialised vessel used to provide a uniform minimum water depth within navigation channels and berths.

The sweep bar will be suspended from a tug. In similar function to a blade on a common earth moving plant such as a grader/bulldozer, the sweep bar has a small blade on the underside. This is designed to gather material into the internal confines of the sweep bar, transporting it as the bar is moved along. As the equipment travels over hollows in the bed, material falls from the bar and fills these. Conversely, small hillocks and rises in the bed are levelled out to provide a uniform minimum water depth.

A sweep bar may also be used in isolation, as a specific campaign if only a small section of seafloor requires removal. Activity such as this is addressed in the separate EMP for a typical Bed Levelling Campaign.
4 Environmental Legislation and Approvals

In addition to the applicable legislation that covers the broader actions of dredging and disposal as set out in the LTMMP Section 2, the environmental legislation relevant to the particular aspects of dredging operations by a Trailing Suction Hopper Dredge is discussed, but is not limited to the legislation listed below;

4.1 Applicable State Legislation

Environmental Protection Act 1994

The objective of the Environmental Protection Act 1994 is to protect Queensland’s environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends consistent with “ecologically sustainable development”.

The protection of Queensland’s environment is to be achieved by an integrated management program that is consistent with ecologically sustainable development.

The program is cyclical and involves the following phases –

- Establishing the state of the environment and defining environmental objectives;
- Developing effective environmental strategies;
- Implementing environmental strategies and integrating them into efficient resource management; and
- Ensuring accountability of environmental strategies.

Until a recent amendment to the EP Act, dredging works undertaken within Port Limits by a Port Authority were exempt from requiring and Environmentally Relevant Activity (ERA) approval.

The 2008 amendments to the Act and subordinate legislation now specify that dredging (extractive and screening activities) requires an ERA 16 as follows:

“Extractive and screening activities (the relevant activity) consists of any of the following-

a) dredging of a total of 1000t or more of material from the bed of naturally occurring surface waters, in a year;

b) extracting, other than by dredging, material from a wild river area;

c) extracting, other than by dredging, a total of 5000t or more of material, in a year, from an area other than a wild river area;

d) screening 5000t or more of material in a year.

Ports North has a general responsibility under the Act to ensure that no environmental harm (serious or material) or environmental nuisance occurs as a result of its activities. This EMP has been prepared to encompass the components of the works to be undertaken by the Contractor, to the extent to which it has control, and will be enacted by the Contractors staff as the working document.
Coastal Protection and Management Act 1995/ Harbours Act

The objective of the Coastal Protection and Management Act 1995 (CPM Act) is “to -

(a) provide for the protection, conservation, rehabilitation and management of the coast, including its resources and biological diversity; and
(b) have regard to the goal, core objectives and guiding principles of the National Strategy for Ecologically Sustainable Development in the use of the coastal zone; and
(c) provide, in conjunction with other legislation, a coordinated and integrated management and administrative framework for the ecologically sustainable development of the coastal zone; and
(d) encourage the enhancement of knowledge of coastal resources and the effect of human activities on the coastal zone.”

The CPM Act requires that a person obtains a tidal works approval for work in, on or above land under tidal water, or land that will or may be under tidal water because of development on or near the land. A tidal works approval essentially approves the engineering design and location of structures (e.g. channels, swing basins, wharves etc). Prior to the CPMA tidal works approvals were referred to as approvals under Section 86 of the Harbours Act (1955). These approvals were issued into perpetuity.

4.2 Applicable Commonwealth Legislation

Environment Protection (Sea Dumping) Act 1981

The Environment Protection (Sea Dumping) Act 1981 is commonwealth legislation providing for the protection of the environment by regulating dumping into the sea, incineration at sea and artificial reef placements, and for related purposes. These requirements are set out further in the Environmental Legislation section of the LTMMP.

4.3 Approvals Summary

Copies of applicable, valid approvals are to be provided in Appendix 2 of this EMP to enable access by dredge crew and a copy will be onboard the dredge at all times.

The dredging contractor will be required to ensure that its dredging operations comply with those conditions of the above approvals for which it is responsible, in accordance with the dredging contractual arrangements. Ports North, as the proponent, is responsible for supplying all relevant information regarding the environmental approvals and associated conditions, including the LTMMP to the contractor.

5 Roles and Responsibilities

The approvals applicable to maintenance dredging campaigns include a range of conditions which must be complied with and some of these conditions relate to operational activities while others relate to broader management issues, environmental monitoring and reporting. Contract negotiations between dredging contractor and Ports North will clarify responsibility for compliance with the various conditions. The following table provides an outline of the roles and responsibilities of the staff involved in the Karumba dredging project. This also provides an outline of the chain of command and links between parties involved in the project.
### Table 5.1: Roles and Responsibilities of Key Employees Associated with the Karumba Maintenance Dredging Campaigns

*** This table is to form the template for the contacts list, and be updated with the campaign specific details once Contractor is appointed, and names and phone numbers of all positions filled out. It is acknowledged that organisation structures, specific staff names and phone numbers will change from time to time.

<table>
<thead>
<tr>
<th>Position</th>
<th>Name and Contact Numbers</th>
<th>Responsibility</th>
<th>Reporting to</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Staff Onboard THSD</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vessel Master</td>
<td></td>
<td>Responsible for all aspects of vessel shipboard management</td>
<td>Manager Dredging Operations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintaining watch and record of marine fauna during dredging and disposal operations</td>
<td></td>
</tr>
<tr>
<td>Chief Engineer</td>
<td></td>
<td>Responsible for operation and maintenance of onboard machinery</td>
<td>Vessel Master</td>
</tr>
<tr>
<td>Crew</td>
<td></td>
<td>Implementation of specific EMP components i.e. spill response, waste, general duty,</td>
<td></td>
</tr>
<tr>
<td><strong>Contractors Staff On-Shore</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site Manager</td>
<td></td>
<td>Management of day to day operations of project</td>
<td>Manager Dredging Operations</td>
</tr>
<tr>
<td>Manager Dredging Operations</td>
<td></td>
<td>Management of overall operations of dredger.</td>
<td>Senior Management</td>
</tr>
<tr>
<td>Environmental Coordinator</td>
<td></td>
<td>Responsible for undertaking monitoring of EMP implementation</td>
<td>Senior Management</td>
</tr>
<tr>
<td>Senior Management</td>
<td></td>
<td>Responsible for overall management of the Contractors dredging activities</td>
<td>CEO/General Manager</td>
</tr>
<tr>
<td><strong>Ports North</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ports North</td>
<td></td>
<td>Ph; (07)4051 2558 Mobile: 0419 657 350 Fax; (07) 4031 2551 Email: <a href="mailto:enquiries@portsnorth.com.au">enquiries@portsnorth.com.au</a></td>
<td></td>
</tr>
<tr>
<td>Chief Executive Officer</td>
<td></td>
<td>Legal compliance</td>
<td>Ports North Board</td>
</tr>
<tr>
<td>GM - Corporate Services</td>
<td></td>
<td>Community – complaints and engagement</td>
<td>CEO</td>
</tr>
<tr>
<td>GM - Planning and Projects</td>
<td></td>
<td>Dredge contract</td>
<td>CEO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Defining dredge requirement, areas and volume</td>
<td></td>
</tr>
<tr>
<td>Port Supervisor</td>
<td></td>
<td>Contact for local port information and coordination of emergency situations</td>
<td>GM-P&amp;P</td>
</tr>
<tr>
<td>Surveyor and Survey Assistant/Draftsperson</td>
<td></td>
<td>Conduct of hydrographic surveys (channel and spoil ground). Determination of areas to be dredged.</td>
<td></td>
</tr>
<tr>
<td>Project Superintendent</td>
<td></td>
<td>Contract supervision, monitoring</td>
<td>GM-P&amp;P</td>
</tr>
<tr>
<td>(may be appointed by Ports North)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment Manager</td>
<td></td>
<td>EMP implementation</td>
<td>GM-P&amp;P</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Contact for coordination and management of environmental incidents (i.e. fauna injuries, hazardous spills)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Auditing and inspection of Sea Dumping Permit, LTMMP and Supervision of monitoring</td>
<td></td>
</tr>
<tr>
<td><strong>MSQ Contacts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maritime Safety Queensland</td>
<td>1300 551 899</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manager Remote Area Services</td>
<td></td>
<td>Contact for Marine Pollution, hazardous spills and shipping safety issues</td>
<td></td>
</tr>
<tr>
<td>Karumba</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6 Environmental Management Plan

The purpose of the Environmental Management Plan (EMP) is to:

- Identify the potential aspects and impacts (including hazards) associated with undertaking the dredging and material relocation works;
- Identify the appropriate mitigation measures for each potential environmental hazard; and
- Indicate the corrective actions to be undertaken if an undesirable impact or unforeseen level of impact occurs.

It should be noted that the TSHD is being operated by a contractor for Ports North to undertake the dredging works. Ultimate responsibility for the project lies with Ports North and this EMP provides a description of only those components of the operational control component of the LTMMP within the control of Ports North as per contract arrangements. Other compliance monitoring and reporting issues are to be addressed by Ports North.

The sections below provide an outline of the structure and details of the component management plans.

6.1 Structure

Each of the following EMP elements address the environmental aspects and subsequent potential impacts as outlined in the following structure of Table 6.1

<table>
<thead>
<tr>
<th>Item</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspect</td>
<td>The Aspect that requires management.</td>
</tr>
<tr>
<td>Impact</td>
<td>The predicted impact on the environment in the absence of sound</td>
</tr>
<tr>
<td></td>
<td>environmental protection and management measures.</td>
</tr>
<tr>
<td>Objective</td>
<td>What is intended to be achieved?</td>
</tr>
<tr>
<td>Management Actions and</td>
<td>Tasks that will be undertaken to implement ensure Objective is met.</td>
</tr>
<tr>
<td>Mitigation Measures</td>
<td>Includes possible measures that may be implemented where suitable.</td>
</tr>
<tr>
<td>Performance Indicators</td>
<td>Qualitative or quantitative measurement to gauge objective.</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Details of measurement of performance indicators.</td>
</tr>
<tr>
<td>Reporting</td>
<td>Nature, timing and responsibility for reporting results.</td>
</tr>
<tr>
<td>Corrective Action</td>
<td>Action to be taken if monitoring indicates objective is not being met.</td>
</tr>
<tr>
<td>Term</td>
<td>Active term of management plan.</td>
</tr>
<tr>
<td>Responsibility</td>
<td>Delegation/nomination of responsibilities for overseeing management plan operation.</td>
</tr>
</tbody>
</table>

6.2 Aspects and Management Plans

The following environmental aspects are the elements of a typical campaign that have been identified as issues requiring specific management to avoid unacceptable environmental impacts, and subsequent management plan components have been developed accordingly.

All permit condition compliance monitoring is to be conducted by Ports North or appointed auditor in conjunction with the following measures.

Waste - The general categories of waste have been defined as follows:
- General Garbage (refuse generated from crew);
- Co-mingled recycled waste including paper, plastics, metals and glass;

Environmental Management Plan – Dredging Campaign – TSHD  Page 1 of 22
- Paper and cardboard waste;
- Sewage Waste (including both black and grey waters); and
- Oily water, oil wastes and other hazardous or regulated wastes such as greases, paints and chemicals.
(due to the isolated location recycling facilities waste may not be available to receive the recycling waste at which stage all waste will go to general waste).

**Noise** – The generation of noise during vessel operation and potential impacts on sensitive receptors forms the basis of this management plan. Issues of workplace noise are to be controlled and managed under existing occupational health and safety protocols within the respective vessel safety management system.

**Turbidity** – Whilst this management plan aims to limit the generation of plumes as much as practical, the principal management response will be to ensure that dredging operations are only undertaken within approved areas. Where required, water quality monitoring of the dredging works will be undertaken by Ports North in accordance with the monitoring component of the LTMMP and any additional management actions required to address approval conditions.

**Protected Marine Fauna** – This management plan addresses the potential for the TSHD to directly impact on protected marine fauna, during dredging (e.g. capture of marine turtles in dredge head), transit (collision) or material relocation operations. Overarching issues of secondary impacts such as habitat disturbance are beyond the scope of this document and would have been addressed in impact assessments associated with the original capital works approvals, or site-specific considerations by regulatory authorities when issuing necessary licenses/permits.

It should be noted that Sea Dumping Permits issued for dredging projects may include a requirement for a “Dredging Window” to avoid impacts to certain species. The proposed dredging period is to be compliant with this condition, or an approved variation granted by the Determining Authority.

**Cultural Heritage** – This management plan is generally in the scope of maintaining a watch on dredge material for unanticipated items of cultural significance. Management plans for items of identified cultural significance which have the potential to be directly impacted by the dredging operations will be developed by the contractor as part of the license/permits works.

**Ballast Water** – The TSHD is likely to has relatively small ballast water tanks which are only discharged in special circumstances (e.g. light draft required for shallow water (<3m) work). With Queensland and New South Wales there are no specific ballast water management requirements for ballast water taken up within Australia’s territorial sea and domestic ports. While there are no current requirements, an earlier guideline titled, Australian Coastal Voyage Ballast Water Management Guidelines, was produced and provided recommendations in relation to domestic ballast water management. The TSHD ballast water management plan is based on those earlier guidelines with the highest level of treatment being adopted as standard, to completely minimise translocation risks. To further minimise the risk of translocation of exotic organisms whenever possible fresh water is to be used to fill the ballast tanks.

**Vessel Washdown** – This management plan is applicable to areas were wash waters may flow directly overboard, such as the deck and dredge head.

**Bunkering of Fuel** – Refuelling the TSHD is to occur by vessel-to-shore connection. There is the potential for fuel spill/leaks to enter the waterways however; this risk is controlled by operating procedures and use of licensed contractors to perform the fuel transfer.
6.2.1 Waste Management

6.2.2 General and recycling waste

The TSHD is to be fitted with sufficient general waste bins, and co-mingled recycling bins for the collection of on-board wastes. These are to be fitted with secured lids to prevent material being blown overboard during either storage or handling. An approved contractor is to collect the bins as required, when the vessel is alongside port reception facilities during re-provisioning/crew-change operations.

<table>
<thead>
<tr>
<th>Element</th>
<th>Waste Management – General Refuse and Recycling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective/Target</td>
<td>To ensure that general refuse produced on-board the TSHD is collected, retained and transferred to appropriate facility without unintentional loss.</td>
</tr>
</tbody>
</table>
| Management Actions and Mitigation Measures | During at-sea operations:  
- Supply of appropriate collection bins in areas such as galley, crew quarters and mess.  
- Transfer of bins as required to large bins on-deck.  
- All on-deck bins secured in position to prevent movement whilst at sea.  
- Material placed in bin to be as compacted as possible to reduce space requirements.  
- Where facilities exist to recycle material, appropriate separation of refuse.  
- Bin lids to be chained down to prevent wind blown material loss at all times.  
- All collection points to be emptied to on-deck bin when near capacity.  
- Visual check to ensure that on-deck bins have sufficient capacity to retain general waste until next scheduled on-shore transfer.  
During transfer:  
- Licensed collector to be used to collect general refuse for transfer to approved facility.  
- Bin lids to be chained in position during transfer to prevent material loss. |
| Performance Indicators       | No loss of general refuse over-board during collection, storage or transfer. |
| Reporting                    | Reporting of material loss over-board to Vessel Master. |
| Corrective Action            | If practicable, retrieve material that was lost overboard. Review procedure causing material loss and rectify immediately. |
| Term                         | During all operations. |
| Responsibility               | Vessel Master. |
6.2.3 Sewage Treatment

The TSHD is to be fitted with a sewage treatment system, which treats all onboard blackwater and greywater. The system should enable compliance with International Maritime Organisation (IMO) criteria and meet the requirements of the Queensland Transport Operations (Marine Pollution) Regulation (2008). Any waste water not able to be treated to sufficient quality for overboard discharge, should be held onboard till such time as onshore discharge to a licensed waste contractor is possible.

<table>
<thead>
<tr>
<th>Element</th>
<th>Waste Management – Sewerage Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Harm to receiving water quality due to discharge of contaminants, including nutrients, faecal coliforms and prescribed water contaminants.</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To ensure sewage generated on-board is appropriately treated and releases are managed.</td>
</tr>
</tbody>
</table>
| Management Actions and Mitigation Measures | During at-sea operations:  
- All sewage effluent (including grey waters and black water) generated onboard shall be directed to the onboard treatment system.  
- Treated effluent shall be diverted to onboard holding tanks, or disposed to ocean if treatment is compliant for intended discharge area.  
- Effluent from the treatment system and holding tank is to be discharged in appropriate locations to ensure compliance with relevant legislation (see Appendix 1 - Untreated sewage discharge- which includes a plan showing restricted locations for discharge of untreated sewerage for Karumba).  
- Sludge tank to be pumped out as required by Chief Engineer after testing.  
- Pump-out of sludge tank to be managed as for untreated sewage discharges and, by way of appropriately licensed contractors where required.  
Service records:  
- The sewage treatment system is to be managed and maintained as described in the applicable sewage treatment manual, operational procedures manual and records maintained in sewage log book.  
- Details of the independent testing entity (name, address) and the date and results of each routine assessment of the treatment system are to be described in the sewage log book.  
System Improvements:  
- Improvements to the sewerage treatment system, aimed at improving effluent discharge quality shall be trialled and monitored |
| Performance Indicators | No sewage discharge within an area that prohibits the discharge of untreated sewerage.  
Ongoing improvement in the quality of effluent discharge from the sewerage treatment system. |
| Monitoring | Vessel Master to monitor vessel location during sewerage discharge events to ensure vessel is not within an area that the discharge of untreated sewage is prohibited.  
Routine testing and analysis of sewage discharge quality by accredited laboratory. |
| Reporting | Reporting of sewerage discharge location in Sewage Log Book.  
Reporting of monitoring results against legislative requirements to Environmental staff. |
| Corrective Action | Review procedure resulting in sewerage discharge in prohibited location and rectify immediately.  
Review sewage storage system inputs and operation. Modify procedures, to improve discharge quality |
| Term | During all operations. |
| Responsibility | Management and operation of on-board system is by the Vessel’s Chief Engineer.  
Ensuring sewerage discharge is not within a prohibited location is by the Vessel’s Master. Sampling results review and corrective action is by Environmental staff in conjunction with Chief Engineer. |
6.2.4 Hazardous Waste

Hazardous waste includes waste oils, oily water, oil sludge, chemicals and paints. Oily water is often contained within the bilge water holding tank and is to be discharged onshore by a licensed contractor.

<table>
<thead>
<tr>
<th>Element</th>
<th>Waste Management – Hazardous Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Environmental harm from improper disposal, handling or loss of hazardous substances.</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To ensure hazardous waste generated on-board is appropriately managed. Respective product Material Safety Data Sheet (MSDS) requirements are met</td>
</tr>
</tbody>
</table>
| Management Actions and Mitigation Measures | During at-sea operations:  
  - Oils may be recycled through the engine until the waste oil forms a sludge which is transferred to a holding tank for onshore pump-out by a licensed contractor.  
  - Any minor amounts of hazardous waste materials are to be contained and stored in bunded areas until discharge onshore.  
  - All hazardous waste to be stored in appropriate manner and clearly marked in accordance with legislative requirements.  

  During Transfer:  
  - Hazardous waste to be collected by licensed contractor only, for disposal at approved facility.  
  - All procedures to minimise spills during transfer of hazardous waste to contractor shall be followed. Spill response equipment shall be easily identifiable and conveniently located. |
| Performance Indicators               | No inappropriate storage or disposal of hazardous wastes. |
| Monitoring                           | Reporting by all crew of any observations of inappropriate storage or handling of hazardous wastes. |
| Reporting                            | Exception reports directly to Vessel Master. |
| Corrective Action                    | Vessel Master to review procedure breakdown and correct if required. This may include staff training. |
| Term                                 | During all operations. |
| Responsibility                       | Management and operation of on-board system is by the Vessel Master, with input from Environmental staff as required. |
6.3 Noise

A modern TSHD should be fitted with well maintained noise reduction devices to limit the noise generated during works as much as possible. Further, the nature of the works is such that the potential for disruptive noise to sensitive places (e.g. residential areas) is limited by distance.

<table>
<thead>
<tr>
<th>Element</th>
<th>Noise Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Noise impacts to sensitive receptors for example residential areas, resulting in complaint about vessel operations.</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To ensure noise generated by operation of the TSHD does not unduly impact adjacent areas.</td>
</tr>
</tbody>
</table>
| Management Actions and Mitigation Measures | • All noise reduction equipment to be maintained as per manufactures’ specifications.  
• Where the vessel is operating in an especially noise sensitive environment (e.g. close proximity to residential areas), crew are to be informed to minimise noise where possible.  
• All noise from activities must not exceed the acoustic quality objectives specified in the Environmental Protection Noise Policy 2008. Noise levels for selected receptors identified in the Environmental Protection Noise Policy are in the table below: |

<table>
<thead>
<tr>
<th>Sensitive receptor</th>
<th>Time of Day</th>
<th>L_{A_{eq},adj,1hr} (Equivalent continuous sound pressure level)</th>
<th>L_{A_{10,adj,1hr}} (Noise level exceed 10% of time)</th>
<th>L_{A_{1,adj,1hr}} (Noise level exceed 1% of time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwelling (outdoors)</td>
<td>Daytime and evening</td>
<td>50</td>
<td>55</td>
<td>65</td>
</tr>
<tr>
<td>Dwelling (indoors)</td>
<td>Daytime and evening</td>
<td>35</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>Night time</td>
<td>30</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>Commercial and retail activity (indoors)</td>
<td>When the activity is open for business</td>
<td>45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Performance Indicators | No noise based complaints regarding the operation of the vessel. |
| Monitoring | All complaints recorded in appropriate system and forwarded to Vessel Master and Environment staff. If necessary noise shall be monitored to determine the level of impact. |
| Reporting | Annual review of all complaints received and follow-up action undertaken. |
| Corrective Action | Vessel Master to investigate source of complaint. If this relates to inappropriate work practices, inform crew of necessary changes and ensure these are undertaken. If complaints relates to plant, investigate effectiveness of noise reduction equipment and review/replace as required. |
| Term | During all operations. |
| Responsibility | Management and operation of on-board systems is by the Vessel Master, with input from Environment staff as required. |
6.4 Turbidity Control

The Dredging Contractor and Ports North will ensure that the dredging operation minimises turbidity production to reduce impacts to adjacent marine resources, such as seagrasses. The TSHD should be fitted with a range of best practice design features (e.g. central column weir and below keel discharge) to minimise turbidity production.

Turbidity monitoring of the dredging works will be undertaken by Ports North in accordance with LTMMMP monitoring plan requirements which has been prepared to address approval requirements. Should the monitoring identify that turbidity production from the dredging works is exceeding approval limits the Vessel Master will be urgently advised and dredging activities will be modified to ensure compliance with these limits.

<table>
<thead>
<tr>
<th>Element</th>
<th>Turbidity Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Potential impacts through deposition, light attenuation or decline to water quality due to anthropogenic elevation of suspended sediment within water column which may impact on marine species, including flora. Impacts to scenic amenity may also occur, giving rise to community complaint or concern.</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To ensure turbid plumes generated by the operation of the TSHD are minimised and comply with approval limits.</td>
</tr>
</tbody>
</table>
| Management Actions and Mitigation Measures | • Within the practicalities of the vessel, minimise the generation of plumes by control of a discharge weir system.  
• Ensure dredging and material relocation is undertaken within the approved areas only by reference to electronic navigation aids and visual marks as required.  
• Observe all site-specific requirements, which may influence dredging times or the use of overflow dredging (e.g. tides, wind direction and velocity etc.).  
• As required under the approval conditions, Ports North is to implement a water quality and turbidity monitoring program if required. |
| Performance Indicators | No dredging or placement of material outside approved areas.  
Turbidity levels as a result of dredging works to be to be maintained within the limits stipulated within relevant approvals |
| Monitoring          | Review of vessel dredging and placement tracks against approved area boundaries.  
Ports North to monitor turbidity levels in accordance with approval requirements. |
| Reporting           | Reporting of any release of dredged material outside the nominated spoil ground to Vessel Master, Environment staff and Ports North Project Superintendent.  
Reporting by Ports North of any exceedence of permitted turbidity limits from monitoring activities to Vessel Master. |
| Corrective Action   | Vessel Master to investigate the reason any release of dredged material outside the nominated spoil ground and take appropriate action.  
Ports North to determine if corrective action to reduce turbidity production is required. Vessel Master to develop and implement appropriate corrective action in consultation with Manager Dredging Operations (Corrective actions may include such as, reduction in load size, no overflow dredging etc.). |
| Term                | During all operations. |
| Responsibility      | Management and operation of on-board systems is by the Vessel Master, with input from Manager Dredging Operations and Environment staff as required.  
Ports North is responsible for determining if turbidity levels at the dredge site are exceeding approval limits and determining if corrective action is required. |
6.5 Protected Marine Fauna

The following procedure outlines the management to be put in place to minimise the risk of harming large marine fauna including turtles, dugongs and cetaceans during dredging operations. In the event of an incident, contacts are to be followed as outlined in this document.

<table>
<thead>
<tr>
<th>Element</th>
<th>Protected Marine Fauna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective/Target</td>
<td>To ensure the minimisation of the capture of, or harm to, protected marine fauna during dredging and material relocation process.</td>
</tr>
<tr>
<td>Actions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Follow the procedures for the protection of marine fauna to meet the conditions outlined in the Sea Dumping Permit. Specifically:</td>
</tr>
<tr>
<td></td>
<td>o Prior to the commencement of each dredging and dumping run, Dredge Vessel Master to check, using binoculars from a high observation platform, for cetaceans, dugongs and turtles within the vicinity of vessel operation (i.e. adjacent to the dredging/dumping run about to be commenced).</td>
</tr>
<tr>
<td></td>
<td>o Dredging and dumping activities may only be commenced if no individuals of large marine fauna have been observed in the area adjacent to the dredge, and where there is a low likelihood of a collision occurring.</td>
</tr>
<tr>
<td></td>
<td>o Where any of the large marine fauna are sighted within the area adjacent to the dredge, dredging/dumping activities are to be halted until the last individual has been observed to leave the vicinity of the dredge.</td>
</tr>
<tr>
<td></td>
<td>• Vessel Master to maintain watch for marine fauna in high risk areas and take necessary action where risk of a collision may exist.</td>
</tr>
<tr>
<td></td>
<td>• Dredging and material placement only in approved areas.</td>
</tr>
<tr>
<td></td>
<td>• Turtle excluders will be fitted where possible during all operations where turtles may reasonably be encountered.</td>
</tr>
<tr>
<td></td>
<td>• Dredge suction to be started only when dredge heads are in contact with seafloor at start of dredge run, and then stopped once dredge heads are lifted from seafloor.</td>
</tr>
<tr>
<td></td>
<td>• Load to be inspected on an opportunistic basis for marine fauna remains.</td>
</tr>
<tr>
<td>Performance Indicators</td>
<td>No dredging or placement of material outside approved areas.</td>
</tr>
<tr>
<td></td>
<td>No capture of, or harm to, protected marine fauna.</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Review of vessel dredging and placement tracks against approved area boundaries.</td>
</tr>
<tr>
<td></td>
<td>Load to be inspected on an opportunistic basis for marine fauna remains.</td>
</tr>
<tr>
<td></td>
<td>Visual monitoring of area adjacent to dredging operations, in accordance with Sea Dumping Permit conditions.</td>
</tr>
<tr>
<td>Reporting</td>
<td>Reporting of exceptions to Vessel Master Environmental staff (including time, nature of incident, species involved.</td>
</tr>
<tr>
<td></td>
<td><strong>This reporting requirement is irrespective of whether the fauna is dead or alive.</strong></td>
</tr>
<tr>
<td></td>
<td>Ports North to be urgently advised by Vessel Master, of any incidents to allow them to notify the Determining Authority of the incident, within timeframe specified in accordance with conditions of the Sea Dumping Permit.</td>
</tr>
<tr>
<td>Corrective Action</td>
<td>Vessel Master to investigate reason for exception and take appropriate action.</td>
</tr>
<tr>
<td>Term</td>
<td>During all operations.</td>
</tr>
<tr>
<td>Responsibility</td>
<td>Management and operation of on-board systems is by the Vessel Master, with input from Environment staff as required.</td>
</tr>
</tbody>
</table>
6.6 Cultural Heritage

Cultural heritage refers to both European and Indigenous heritage issues.

<table>
<thead>
<tr>
<th>Element</th>
<th>Cultural Heritage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective/Target</td>
<td>To ensure dredging operations do not disturb/destroy items of European or non-European cultural significance.</td>
</tr>
</tbody>
</table>
| Actions                  | • Ensure dredging and material relocation is undertaken within the approved areas only by reference to electronic navigation aids and visual marks as required.  
• Undertake opportunistic visual inspection of dredge load and dredge heads, reporting any items of suspected cultural significance. If items are found, retain and report to relevant authorities through Vessel Master and Environment staff. |
| Performance Indicators   | No disturbance of items of cultural significance.                                  |
| Monitoring               | Opportunistic inspection of the dredged material for evidence of items of cultural heritage. Monitoring of dredge movement through use of electronic aids to ensure it is within designated area. |
| Reporting                | Reporting of exceptions to Vessel Master and Environment staff.                    |
| Corrective Action        | Vessel Master to investigate reason for exception and take appropriate action.      |
| Term                     | During all operations.                                                             |
| Responsibility           | Management and operation of on-board systems is by the Vessel Master, with input from Environment staff as required. |

6.7 Bunkering of Fuel

The TSHD is regularly re-fuelled by the use of a licensed contractor, typically on crew change.

<table>
<thead>
<tr>
<th>Element</th>
<th>Bunkering of Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Potential environmental harm from fuel product spills if approved operating procedures are not enacted</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To ensure bunkering of fuel to the TSHD is appropriately transferred and spillage is prevented.</td>
</tr>
</tbody>
</table>
| Management Actions and Mitigation Measures | During land transfer:  
• Licensed contractor is used to transfer fuels and levels shall be monitored.  
• Standard work procedures and bunkering operations are to be followed, including those in place by the fuel supply contractor. |
| Performance Indicators         | No spills or leaks during fuel transfer.                                           |
| Monitoring                     | Visual inspections of fuel-dispensing equipment during fuel transfer.              |
| Reporting                      | Reporting of unanticipated spill/leak to Vessel Master in the first instance, then Manager Dredging Operations and Environment staff. |
| Corrective Action              | In the event of a major spill, call Emergency Spill Response team for corrective action.  
Vessel Master to investigate source and cause of spill or inappropriate work practices. Change to operating procedures and inform crew. |
| Term                           | During all operations.                                                            |
| Responsibility                 | Management and operation of bunkering of fuel is by the Vessel Master.            |
6.8 Ballast Water and Hull Fouling Management

Given all dredging will occur within Port limits there is a low risk associated with the ballast water. However, if the TSHD is going to leave following a dredging job within Port limits or returning from a dredging job outside Port limits, the following shall be followed.

<table>
<thead>
<tr>
<th>Element</th>
<th>Ballast Water – Hull Fouling Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Translocation of marine flora and fauna species from another port to the site of vessel operations may have a long term deleterious impact to natural resident marine flora and fauna. This is especially the case for known marine pest species.</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To ensure that the risk of translocation of organisms in ballast water by the TSHD is minimised.</td>
</tr>
</tbody>
</table>
  - Before leaving Port of origin, undertake a thorough hopper wash within the material location area only.  
  - If discharge pipes have been utilised during operations, undertake a thorough flush of these systems.  
  - Inspect hopper and dredge gear (esp. heads) to ensure that no material which may transport organisms (such as sediments, organic material or waters) is retained. During transit between areas of operation:  
  - Any ballast tanks holding seawaters will be exchanged with a minimum 150% of design volume with seawaters at a location as distant from the coastline or other shallow (<100m) areas as possible, but not less than 5nm.  
  - Ballast tanks filled with freshwaters will be retained without treatment.  
  - Waters held within the hopper during transit will be treated as for other ballast waters. During operations at dredge area:  
  - Release of ballast waters will be minimised at all times;  
  - A record will be kept of volumes, location and times of ballasting and deballasting operations. Leaving Port of Operations:  
  - When leaving the Port of Operations the vessel, hoppers and pipe work is to be adequately inspected and cleansed to ensure potential for translocation of pest species to next port of call. Follow specific vessel operation procedures. |
| Performance Indicators | Contract requirements for vessel inspection, proof of freedom and prior port of operation clearance is complete prior to vessel arrival and commencement of dredging. No release of high risk ballast water during operations. |
| Reporting | Vessel Master to maintain record of operations and review for non-conformances. |
| Corrective Action | Review procedure causing release and rectify immediately. |
| Term | During all operations. |
| Responsibility | Vessel Master. |
6.9 Vessel Wash Down

This management plan relates to the washing of the dredge head or the deck of the TSHD where an accumulation of dredge spoil may have occurred.

<table>
<thead>
<tr>
<th>Element</th>
<th>Vessel Wash down</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Potential harm from cleaning agents may occur if improper agents are used in vessel cleansing. Wash down of hopper, pipe work or dredge heads in areas outside the approved work area or spoil ground may lead to additional turbidity impacts, or deposition of spoil outside approved disposal site.</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To minimise the release of potential contaminates to enter the environment.</td>
</tr>
</tbody>
</table>
| Management Actions and Mitigation Measures | • Prior to washing, preference shall be given to sweeping the deck and/or equipment.  
• If washing is required, biodegradable degreaser shall only be used where necessary and will be applied sparingly.  
• Only ‘quick-break’ degreasers shall be used and any discharges shall be minimised.  
• Wash down of the deck and or dredge head shall only occur within the designated dredge area.  
• Degreasers only to be used if sweeping or watering the deck/equipment is not appropriate. |
| Performance Indicators | No inappropriate use of degreasers or wash down in undesignated areas.          |
| Monitoring            | Reporting by crew of any observations of contamination to the waterway whilst washing the deck/equipment. |
| Reporting             | Exception reports directly to vessel Master.                                      |
| Corrective Action     | Vessel Master to review procedure breakdown and correct if required. This may include staff training. |
| Term                  | During all operations.                                                           |
| Responsibility        | Management and operation of on-board system is by the Vessel Master, with input from Environment staff as required. |

6.10 Environmental Complaints

Any complaints received by Dredge Vessel crew relating to the operation of the TSHD will be recorded as part of standard operating procedures. Complaints will be recorded on the appropriate form and forwarded to the Vessel Master. The Master is to then initiate actions to resolve/investigate the complaint as required, with assistance from Ports North staff as necessary. A copy of all complaints will be forwarded to the respective Ports North staff via the Site Supervisor.

Issues which are not directly related to the operation of the TSHD, but are related to the Karumba dredging project will be forwarded to the Site Supervisor and Ports North. Whilst feedback on the resolution of the issue will be sought for recording to Ports North’s Management Systems, the management of the issue will be the responsibility of the Project Superintendent and Ports North protocols.

6.11 Dredging Activity

The crew of the TSHD are to keep a record of dredging activity, which meets Ports North reporting requirements under the Sea Dumping Permit. Such information will include the times and dates of each dumping run, begin and end points of dredge runs, material type, volume, location of material relocation and other pertinent observations as part of the standard vessel operating procedures. This data will be forwarded to Ports North at the completion of works.

Regular review and checking of dredge location relative to approved area, review of dredge volume to date relative to permitted campaign volume and verification of disposal point or track records will be completed by the Contactor to ensure compliance with applicable permits.
7 Emergency Procedures

The TSHD is to maintain a Shipboard Emergency Plan, which outlines the role, responsibilities and actions to be followed during an emergency, including uncontrolled release of oils/fuels.

Further, all crew are to be trained and accredited in accordance with the Australian Maritime Safety Authority (AMSA) requirements for Australian Coastal voyages.

It is recommended that the TSHD vessel maintains an accredited to AS4801 Safety Management System. As part of this system, all onboard procedures are to be available to all crew in a written format in the Operational Procedures Manual and a vessel log is to be maintained by the Vessel Master.

Emergency Contact Details

<table>
<thead>
<tr>
<th>Reporting to</th>
<th>Contact Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AMSA Marine Incident Reporting</strong></td>
<td></td>
</tr>
<tr>
<td>Via Mobile Phone)</td>
<td>1800 641 792</td>
</tr>
<tr>
<td>Via Satellite</td>
<td>00612 6230 6811</td>
</tr>
<tr>
<td><strong>Harbour Master (Cairns)</strong></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td>07 4052 7470 (24 Hours)</td>
</tr>
<tr>
<td>Mobile</td>
<td>0418 774 028</td>
</tr>
<tr>
<td><strong>Port Control (via Cairns)</strong></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td>07 4052 7470 (24 Hours)</td>
</tr>
<tr>
<td>Mobile</td>
<td>0418 774 028</td>
</tr>
<tr>
<td><strong>Medical Facilities</strong></td>
<td></td>
</tr>
<tr>
<td>Karumba Health Centre</td>
<td>07 4745 9137</td>
</tr>
<tr>
<td>Normanton Road Karumba</td>
<td></td>
</tr>
<tr>
<td>Normanton Hospital Brown St Normanton</td>
<td>07 4745 1144</td>
</tr>
</tbody>
</table>

8 Reporting

A final close out report summarising the outcomes of the EMP implementation is to be developed by the Contractor, noting any reportable items in the respective sections above, outcome of the campaign, and any observations that may be of interest to the TACC and DSEWPaC. Such close out report will be provided to and reviewed by Ports North.
9 Appendices

9.1 Appendix 1 Sewage Discharge Areas

Untreated Sewage Discharge Karumba

The discharge of untreated sewage, is required to comply with s47 of Transport Operations (Marine Pollution) Act 1995 (TOMPA), Schedule 4 of Transport Operations (Marine Pollution) Regulation 2008 (TOMPR) as prescribed below.
9.2 Appendix 2 Approvals

Permits and Licences for Project

- valid copies of applicable environmental approvals to be attached as at time of contract resolution and commencement of EMP implementation
Appendix 11

Port of Karumba LTMMMP

Channel Bed Levelling

ENVIRONMENTAL MANAGEMENT PLAN

Template for Inclusion in
Long Term Management and Monitoring Plan (LTMMMP)
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Document Control

<table>
<thead>
<tr>
<th>Version</th>
<th>Drafted</th>
<th>Released</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Draft and revision by Far North Queensland Ports Corporation Ltd</td>
<td>June 2009</td>
</tr>
<tr>
<td>1</td>
<td>Updated for LTMMP to form template</td>
<td>January 2011</td>
</tr>
<tr>
<td>2</td>
<td>Updated as Appendices for LTMMP and change to Agency names</td>
<td>April 2012</td>
</tr>
<tr>
<td>3</td>
<td>Updated for Final LTMMP</td>
<td>January 2013</td>
</tr>
</tbody>
</table>
1 Scope

This document forms an Appendix to the Karumba Long Term Management and Monitoring Plan (LTMMP) and is to be considered a template for use by an appointed bed levelling vessel contractor as engaged by Ports North for the conduct of bed levelling campaigns at Port of Karumba. The Contractor may already have an existing document for their own operations, and in such case those management plan specifications shall prevail to the extent where this document, as approved by the DSEWPaC will have superiority.

2 Introduction

Environmental management measures have been developed for the proposed bed levelling works to ensure environmental safeguards are in place to minimise impact on the natural environment. All personnel involved in the project are required to demonstrate a general environmental duty of care throughout the project. This Environmental Management Plan (EMP) identifies potential impacts and the management strategies to be implemented during the bed levelling works.

Far North Queensland Ports Corporation Limited (FNQPC), trading as Ports North, has an Environmental Management Framework, and associated Policy, which provides a framework for continually improving operations and practices (refer Appendix A).

Ports North staff and contractors involved in this project are required to protect the environment under requirements of applicable legislation, including the Queensland Environmental Protection Act 1994. The appointed Contractor is required to comply with the requirements of Ports North’s Environment Policy and all management measures specified below.

Bed levelling works are an interim low environmental risk maintenance activity aimed at producing navigable depth at least cost and in a timely manner to allow continued operation of shipping channel and the port.

3 Description of Proposed Activities

The objective of this work is to conduct bed levelling or drag baring works, to relocate accumulated sediments from the shallow section of the channel, to adjacent deeper sections and allow sufficient draft until the regular maintenance dredging campaign.

Previous bed levelling activities have typically been completed during a two week campaign.

4 Legislative Requirements

Approvals under applicable sections of Commonwealth and State environmental legislation are maintained by Ports North for areas in which dredging, bed levelling or disposal may occur. Such approvals may be ongoing development approvals for the subject area or require an annual renewal. Brief description of key legislative requirements is provided as follows;

Environmental Protection Act 1994

Under the Queensland Environmental Protection Act 1994 (EP Act), an environmental duty of care is required at all stages of the project by all staff (Section 316 of the EP Act). The basic principles of the EP Act should be understood by all project staff.

No approvals or thresholds are triggered for the conduct of bed levelling works under the Environmental Protection Regulation 2008, and hence there are no Environmentally Relevant Activities (ERA’s) involved in the proposed activity.
Fisheries Act 1994

Approvals under the *Fisheries Act 1994* are required where direct impacts to marine flora or fauna defined under the Act are likely to occur. No such approvals are required for either the maintenance dredging campaigns, or bed levelling work as prior surveys by the former Department of Primary Industries and Fisheries (now DAFF) have determined the spatial extent of seagrass meadows as being outside the channel and works area. Across the southern Gulf of Carpentaria, light limitation due to natural turbidity precludes colonisation of marine flora such as seagrass from such depths as those that are found within the maintained channel.

Coastal Protection and Management Act 1998

An approval under the former *Section 86* of the *Harbours Act 1955* is in place for works on defined areas of the sea bed within the port limits inclusive of dredging, disposal and bed levelling.

Nature Conservation Act 1992

Under the *Nature Conservation Act 1992*, individuals and organisations have an obligation to prevent any potential injury or harm to flora and fauna. All environmental safeguards must be implemented, particularly during periods of likely movement of turtles, dugong or other large marine fauna.

5 Responsibilities and Contacts

A contacts list based on the example below is to be generated for the project once Contract arrangement is finalised to ensure chain of communication is clearly documented.

Contact details for the following positions will be recorded;

<table>
<thead>
<tr>
<th>Position</th>
<th>Name and Contact Number</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superintendent</td>
<td></td>
<td>Contractor liaison</td>
</tr>
<tr>
<td>Ports North Environment Manager</td>
<td></td>
<td>EMP implementation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Incident recording and reporting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supervise applicable monitoring</td>
</tr>
<tr>
<td>Contractor</td>
<td></td>
<td>Conduct of drag bar works</td>
</tr>
<tr>
<td>Ports North Port Supervisor</td>
<td></td>
<td>Customer and stakeholder liaison</td>
</tr>
<tr>
<td>Ports North General Manager Planning and Projects</td>
<td></td>
<td>Contract management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Customer and stakeholder liaison</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supervision</td>
</tr>
<tr>
<td>Ports North General Manager Corporate Services</td>
<td></td>
<td>Supervision of contractors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Community engagement and complaints</td>
</tr>
</tbody>
</table>
6 Implementation
The Contractor will be responsible for the implementation of this EMP for the duration of the project including:

- monitoring the environmental management of day-to-day dredge vessel operations;
- ensure that all personnel working onsite are aware of their environmental responsibilities and the importance of the EMP.
- regular inspection of the adequacy of all environmental controls, including health and safety requirements.

7 Induction
All personnel working onsite must attend an induction or ‘tool box’ by the Principal Contractor prior to commencing works. The induction will cover relevant provisions from this EMP, including:

- Performing work duties with minimal impact on the existing environment
- General environmental duty of care
- Incident recognition and reporting – including marine fauna

Superintendent will maintain a record (Diary, Register or File) of the completed inductions.

8 Auditing
An environmental audit may be conducted by Ports North to determine implementation status of this EMP at any time during the project. The Contractor must keep a copy of this document together with any relevant environmental licence, permit or approvals onsite at all times.

The Port Supervisor may also inspect the works at any time to ensure all project commitments by the Contractor are implemented.

9 General Environmental, Safety or Community Impacts
To minimise impacts on social and environmental aspects of the project, the following management measures shall be adopted:

- All site personnel will be advised of their responsibilities for reporting any potential or actual environmental harm in accordance with the Environmental Protection Act 1994.
- The Superintendent for the project is to be notified of any safety or environmental incidents (including complaints) that occur immediately.
- An Incident Form will be completed and remedial actions will be monitored.
- Cultural heritage duty of care – observation and reporting duties.
- The Contractor is required to record all details of any community complaint received and to notify Superintendent including details of the action taken to rectify the situation.
- The Contractor will comply with all employer and employee obligations under the Work Health and Safety Act 2011 and shall prepare a Safety Management Plan to cover site activities.
- Port Supervisor will consult with relevant stakeholders prior to commencement of works.
- Notice to mariners will be implemented by Maritime Safety Queensland, alerting recreational and commercial fishers and other port traffic to the location and extent of works.
- Superintendent will maintain a diary record of any complaints received and actioned.
10 Environmental Management Elements

This section provides principles, controls and management strategies for the different aspects of the project, which must be adhered to at all times by all persons involved in the project to reduce the potential impacts identified.

10.1 Aspects and Impacts

Under conditions of general operations, with all management actions, mitigation measures in place, the following qualitative risk profile is considered to prevail.

<table>
<thead>
<tr>
<th>Standard Environmental Aspects</th>
<th>Potential Impacts</th>
<th>Consequence</th>
<th>Likelihood</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td>Impacts to sensitive receptors and subsequent complaints</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Odour/ Air Emission</td>
<td>Impacts to sensitive receptors and subsequent complaints</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Water Quality</td>
<td>Influence on quality of receiving waters from works, aesthetics, and subsequent impacts to flora and fauna</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Contaminated Sediments</td>
<td>Mobilisation of contaminants in to water column and subsequent water quality impacts</td>
<td>M</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Marine Fauna</td>
<td>Damage to large marine fauna, marine animal strikes</td>
<td>H</td>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>Cultural Heritage</td>
<td>Damage to artefacts or sites</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>Natural Disaster</td>
<td>Surge, wind, flooding</td>
<td>L</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Waste (Solid &amp; Liquid)</td>
<td>Pollutant release, complaints</td>
<td>M</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td>Community Engagement</td>
<td>Impacts to sensitive receptors and subsequent complaints</td>
<td>M</td>
<td>L</td>
<td>M</td>
</tr>
</tbody>
</table>

Detail on theses Aspects and Impacts, along with detail of typical environmental management plan content is explored in the following sections in the context of a typical bed levelling operation;
### 10.1.1 Water Quality including Turbidity

After consideration of possible spoil contaminants has been assessed and material considered suitable for dredging and disposal, the primary consideration then relates to sedimentation and turbidity. Secondary water quality effects such as changes to dissolved oxygen, sulphides, pH and conductivity are typically of very minor risk, The Contractor and Ports North will ensure that bed levelling operations minimises turbidity production to reduce impacts to adjacent marine resources, such as seagrasses wherever practical through use of best practice equipment, mitigation measures and effective management of the campaign. Monitoring component for water quality impacts of dredging and bed levelling works will be implemented in accordance with LTMMP monitoring plan which has been prepared to address approval requirements.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Water Quality - Turbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact</strong></td>
<td>The primary environmental impacts associated with bed levelling is the re-suspension of sediment into the water column and the creation of suspended particle plumes which may affect adjacent areas (e.g flora) by sedimentation or reduction of light penetration through the water. Natural turbidity levels in the coastal zone of the Gulf of Carpentaria typically observed at Port of Karumba can be very high, dependant on wind, tidal and catchment runoff conditions. Therefore short term works are expected to be well within natural tolerances. Previous extensive monitoring completed since 1996 and subsequent maintenance dredging indicates natural turbidity values to 300NTU at Alligator Bank under low water levels and strong onshore northerly wind conditions. Sediments and turbidity from the works are most likely to move toward sensitive areas in period of north-west to north-east winds and incoming spring tides.</td>
</tr>
<tr>
<td><strong>Objective/Target</strong></td>
<td>To ensure turbid plumes generated by the operation of bed levelling equipment is minimised and comply with approval conditions.</td>
</tr>
</tbody>
</table>
| **Management Actions and Mitigation Measures** | • Within the practicalities of the vessel, minimise the generation of plumes by control of vessel operations.  
• Ensure dredging and material relocation is undertaken within the approved areas only by reference to electronic navigation aids and visual marks as required.  
• Observe all site-specific requirements, which may influence work times (e.g. tides, wind direction and velocity etc.).  
• As required under the approval conditions, Ports North is to implement a water quality and turbidity monitoring program if required by LTMMP or Permit. |
| **Performance Indicators** | No dredging or placement of material outside approved areas. Turbidity levels as a result of dredging works to be to be maintained within the limits stipulated within relevant approvals. |
| **Monitoring** | Review of vessel dredging and placement tracks against approved area boundaries. Ports North to monitor turbidity levels in accordance with approval requirements and LTMMP initiatives. |
| **Reporting** | Reporting of any bed levelling activity outside the nominated works area by Vessel Master to Environment staff and Ports North Project Superintendent. Reporting by Ports North of any cases where results exceed permitted turbidity limits from monitoring activities to Vessel Master. |
| **Corrective Action** | Ports North to investigate actions of Vessel Master to determine reason for any activity outside the nominated work area and take appropriate action. Should the monitoring identify that turbidity production from the bed levelling works is exceeding approval limits the Vessel Master will be urgently advised and dredging activities will be modified (duration, location, intensity) to ensure compliance with these limits. Ports North to determine if corrective action to reduce turbidity production is required. Vessel Master to develop and implement appropriate corrective action in consultation with Superintendent. |
| **Term** | During all operations. |
| **Responsibility** | Management and operation of on-board systems is by the Vessel Master. Ports North is responsible for determining if turbidity levels at the work site are exceeding approval limits and determining if corrective action is required. |
10.1.2 Contaminated Sediments

Previous sediment analysis plan (SAP) implementation at the Port of Karumba has occurred in 2002, 2006 and 2009 and has shown material within the entrance channel to be generally clean and consist predominantly of natural concentrations of base metals, an absence of herbicides or pesticides and low concentrations of antifouling paint residue tri-butyl tin. Material from Port of Karumba has been assessed previously as suitable for placement at sea and is considered un-contaminated.

Consequently no specific water quality monitoring for contaminants is proposed for routine bed levelling operations.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Contaminated Sediments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Movement of contaminated sediment during bed levelling has potential to mobilise elements into the water which may have acute or chronic effects to flora and fauna, or may then disperse to surrounding areas. An understanding of the contaminant status of the sediment to be dredged is required and is typically assessed when determining disposal options for dredging prior to capital or maintenance dredging campaigns in accordance with the National Assessment Guidelines for Dredged Material (NAGD) 2008.</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To ensure mobilised sediments generated by the operation of bed levelling equipment does not result in water quality impacts to surrounding flora, fauna and is minimised to comply with approval conditions.</td>
</tr>
<tr>
<td>Management Actions and Mitigation Measures</td>
<td>Ensure conduct of Sediment Analysis Plan process as per NAGD (2008) and that potential water quality impacts are assessed for proposed spoil. Within the practicalities of the vessel, minimise the generation of plumes by control of vessel operations. Ensure dredging and material relocation is undertaken within the approved areas only by reference to electronic navigation aids and visual marks as required. As required under the approval conditions, Ports North is to implement a water quality and turbidity monitoring program if required by LTMMP or Permit.</td>
</tr>
<tr>
<td>Performance Indicators</td>
<td>An approved Sediment Analysis Plan is implemented and Report is approved by the DSEWPaC for the proposed work area.</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Ensure SAP process is implemented as set out in LTMMP, and in the event that contaminants are detected at a level above which water column effects may occur proceed through Phase III and IV to determine requirement for any specific contaminant monitoring requirement.</td>
</tr>
<tr>
<td>Reporting</td>
<td>Reporting of verifiable reports of contaminant issues that have been confirmed as caused by bed levelling activity. Reporting by Ports North of any cases where results exceed permitted limits from monitoring activities to DSEWPaC.</td>
</tr>
<tr>
<td>Corrective Action</td>
<td>Ports North to Implement SAP and any required specific contaminant monitoring if required.</td>
</tr>
<tr>
<td>Term</td>
<td>During all operations.</td>
</tr>
<tr>
<td>Responsibility</td>
<td>Ports North is responsible for ensuring SAP is implemented and any required actions in respect of contaminant monitoring are addressed.</td>
</tr>
</tbody>
</table>
### 10.1.3 Waste Management

The bed levelling vessel and supporting vessels are to be fitted with sufficient waste bins for the collection of on-board wastes until such time as appropriate on shore refuse disposal can be enacted.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Waste Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Un-controlled release of waste from work sites as litter may impact the nearby environment and also present a visual impact. Inappropriate disposal of waste that does not follow the waste management hierarchy of reduce, reuse, recycle dispose impacts on resource availability and future sustainability of materials supply.</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To ensure that general refuse produced on-board the vessels is collected, retained and transferred to appropriate facility without unintentional loss.</td>
</tr>
</tbody>
</table>
| Management Actions and Mitigation Measures | During at-sea operations:  
  - Supply of appropriate collection bins in areas such as galley, crew quarters and mess.  
  - Transfer of waste as required to on-deck bins.  
  - All on-deck bins secured in position to prevent movement whilst at sea.  
  - Material placed in bin to be as compacted as possible to reduce space requirements.  
  - Where facilities exist to recycle material, appropriate separation of refuse.  
  - These are to be fitted with secured lids to prevent material being blown overboard during either storage or handling.  
  - Bin lids to be chained down to prevent windblown material loss at all times.  
  - All collection points to be emptied to on-deck bin when near capacity.  
  - Visual check to ensure that on-deck bins have sufficient capacity to retain general waste until next scheduled on-shore transfer.  
  - During transfer:  
    - An approved contractor is to collect the bins as required when the vessel is alongside port reception facilities.  
    - Licensed collector to be used to collect general refuse for transfer to approved facility.  
    - Bin lids to be chained in position during transfer to prevent material loss.  
  General  
  Potential wastes generated from the project are likely to be minimal and consist of minor volumes of waste generated by the crew onboard the bed levelling vessel.  
  - Minimise waste generation. Adopt the waste minimisation practices of reduce, reuse and recycle.  
  - Ensure there is no contamination of surrounding environments in compliance with the General Environmental Duty of the Environmental Protection Act 1994.  
  - Waste removal should go to an approved landfill facility unless other conditions apply.  
Complete Daily EMP Checklist – refer Appendix D |
| Performance Indicators | No loss of general refuse over-board during vessel operations, collection, storage or transfer. |
| Monitoring | Regular visual assessment of collection points and on-deck bins. |
| Reporting | Reporting of material loss over-board to Vessel Master.  
Complete Incident Form –Appendix B |
| Corrective Action | If practicable, retrieve material that was lost overboard.  
Review procedure causing material loss and rectify immediately. |
| Term | During all operations. |
| Responsibility | Crew and then Vessel Master. |
### 10.1.4 Noise

Vessels and equipment utilised in a typical bed levelling campaign should be fitted with well maintained noise reduction devices to limit the noise generated during works as much as possible. Further, the nature of the works and remote rural port locations is such that the potential for disruptive noise to sensitive places (e.g., residential areas) is limited by distance.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Noise Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Noise generated from vessels plant or equipment during development or maintenance works has potential to disturb the amenity of surrounding areas, including noise sensitive areas such as residential areas. Infrequent or high volume noise is typically a cause for complaint, especially outside normal working hours. Ambient noise levels within the Port of Karumba are expected to be generally at a low background level with some influence of transiting vessel traffic from Port facilities. Minimal impact is normally expected on nearby sensitive receptors.</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To ensure noise generated by operation of the Bed Leveller does not unduly impact adjacent areas.</td>
</tr>
</tbody>
</table>
| Mitigation Measures and | • All noise reduction equipment to be maintained as per manufactures’ specifications.  
  • Where the vessel is operating in an especially noise sensitive environment (e.g., close proximity to residential areas), crew are to be informed to minimise noise where possible.  
  • All noise from activities must not exceed the acoustic quality objectives specified in the Environmental Protection Noise Policy 2008. Noise levels for selected receptors identified in the Environmental Protection Noise Policy. Noise generated by vessels involved in the bed levelling works is not likely to be significant, nor is it likely to be located near noise sensitive areas. Prior approval is required from Ports North if works are expected to occur outside these hours:  
    • 6:00am – 6:00pm (Monday – Sunday).  
    • All equipment is to be maintained and operated in accordance with the Australian standard AS 2436:1981 “Guide to noise control on construction, maintenance and demolition sites”.  
    • Vehicles and equipment will be turned off when not in use.  
    • All noise complaints shall be recorded and reported to the Superintendent as soon as practical.  
  Complete Daily EMP Checklist – refer Appendix D                                                                 |
| Management Actions      | No noise based complaints regarding the operation of the vessel.                                                                                                                                               |
| Performance Indicators  | All complaints recorded in appropriate system and forwarded to Vessel Master and Environment staff. If necessary noise shall be monitored to determine the level of impact.                                                   |
| Monitoring              | Annual review of all complaints received and follow-up action undertaken. Complete Incident Form – Appendix B                                                                                               |
| Reporting               | Vessel Master to investigate source of complaint. If this relates to inappropriate work practices, inform crew of necessary changes and ensure these are undertaken. If complaints relates to plant, investigate effectiveness of noise reduction equipment and review/replace as required. Should additional complaints be received following implementation of the above measures, then additional Mitigation Measures will be developed as required. |
| Corrective Action        | During all operations.                                                                                                                                                                                        |
| Responsibility          | Management and operation of on-board systems is by the Vessel Master, with input from Environment staff as required.                                                                                           |
### 10.1.5 Hull Fouling Management

Maintenance of effective hull protection systems and minimisation of fouling through routine slipping and cleaning is required to ensure a low risk from translocation of potential marine pest species to or from the Port of Karumba. This is especially the case where a foreign vessel is brought into the country to complete the contract. Low ballast water volume requirement for bed levelling vessels and hence lower risk mean hull fouling is a more probable issue. The following approach is to be implemented.

<table>
<thead>
<tr>
<th>Element</th>
<th>Ballast Water – Hull Fouling Management</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact</strong></td>
<td>Translocation of marine flora and fauna species from another port to the site of vessel operations may have a long term deleterious impact to natural resident marine flora and fauna. This is especially the case for known marine pest species.</td>
</tr>
<tr>
<td><strong>Objective/Target</strong></td>
<td>To ensure that the risk of translocation of organisms in ballast water and hull fouling is minimised.</td>
</tr>
<tr>
<td><strong>Management Actions and Mitigation Measures</strong></td>
<td>Implement best practice vessel maintenance and management Conduct actions required under ANZECC Hull Maintenance Guidelines, AQIS and Bio-Security Queensland invasive species protocols. Implement National Biofouling Management Guidance for Non-trading Vessels <em>(Commonwealth of Australia, 2009).</em> Finalising operations at Port: • Before leaving Port of origin, undertake a thorough wash within the work area only. • undertake a thorough flush of pipe work systems. • Inspect drag bar, chains, ropes etc to ensure that no material which may transport organisms (such as sediments, organic material or waters) is retained. During transit between areas of operation: • Any ballast tanks holding seawaters will be exchanged with a minimum 150% of design volume with seawaters at a location as distant from the coastline. • Ballast tanks filled with freshwaters will be retained without treatment. During operations at dredge area: • Release of ballast waters will be minimised at all times; • A record will be kept of volumes, location and times of ballasting and deballasting operations. Leaving Port of Operations • When leaving the Port of Operations the vessel, hull, and pipe work is to be adequately inspected and cleansed to ensure potential for translocation of pest species to next port of call. Follow specific vessel operation procedures.</td>
</tr>
<tr>
<td><strong>Performance Indicators</strong></td>
<td>Contract requirements for vessel inspection, proof of freedom and prior port of operation clearance is complete prior to vessel arrival and commencement of dredging. No release of high risk ballast water during operations.</td>
</tr>
<tr>
<td><strong>Reporting</strong></td>
<td>Vessel Master to maintain record of operations and review for non-conformances.</td>
</tr>
<tr>
<td><strong>Corrective Action</strong></td>
<td>Review procedure causing release and rectify immediately.</td>
</tr>
<tr>
<td><strong>Term</strong></td>
<td>During all operations.</td>
</tr>
<tr>
<td><strong>Responsibility</strong></td>
<td>Vessel Master.</td>
</tr>
</tbody>
</table>
## 10.1.6 Air Emissions

The generation of emissions with potential to impact on air quality during vessel operation and potential impacts on sensitive receptors forms the basis of this section. Issues of workplace air quality are to be controlled and managed under existing occupational health and safety protocols within the respective vessel safety management system.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Air Quality - Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact</strong></td>
<td>Vessel operation has the potential to generate visible and invisible exhaust emissions which may have potential to cause nuisance impacts to nearby sensitive receptors. Emissions generated from vessels plant or equipment during development or maintenance works has potential to disturb the amenity of surrounding areas, including sensitive areas such as residential areas. Ambient air quality within the Port of Karumba are expected to be generally in excellent natural condition with minimal influence of transiting vessel traffic from Port facilities, and industrial land use. Minimal impact is normally expected on nearby sensitive receptors.</td>
</tr>
<tr>
<td><strong>Objective/Target</strong></td>
<td>To ensure air quality emissions generated by operation of the bed levelling vessel plant and equipment does not unduly impact adjacent areas.</td>
</tr>
<tr>
<td><strong>Mitigation Measures</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Management Actions</strong></td>
<td>• All equipment to be maintained as per manufactures’ specifications.</td>
</tr>
<tr>
<td></td>
<td>• All emissions from activities must not exceed the applicable air quality objectives specified in the Environment Protection (Air) Policy 2008.</td>
</tr>
<tr>
<td></td>
<td>• Air quality emissions generated by vessels involved in the bed levelling works is not likely to be significant, nor is it likely to be located near noise sensitive areas.</td>
</tr>
<tr>
<td></td>
<td>• All equipment is to be maintained and operated in accordance with the applicable Australian Standards.</td>
</tr>
<tr>
<td></td>
<td>• Vessels and equipment will be turned off when not in use.</td>
</tr>
<tr>
<td></td>
<td>• All air quality complaints shall be recorded and reported to the Superintendent as soon as practical.</td>
</tr>
<tr>
<td></td>
<td>Complete Daily EMP Checklist – refer Appendix E</td>
</tr>
<tr>
<td><strong>Performance Indicators</strong></td>
<td>No air quality based complaints regarding the operation of the vessel.</td>
</tr>
<tr>
<td><strong>Monitoring</strong></td>
<td>All complaints recorded in appropriate system and forwarded to Vessel Master and Environment staff. If necessary air quality may be monitored to determine the level of impact.</td>
</tr>
<tr>
<td><strong>Reporting</strong></td>
<td>Annual review of all complaints received and follow-up action undertaken. Complete Incident Form –Appendix B</td>
</tr>
<tr>
<td><strong>Corrective Action</strong></td>
<td>Vessel Master to investigate source of complaint. If this relates to inappropriate work practices, inform crew of necessary changes and ensure these are undertaken. If complaints relates to plant, investigate effectiveness of emission reduction equipment and review/replace as required. Contractor to visually monitor emission levels through observation on a daily basis Should additional complaints be received following implementation of the above measures, then additional Mitigation Measures will be developed as required.</td>
</tr>
<tr>
<td><strong>Term</strong></td>
<td>During all operations.</td>
</tr>
<tr>
<td><strong>Responsibility</strong></td>
<td>Management and operation of on-board systems is by the Vessel Master, with input from Environment staff as required.</td>
</tr>
</tbody>
</table>
10.1.7 Marine Fauna

Operation of vessels, including bed levelling plant and equipment in coastal environments has a risk of harming large marine fauna including turtles, dugongs and cetaceans; however this risk is typically very low due to the mobile nature of most species and slow movement of bed levelling equipment.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Marine Fauna</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact</strong></td>
<td>Local flora and fauna may be disturbed as a result of the bed levelling works due to –</td>
</tr>
<tr>
<td></td>
<td>• Presence of vessel in proximity to exposed intertidal mud flats which may disturb birdlife,</td>
</tr>
<tr>
<td></td>
<td>• Increased sedimentation which may impact nearby seagrass,</td>
</tr>
<tr>
<td></td>
<td>• Direct contact impacts of vessel with marine fauna such as crocodiles, dugong and turtles.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objective/Target</th>
<th>Minimise capture of, or harm to, protected marine fauna during bed levelling operations and vessel operations.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Management Actions and Mitigation Measures</strong></td>
<td>Follow the procedures for the protection of marine fauna to meet the conditions outlined in the Sea Dumping Permit. Specifically:</td>
</tr>
<tr>
<td></td>
<td>• Prior to the commencement of each bed levelling run, Vessel Master to check, from a high observation platform, for cetaceans, dugongs and turtles within the vicinity of vessel operation (i.e. adjacent to the vessel about to be commenced).</td>
</tr>
<tr>
<td></td>
<td>• Bed levelling activities may only be commenced if no individuals of large marine fauna have been observed in the area adjacent to the vessel, and where there is a low likelihood of a collision occurring.</td>
</tr>
<tr>
<td></td>
<td>• Where any of the large marine fauna are sighted within the area adjacent to the bed levelling vessel, activities are to be halted until the last individual has been observed to leave the vicinity of the vessel.</td>
</tr>
<tr>
<td></td>
<td>Vessel Master to maintain watch for marine fauna in high risk areas and take necessary action where risk of a collision may exist.</td>
</tr>
<tr>
<td></td>
<td>Bed levelling works only in approved areas.</td>
</tr>
<tr>
<td></td>
<td>Avoid and prevent injury to all wildlife during the project.</td>
</tr>
<tr>
<td></td>
<td>Complete Daily EMP Checklist – refer Appendix D</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Performance Indicators</strong></th>
<th>No bed levelling outside approved areas.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No capture of, or harm to, protected marine fauna.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Monitoring</strong></th>
<th>Review of vessel tracks against approved area boundaries.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Review of bed levelling vessel log book for events where fauna was encountered. Visual monitoring of area adjacent to operations, in accordance with Sea Dumping Permit conditions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Reporting</strong></th>
<th>Reporting of exceptions to Vessel Master and Environmental staff (including time, nature of incident, species involved).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>This reporting requirement is irrespective of whether the fauna is dead or alive.</strong></td>
</tr>
<tr>
<td></td>
<td>Ports North to be urgently advised by Vessel Master, of any incidents to allow them to notify the DSEWPaC of the incident, within timeframe specified in accordance with conditions of the Sea Dumping Permit.</td>
</tr>
<tr>
<td></td>
<td>Complete Incident Form – Appendix B</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Corrective Action</strong></th>
<th>Vessel Master to investigate exception, and take appropriate action.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In the event of a sick or injured animal, the Contractor shall notify the Superintendent or Port Supervisor who will follow up with Environment staff and QPWS-DEHP.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Term</strong></th>
<th>During all operations.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Responsibility</strong></th>
<th>Management and operation of on-board systems is by the Vessel Master, with input from Environment staff as required.</th>
</tr>
</thead>
</table>
## 10.1.8 Community Engagement

Management of interactions between bed levelling vessels and community members, delays to vessel movement and general misunderstanding of the process of bed levelling may lead to complaint by members of the public. The following section outlines the framework for this important aspect of the works;

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Community Engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Impact</strong></td>
<td>Extreme weather or natural disaster events including tropical cyclones, storm surge, tsunami, flooding, and abnormal weather patterns may impact dredging or bed levelling work.</td>
</tr>
<tr>
<td><strong>Objective/Target</strong></td>
<td>To ensure dredging operations are completed without undue community complaint. Community is well informed of the occurrence of the works and informed of the environmental management measures in place.</td>
</tr>
<tr>
<td><strong>Management Actions and Mitigation Measures</strong></td>
<td>Ensure notice is provided via signage at boat ramps and if applicable MSQ “Notice to Mariners”. Schedule of forth coming works is to be advised well in advance of works through the Karumba Technical Advisory Consultative Committee (TACC) for dissemination to respective stakeholder groups,</td>
</tr>
<tr>
<td><strong>Performance Indicators</strong></td>
<td>No complaints in regard to impact of works on the community.</td>
</tr>
<tr>
<td><strong>Monitoring</strong></td>
<td>Check signage, notices. Port Supervisor to monitor community interactions and discussions and advise General Manager Projects and Planning or General Manager Corporate Services of any emerging issues.</td>
</tr>
<tr>
<td><strong>Reporting</strong></td>
<td>Reporting of complaints by Port Supervisor, Vessel Master and Environment staff.</td>
</tr>
<tr>
<td><strong>Corrective Action</strong></td>
<td>Ports North to investigate reason for exception and take appropriate action.</td>
</tr>
<tr>
<td><strong>Term</strong></td>
<td>During all operations.</td>
</tr>
<tr>
<td><strong>Responsibility</strong></td>
<td>Ports North Operations staff and Ports North dredge contract supervisor.</td>
</tr>
</tbody>
</table>
10.1.9 Natural Disaster

Events involving significant weather or geographic events may periodically give rise to situations where additional management actions may be required to prepare and protect of works, plant or equipment to minimise risk of subsequent environmental harm.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Natural Disaster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>Extreme weather or natural disaster events including tropical cyclones, storm surge, tsunami, flooding, and abnormal weather patterns may impact dredging or bed levelling work.</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To ensure dredging operations are prepared and a clear plan of action is in place for natural disaster events to minimise risk of release of contaminants, physical impacts from dredge vessels.Nil damage to plant or equipment or surrounding environmental assets.</td>
</tr>
<tr>
<td>Management Actions and Mitigation Measures</td>
<td>Ensure respective Port Contingency and Emergency Plans are in place. MSQ cyclone contingency plan is enacted Dredging contractors’ staff are to be aware of Contingency Plan requirements and topic is addressed during induction process Complete Daily EMP Checklist – refer Appendix D</td>
</tr>
<tr>
<td>Performance Indicators</td>
<td>Nil damage to plant or equipment or surrounding environmental assets due to dredge plant equipment or discharges from said equipment during a natural disaster event.</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Check induction records Ensure port supervisor has copies of contingency plans available to advise dredging contractor</td>
</tr>
<tr>
<td>Reporting</td>
<td>Reporting of exceptions by Vessel Master and Environment staff. Complete Incident Form –Appendix B</td>
</tr>
<tr>
<td>Corrective Action</td>
<td>Ports North to investigate reason for exception and take appropriate action.</td>
</tr>
<tr>
<td>Term</td>
<td>During all operations.</td>
</tr>
<tr>
<td>Responsibility</td>
<td>Port operations staff and Ports North dredge contract supervisor.</td>
</tr>
</tbody>
</table>
### 10.1.10 Cultural Heritage

Cultural heritage refers to both European and Indigenous heritage issues.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Cultural Heritage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact</td>
<td>The project area has been previously disturbed whereby the likelihood of uncovering a cultural heritage item is minimal. However, there is still potential to uncover an item of cultural significance, however potential for observation of such items on the seafloor or hopper or drag head is considered minimal.</td>
</tr>
<tr>
<td>Objective/Target</td>
<td>To ensure dredging operations do not disturb/destroy items of European or non-European cultural significance.</td>
</tr>
</tbody>
</table>
| Management Actions and Mitigation Measures | • Ensure cultural heritage investigation has been adequately addressed in initial project assessment process and that likelihood of disturbance is thereby low.  
• Ensure dredging and material relocation is undertaken within the approved areas only by reference to electronic navigation aids and visual marks as required.  
• Undertake opportunistic visual inspection of dredge load and dredge heads, reporting any items of suspected cultural significance. If items are found, retain and report to relevant authorities through Vessel Master and Environment staff.  
• Implement requirements in regard to the Queensland Aboriginal and Torres Strait Islander Duty of Care guidelines all times during the project, in accordance with the obligations of the *Aboriginal and Torres Strait Island Act 2005*.  
• All onsite personnel are responsible for reporting any potential cultural heritage items or objects, particularly during earthworks  
• If a cultural heritage item is found (excluding human skeleton remains, which are to be reported to the police), works in the immediate area of the find shall cease and CPL will be advised. The Traditional Owners and DEHP shall be contacted.  
• Complete Daily EMP Checklist – refer Appendix D |
| Performance Indicators | No disturbance of items of cultural significance. |
| Monitoring              | Opportunistic inspection of the dredged material for evidence of items of cultural heritage. Monitoring of dredge movement through use of electronic aids to ensure it is within designated area. |
| Reporting               | Reporting of exceptions to Vessel Master and Environment staff.  
Complete Incident Form – Appendix B |
| Corrective Action       | Vessel Master to investigate reason for exception and take appropriate action. |
| Term                    | During all operations. |
| Responsibility          | Management and operation of on-board systems is by the Vessel Master, with input from Environment staff as required. |
Appendix A  Environment Policy

Insert Contractors Environment Policy, or default to Ports North Policy
Appendix B   Incident Report Form

PORTS NORTH
ENVIRONMENTAL INCIDENT REPORT FORM

This form is to be completed for any environmental accident or incident.
Please note: this form is to be filled in after the event at the time of the incident. Please call either:

- Port Supervisor
- Operations Office Cairns – (07) 4051 2558 or 0419 657 350
- Environment Manager – (07) 4052 3920 or 0439 723 008

Once completed, please forward to
Environment Manager, Ports North, PO Box 594, Cairns Qld 4870. Ph: 4052 3820, Fax: 4052 3853

<table>
<thead>
<tr>
<th>Event Details</th>
<th>Please Circle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incident</strong></td>
<td><strong>Near Miss</strong></td>
</tr>
<tr>
<td>(release or harm to environment occurred)</td>
<td>(no release to environment or harm)</td>
</tr>
<tr>
<td>When:</td>
<td>Date _ _ / _ / _</td>
</tr>
<tr>
<td>Reported BY:</td>
<td>Date _ _ / _ / _</td>
</tr>
<tr>
<td>Reported TO:</td>
<td>Date _ _ / _ / _</td>
</tr>
<tr>
<td>Location details:</td>
<td></td>
</tr>
</tbody>
</table>

**Description**

Describe clearly the circumstances leading to the accident/incident, and the accident/incident itself. As far as possible verify the facts recorded, and identify witnesses.

<table>
<thead>
<tr>
<th>Type</th>
<th>If Spill – Approx Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cause/Circumstance</td>
<td>Drawing?</td>
</tr>
</tbody>
</table>

**Name**

**Position**

**Organisation**

**Telephone**

**Signature**

**Date**
Prevention: To be completed by Manager/Supervisor

Method of Cleanup:

Equipment Used

Method and Location of Waste Disposal

Existing Measures in Place to prevent or Minimise this type of event:

Follow Up:

Measures to be implemented to prevent this occurring again:

Name

Signature

Position

Date

Organisation

Close Out: To be completed by Environment section

Recorded in Register?

Follow Up Letter Sent to Company

Feedback provided to Reporter?
Appendix C  Site Plan of Works Area
## Appendix D 
### Daily EMP Check Sheet

**PORTS NORTH**

**DREDGING ENVIRONMENTAL MANAGEMENT PLAN - IMPLEMENTATION CHECKLIST**

<table>
<thead>
<tr>
<th>Job:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start Date</strong></td>
<td><strong>Week Number</strong> 1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>

**Complete the following section prior to commencing works**

| 1) Are the Environment Manager or Officers contact numbers available to all staff? | Yes / No |
| 2) Are staff induction records up to date? | Yes / No |
| 3) Is the QPWS Marine Animal Incident number easily available to all staff? Ph: 1300 130 372 | Yes / No |
| 4) Are copies of the Incident Report Form accessible? | Yes / No |
| 5) Does the Works Supervisor hold all relevant emergency contacts and understand the correct reporting procedures for major environmental incidents? | Yes / No |
| 6) Is the Complaint Register available? | Yes / No |
| 7) Copies of the EMP are available to all staff? | Yes / No |

**Complete the following section during the works (daily inspection)**

<table>
<thead>
<tr>
<th>Day</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Are all waste containment structures functioning correctly?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Are all waste bins of suitable capacity to contain all wastes (food wastes, etc.)?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Has equipment been checked to ensure it is in good working condition and not leaking oils, lubricants or fuel?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Are emergency spill kits available to staff at all times?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) Are the Spill Response procedures available and up to date, and all staff adequately trained?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6) Records of vessel maintenance are accurate and up to date?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7) All complaints have been recorded and details forwarded where required?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8) Have all trackable wastes been stored and disposed of appropriately?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9) Register of all MSDS documents is up to date for all chemicals on board?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10) All records of marine wildlife that could possibly have been impacted by the works have been reported to the contract supervisor and QPWS?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11) Record of working hours is complete – and within the permitted timeframe?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12) All operating plant have been inspected for excess noise?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13) Are there any incidents requiring reporting today?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Add brief incident details here:**

**Complete section upon conclusion of works**

| 1) Have all appropriate authorities been notified that works have been completed (MSQ, GERMPA, other Agencies)? |  |
| 2) Have the Incident and Complaint Registers been forwarded to Environment Manager? |  |

**Works Supervisor...**

**Date...**

**Notes:**

[Ports North Logo]

Karumba LTMMP App13.11 - Bed Levelling EMP Template  20 of 21
Appendix 12

Water Quality Monitoring Plan

Dredging and Bed Levelling Campaign

Port of Karumba

Entrance Channel Maintenance Dredging
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Document Control

<table>
<thead>
<tr>
<th>Document Control</th>
<th>Drafted</th>
<th>Released</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original by Far North Queensland Ports Corporation Ltd for 2009 Bed Levelling campaign</td>
<td>August 2009</td>
<td>September 2009</td>
</tr>
<tr>
<td>Revised for 2010 campaign</td>
<td>March 2010</td>
<td>May 2010</td>
</tr>
<tr>
<td>Updated for inclusion in LTMMMP–for Dredging and Bed Levelling campaigns</td>
<td>February 2011</td>
<td>February 2011</td>
</tr>
<tr>
<td>Updated as Appendices for LTMMMP Ver 6 lodged with DSEWPaC in March 2012, Agency references updated</td>
<td>April 2012</td>
<td>June 2012</td>
</tr>
<tr>
<td>Updated for LTMMMP Ver 7 lodged with DSEWPaC in August 2012, Agency references updated</td>
<td>August 2012</td>
<td>August 2012</td>
</tr>
<tr>
<td>Updated for LTMMMP Ver 8, Monitoring Flowchart updated.</td>
<td>August 2012</td>
<td>September 2012</td>
</tr>
<tr>
<td>Updated for Final LTMMMP</td>
<td>January 2013</td>
<td>February 2013</td>
</tr>
</tbody>
</table>
1 Introduction

Environmental management measures have been developed for the proposed dredging or bed-levelling campaigns to ensure environmental safeguards are in place to minimise impact on the natural environment. All personnel involved in the project are required to demonstrate a general environmental duty of care throughout the project. The LTMMMP and campaign specific details of the Environmental Management Plan (EMP) are to be implemented by the appointed contractor. This Water Quality Monitoring Plan is to be implemented to address the monitoring requirements of LTMMMP and builds on the program implemented in 2010 to address the conditions of the ERA16 approval granted by the DEHP (formerly DERM) in (Appendix E).

Ports North (PN) has an Environmental Management Framework, and associated Policy, which provides a framework for continually improving operations and practices.

Staff and contractors involved in this project are required to protect the environment under the relevant environmental legislation and general environmental duty. The appointed contractor is required to comply with the requirements of Ports North’s Environment Policy and all management measures specified below.

Prolonged flooding in the Norman and Bynoe River catchments may result in extensive periods of freshwater discharge, high turbidity and sediment deposition in the adjacent coastal zone, including impacts to marine flora and fauna. Significant declines in seagrass condition are often predicted as a consequence of the prolonged effects of the flood events, however advice and prior findings of DAFF (formerly DEEDI-Fisheries Queensland) seagrass surveys may show an initial early dry season decline but return to an advanced state of recovery in biomass or distribution by the start of the next wet season. Additional short duration and intensity flood events or successive large annual events may make seagrass reserves more susceptible to potential impacts of dredging, however this level of resilience has not been researched or documented. Monitoring of dredge generated turbidity, assessed as the primary water quality impact to marine flora at this Port, is considered a precautionary approach, and is included as a precautionary measure for the ongoing maintenance dredging of the Port of Karumba.

Due to natural accumulation of sediments, parts of the channel may shallow to less than 3.5m design depth of the channel.

The objective of this work is to monitoring the primary water quality parameters in conjunction with maintenance dredging by the trailer suction hopper dredge vessel and or associated post dredging bed levelling or drag baring works, to remove and relocate accumulated sediments from shallow sections of the channel with all spoil relocated to the spoil ground.

2 Location

The proposed sampling area is the entrance channel to the Port of Karumba, located on the south eastern coast of the Gulf of Carpentaria. The project is located with the Port Limits. Refer Appendix C for site location.

The entrance channel is used by various vessels including the barge Wunma for transfer of mineral concentrates, commercial fishing fleet, Sea Swift shipping company barges, and numerous recreational fishing boats. Commercial shipping to the port delivers supplies and services to the Karumba community and services the extensive prawn trawl fishing fleet that is based from Karumba.
3 Legislative Requirements

Environmental Protection Act 1994

Under the Environmental Protection Act 1994 (EP Act), environmental duty of care is required at all stages of the project by all staff (Section 316 of the EP Act). The basic principles of the EP Act should be understood by all project staff.

Under the Environmental Protection Regulation 2008, the action of maintenance dredging is classified as Environmentally Relevant Activity (ERA) 16 Extractive and Screening Activity 1(c) dredging 100,000 to < 1 million t/yr. Development Approval SPDE00100610 was issued by the former Department of Environment and Resource Management (DERM) (now DEHP) (see Appendix E) and a Registration Certificate issued to the appointed dredging contractor.

Fisheries Act 1994

Approvals under the Fisheries Act 1994 are required where direct impacts to marine flora or fauna defined under the Act are likely to occur. No such approvals are required for maintenance dredging campaigns as prior surveys have determined the spatial extent of seagrass meadows as being outside the channel and works area. Extent of the primary fisheries habitat, namely the extensive seagrass meadows is shown in Appendix A.

Coastal Protection and Management Act 1998

An approval under the former Section 86 of the Harbours Act 1955 is in place for works on defined areas of the sea bed within the port limits inclusive of dredging, disposal and bed levelling. Permit N25001 issued 1996, amended September 1996, defines the approved structure of the channel and spoil ground.

Nature Conservation Act 1992

Under the Nature Conservation Act 1992, individuals and organisations have an obligation to prevent any potential injury or harm to flora and fauna. All environmental safeguards must be implemented, particularly during periods of likely movement of turtles, dugong or other large marine fauna.

Environment Protection (Sea Dumping) Act 1981

The Sea Dumping Act enables Australia to implement obligations under the “London Protocol” for sea disposal activity. The act applies to all vessels in Australian waters for the regulation of waste disposal to sea, inclusive of dredge spoil. An approval by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), is to be issued as a Sea Dumping Permit.

Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)

This Act regulates those activities which may have a significant impact on matters of national environment significance (NES) and establishes an integrated regime for biodiversity conservation and the assessment and management of important protected areas. Matters of national significance include: World Heritage properties, RAMSAR wetlands, listed migratory species and ecological communities, listed migratory species, commonwealth marine areas, national heritage places, nuclear actions and actions on commonwealth land or involving commonwealth agencies. Dredging and disposal activity at Port of Karumba has potential to influence listed and migratory species, including turtles, dugong crocodiles, and wader birds. Assessment of these interactions on matters of NES is made by DSEWPaC in consideration of approvals for dredging and sea dumping.
4 Impact to Sensitive Areas

The dominant sensitive environmental areas adjacent to the proposed works are the seagrass meadows, and intertidal mudflats. Foreshore intertidal mudflats and surrounding coastal wetlands are host to numerous species of resident and migratory wading birds, many with international conservation significance. Seagrass meadows at the Port of Karumba are shown in Appendix A. Meadows adjacent to the channel are mostly low biomass meadows of *Halodule uninervis* and *Halophila ovalis* found growing over Alligator Bank between the Norman River, and south to the Bynoe River. For example, monitoring by the former DEEDI-Fisheries Queensland) (now DAFF) during November 2011 indicated a core meadow of 1454 Ha with surrounding aggregated fringing patches. Density was the third highest on record and above the 18 year average.

Dugong activity is generally a regular feature and evident at sites within the meadow area.

The works area has previously been dredged and bed levelled, and extensive monitoring of potential impacts from those works has been implemented in previous works campaigns, including significantly larger programs. Impacts identified from those larger works campaigns have been assessed as minimal, potential impacts of dredge generated turbidity to adjacent sensitive marine areas are considered to be low.

It is noted that the framework outlined in this Plan, including methodology for sampling may be applied, where agreed with DSEWPaC and TACC for other sensitive areas of interest other than Alligator Bank.

5 Responsibilities, Implementation and Auditing

Ports North will be responsible for conduct of this Water Quality Monitoring Plan, or through the use of a suitably qualified environmental consultant.

The Contractor will be responsible for the implementation of the EMP for operation of the dredging vessel and ancillary vessels for the duration of the project (refer LTMMP Appendix 13-10 or 13-11 for detail).

The Contractor and Supervisor are required to ensure that all personnel working onsite are aware of their environmental responsibilities and the importance of the project EMP and implementation of this Monitoring Plan.

Ports North staff may conduct an environmental audit in accordance with the project EMP and to ensure the implementation of this Monitoring Plan at any time during the project. The Port Supervisor may also inspect the works at any time to ensure all project commitments are been implemented.

6 Monitoring Elements

This section identifies the components of the water quality monitoring plan for the project and must be followed to ensure compliance with LTMMP and the Permit requirements.

6.1 Water Quality including Turbidity

**Impact**

The primary environmental impacts associated with dredging is the re-suspension of sediment into the water column and the creation of suspended particle plumes which may affect adjacent areas (e.g flora) by settlement and accumulation of particles [Sedimentation] or reduction of light penetration through the water [Turbidity]. Natural turbidity levels in the coastal zone of the Gulf of Carpentaria typically observed at Port of Karumba can be very high, dependant on wind, tidal and catchment runoff conditions. Therefore dredging works are expected to be generally within natural tolerances, but episodic peaks in concentration may occur. Previous extensive monitoring completed as part of the 1996 capital dredging and subsequent maintenance dredging, including the campaign during 2008 indicated natural turbidity range of up to 300NTU at Alligator Bank under low water levels and strong onshore northerly wind conditions.

**Management**
Although minimal impacts from contaminated sediments on water column or turbidity on the seabed at sensitive areas (discussed below) are expected, Sediments from the works are most likely to move toward sensitive areas in period of north-west to north-east winds and incoming spring tides. Specific water quality monitoring conditions have been included in previous approvals, such as the ERA16 approval for the 2010 campaign.

The Monitoring Program flowchart is outlined in Appendix B.

6.2 Contaminated Sediments

Impact

The movement of contaminated sediment during dredging has potential to mobilise elements into the water which may have acute or chronic effects to flora and fauna, or may then disperse to surrounding areas. An understanding of the contaminant status of the sediment to be dredged is required and is typically assessed when determining disposal options for dredging prior to capital or maintenance dredging campaigns in accordance with the National Assessment Guidelines for Dredged Material (NAGD) 2008.

Management

Sediment analysis plan implementation at the Port of Karumba was completed in 2009 and showed that material within the entrance channel to be generally clean and consist predominantly of natural concentrations of base metals, an absence of herbicides or pesticides and low concentrations of antifouling paint residue tri-butyl tin. Material from the Port of Karumba has been assed previously as suitable for placement at sea and is considered un-contaminated. The 2009 SAP Report was approved by DSEWPaC and forms a component of the Sea Dumping Permit application.

Consequently no specific water quality monitoring for contaminants is proposed.

6.3 General Water Quality Parameters

Collection of data on parameters inclusive of temperature, ph, salinity, dissolved oxygen may be included as comparative indices to assist in identification in any trends observed in the target turbidity parameter, such as freshwater/saltwater stratification as well as contribute to the general port environmental database.

7 Monitoring Matrix

The above evaluation of potential aspects and impacts of the work and subsequent management options give rise to the following monitoring elements to be implemented under normal conditions, and in the absence of a “contaminating” event/incident;

<table>
<thead>
<tr>
<th>Impact</th>
<th>Specifics</th>
<th>Required</th>
<th>Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality</td>
<td>Dissolved Metals</td>
<td>No</td>
<td>Nil sediment contaminant concerns</td>
</tr>
<tr>
<td></td>
<td>Tri-Butyl Tin</td>
<td>No</td>
<td>Nil sediment contaminant concerns</td>
</tr>
<tr>
<td></td>
<td>Herbicides and Pesticides</td>
<td>No</td>
<td>Nil sediment contaminant concerns</td>
</tr>
<tr>
<td></td>
<td>PAH/BTEX/TPH</td>
<td>No</td>
<td>Nil sediment contaminant concerns</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Yes</td>
<td>-Define lateral extent of plume relative to seagrass meadows.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-useful data to inform management of future bed levelling/dredging works.</td>
</tr>
<tr>
<td>Ph, T°C, Cond, %DO</td>
<td>Yes</td>
<td></td>
<td>Useful ambient data able to be collected at same time as turbidity</td>
</tr>
</tbody>
</table>
8 Methods

All personnel implementing this monitoring plan must be familiar with intent of the LTMMP and respective campaign specific EMP (refer Appendix of LTMMP Appendix 13-10 and 13-11), the requirements of this plan, and State Water Quality Monitoring and Sampling Manual (2009) for the correct methods of sampling to be implemented.

The Management Framework Flowchart (Appendix B) for implementing the Water Quality Monitoring Plan is set out below. Observation of tidal predictions for Port of Karumba for proposed dredging period is to be conducted to identify periods with highest likelihood of moving turbid plumes across Alligator Bank (larger incoming spring tides). Highest likelihood periods however are contingent on flood/incoming spring tides, where if suitable wind/sea state condition prevail, and water level is high enough to inundate the flats, may present a condition suitable for dispersion of turbid plumes to the Alligator Bank seagrass meadows.

A reactive approach to monitoring and subsequent mitigation measures through management of dredge vessel operations is to be employed for this Plan, and a trigger value of 62ntu (or other such approved value) for a period of greater than 72 hours (or other such approved period) at specified points has been assigned.

In-situ point sampling will be conducted from a small vessel at locations identified in Appendix C. Exact location of sampling for site W3 may vary depending on direction of dredge plume migration and conditions, and a nominal outer and inner site have been identified that should have “background or reference” qualities,

Sample Site Locations

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Location</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>KA-W1</td>
<td>Edge of seagrass meadow - near rear channel lead</td>
<td>Potential Impact</td>
</tr>
<tr>
<td>KA-W2</td>
<td>Edge of seagrass meadow - near channel</td>
<td>Potential Impact</td>
</tr>
<tr>
<td>KA-W3_inner</td>
<td>Mid Channel – between Karumba and Alligator Points</td>
<td>Reference</td>
</tr>
<tr>
<td>KA-W3_outer</td>
<td>Sand flats adjacent to outer channel</td>
<td>Reference – alternate site if W3_inner is affected by dredge turbidity, or wind/tide/current direction dictates need for Reference site in this area</td>
</tr>
</tbody>
</table>

Data will be gathered by suitably trained field staff using calibrated instruments, with data recorded to a field sheet shown at Appendix D.

If suitable tide and weather conditions prevail, aim for two sampling events per day, at approximately Start, Middle and toward End of proposed campaign to verify success of the management and mitigation measures conducted during the dredging or bed levelling operation.
9 Results and Reporting

Outcomes of the monitoring will be consolidated and comparison of results at W1 and W2 assessed against the background ambient conditions at reference site W3 and turbidity “Trigger” value of 62 NTU (or other such approved value). This process will follow the process and management triggers outlined in Appendix B, and subsequent reporting requirements within the respective campaign EMP.

Results will also trigger the respective management and corrective actions where an exceedence occurs.

An assessment will be conducted at conclusion of each sampling event, and any requirements for Management Actions triggered as per the campaign specific EMP.

Overall findings of the Plan implementation will be concluded in the Project Close-Out Report to inform stakeholders and future decisions on environmental management options for dredging works at Port of Karumba.

Information gathered in each round of monitoring will contribute to the environmental monitoring database for the Port of Karumba maintained by Ports North.
Appendix A

Example Seagrass Distribution

Map 2. Changes in the port of Karumba seagrass from thinning to a meadow, October 2003 to November 2011.
## Appendix B  Monitoring Process and Flowchart

### Karumba Water Quality Monitoring Plan - Process Diagram

Ports North Environment staff, in conjunction with the dredge/bed levelling project manager will determine the need for water quality monitoring firstly by assessing if the following conditions in Evaluation Process and Monitoring Procedure below are met;

### Evaluation Process

<table>
<thead>
<tr>
<th>Criteria A</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Timing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the campaign scheduled and approved outside the period 1 May to 30 September?</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td><strong>Method, Scale and Intensity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has scale of works changes significantly to &gt;690,000m³ (i.e. greater than 50% increase over average dredging volume)?</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Is an increased intensity of campaign proposed (i.e. more than one dredge in operation, or full time overflow)?</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Is a dredge other than the TSHD Brisbane proposed? (i.e. use of a cutter suction or grab dredge etc.)</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Is a dredge without turbidity management features proposed? (i.e. no central weir control, under keel discharge, or overflow control)</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td><strong>Management or Monitoring Survey Outcomes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has scientific advice on ecological receptors provided to the TACC, and a corrective action to the existing monitoring arrangements been agreed by the TACC and Ports North?</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Have water quality or turbidity issues been identified as a concern for seagrass health as a result of most recent survey?</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are works in channel beside Alligator Bank (i.e. between Karumba Point and Beacon 9 or 10)?</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Are works proposed adjacent to a recently identified sensitive area?</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

If there is a “Yes” positive response to any of Criteria “A”, proceed to Criteria “B”.  
If all are “NO”, no monitoring is required.

### Criteria B

<table>
<thead>
<tr>
<th>Criteria B</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weather and Tide</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are strong on-shore wind conditions forecast? [i.e. &gt;15kn N to W]</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Will the tide height allow a potential plume to reach seagrass meadows (i.e. Alligator Bank)? [i.e Karumba Tide &gt;1m]</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

If one Criteria A is “Yes” and both of Criteria B are “Yes” then initiate monitoring as per “Monitoring Procedure” overleaf/below.  
If both are “No”, NO MONITORING

Make Note in Close Out Report

---

If Monitoring is Triggered by above Evaluation Process, implement Monitoring Procedure, below, if suitable tide and weather conditions prevail, aiming for two sampling events per day, at approximately Start, Middle and toward End of proposed campaign to verify success of the management and mitigation measures conducted during the dredging or bed levelling operation.
Monitoring Procedure

Monitoring is required as a result of above Evaluation Process

Identify direction of prevailing current, wind and plume

Check Tide Tables and identify two periods for sampling

Sample at (background/reference site) i.e. W3 >100m upstream/current/up wind of dredge

Calculate “Background Value”

i.e. (W3 + 25%) = “X” ntu

Identify direction of prevailing current, wind and plume

Sample at W1 and W2 along edge of Alligator Bank seagrass or other defined sensitive area within an hour

Are either W1 or W2 greater than “Trigger”

Yes

No

Is this the 3rd consecutive day (within 72hrs) of above “Trigger”? 

Yes

No

Record values in Database

Works are Compliant [continue dredge schedule]

Implement Management and Corrective Actions

Refer to LTMMP Section 10.7.4

Appendix 13-10 Dredge EMP

Appendix 13-11 Bed Levelling EMP

Tier 1 - Management Actions

- vessel turbidity management
  - make changes to onboard arangements; i.e. central weir settings, duration of overflow

Tier 2 - Management Actions

- dredging intensity
  - make changes to minimise plume generation or control extent and intensity via
    - Location, Timing, or Direction

Tier 3 – Management Actions

- campaign program
  - Halt or restrict dredging campaign until such time as water quality conditions improve
  - refer to TACC for technical input

Are management actions effective?

Yes

No

Implement next Tier

Implement next Tier

Report

a) a Non-Conformance if Permit or Licence conditions are exceeded.

b) details to Agencies and TACC

c) Close-Out Report

At end of campign summarise the following;
- monitoring results,
- note if no monitoring was required.
Work site

Alligator Bank Seagrass Meadow

KA-W2

KA-W1

KA-W3

Monitoring may be required if work within this section of channel and suitable conditions prevail
### Water Quality Monitoring Field Data Sheet

#### Rainfall to 9am  Rainfall to 3pm  Cloud Cover (1/6ths)  Wind Speed (knots)  Wind Direction

#### Tide Times and Heights:

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Site</th>
<th>Strata</th>
<th>Depth (approx m's)</th>
<th>Turbidity (NTU)</th>
<th>Dissolved Oxygen (mg/l)</th>
<th>Salinity (%)</th>
<th>pH</th>
<th>Temperature (0°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>KA-W1-a</td>
<td>Surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>KA-W1-b</td>
<td>Depth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>KA-W2-a</td>
<td>Surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>KA-W2-b</td>
<td>Depth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>KA-W3-a</td>
<td>Surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>KA-W3-b</td>
<td>Depth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments

Field Staff  Signed by Field Data Recorder  Data Input Date  Signed by Data Input Staff
Appendix E  Example of conditions - ERA16 Permit

Development Permit SPDE00100610  CONDITIONS

Conditions for ERA 16 Extractive or screening activities Threshold 1(c) – Dredging material >100,000 – 1 million t/yr

Interest: General

Limitations of permit

G1 This development permit attaches to the part of the port area defined by the map in Attachment 1
G2 This development permit authorises ERA 16 (dredging) that is for maintenance work on lawful work as specified by the diagrams in Attachment 2.
G3 The port authority of the port area to which this permit attaches must maintain direction of any operator carrying out an activity authorised by this permit.

Prevent environmental harm

G4 The operator must ensure that environmental harm is not caused by this ERA except where specifically permitted by a condition of this development permit.

Maintenance of measures, plant and equipment

G5 The operator must:
(a) install all measures, plant and equipment necessary to ensure compliance with the conditions of this development permit
(b) maintain and calibrate such measures, plant and equipment in an efficient condition and keep records of the maintenance
(c) operate such measures, plant and equipment in an efficient manner.

Integrated environmental management system (IEMS)

G6 The operator must implement an integrated environmental management system (IEMS) from (the commencement of this ERA or specified date). The IEMS must identify all causes of environmental harm, including but not limited to the actual and potential release of any contaminants, the nature of the environmental harm and the actions that will be taken to prevent environmental harm being caused. The IEMS must be made available to the Administering Authority when requested.

The IEMS must achieve the following outcomes:
(a) material intended to be dredged under this permit is tested and analysed in accordance with the latest version of the National Assessment Guidelines for Dredging 2009
(b) significant and sensitive receptors (including for example wetland and ecosystem features) in the port area are identified and mapped
(c) environmental aspects and potential impacts are identified
(d) control measures that minimise the potential for environmental harm are in place
(e) contingency plans and emergency procedures are in place
(f) organisational structures, accountability and responsibility is recorded
(g) arrangements for effective communication are documented and undertaken
(h) all contaminant releases are monitored
(i) staff are trained and aware of the requirements of this permit
(j) appropriate records are kept
(k) reviews of environmental performance and continual improvement are undertaken periodically.

G7 The IEMS must not be implemented or amended in a way that contravenes any condition of this development permit.

Monitoring Plan

G8 The operator must implement a monitoring plan that complies with the latest version of the Administering Authority’s Water Quality Sampling Manual from the commencement of this ERA.

The monitoring plan must achieve the following outcomes:
(a) long-term ecological impacts associated with dredging operations are monitored
(b) compliance with the conditions of this development permit is monitored
(c) operations are adjusted in response to monitoring results to ensure compliance with development permit conditions.

G9 The monitoring plan must include (but not be limited to) the following:
(a) a description of the dredge equipment to be used, including the discharge points for turbid waters
(b) a plan for the lawful disposal of the dredged material
(c) a list of environmental values located within and adjacent to the dredge operation
(d) the methods for collection and analysis of the samples (including specific areas to be monitored, when monitoring is to be undertaken and duration of monitoring)
(e) the methods for analysing the data and responding to the results.

Records

G10 The operator must maintain a record of sites where dredging is carried out (specifying the boundaries of the dredged area by GPS coordinates) and the volume of material removed from each site (to the nearest tonne), and submit these records to the port authority.

G11 The port authority must maintain a record of all documents or information provided under condition G13 and all monitoring results required by this permit.

G12 All records required by this permit must be kept for five years and be made available to the administering authority upon request.
Complaint response
G13 The port authority must record the following details for all complaints received and provide to the administering authority upon request:
(a) time, date, name and contact details of the complainant
(b) reasons for the complaint
(c) details of investigations undertaken by the port authority
(d) conclusions formed
(e) actions taken to resolve the complaint.

Notification
G14 Any incident of environmental harm (including a reasonable suspicion that environmental harm has or is likely to have occurred) outside the lawful work as specified in condition G2 must be reported as soon as practicable to the relevant DERM regional office.

Interest: Air Nuisance
A1 The release of airborne contaminants from the activity must not cause environmental nuisance.

Interest: Noise Nuisance
N1 Noise from the activity must not cause environmental nuisance.

Interest: Water
Release of contaminants
W1 Contaminants must not be directly or indirectly released to waters other than wastewater released from the discharge point during the loading and unloading of dredge spoil.
W2 In carrying out the ERA, the release of contaminants (including any release caused by extraction of material from the bed of waters) must:
(a) only occur within the permitted areas specified in condition G2
(b) not have any properties which are capable of causing environmental harm
(c) not produce any slick or other visible evidence of oil or grease, nor contain visible floating oil, grease, scum, litter or other objectionable matter
(d) be carried out taking all practical measures necessary to minimise the concentration of suspended solids released during the loading and pump-out of the vessel.

Equipment
W3 Any dredging must be conducted using equipment that is in survey and registered and, in relation to environmental performance, is equal to or better than the following equipment:
(a) Trailing Suction Hopper Dredge that is equipped, as a minimum, with:
   (i) below keel discharge of tail waters via an anti-turbidity control valve
   (ii) on-board systems for determining solids to water ratio or density of dredged material
   (iii) electronic positioning and depth control system for defining the location and depth of dredging activities
   (iv) dredge heads and depth control capable of, and where appropriate, fitted with fauna exclusion devices (e.g. turtle deflectors).
(b) Cutter Suction Dredge that is equipped, as a minimum, with:
   (i) electronic positioning and depth control system for defining the location and depth of dredging activities
   (ii) continuous delivery connection (e.g. floating or submerged pipeline) to an approved placement site
   (iii) a process or process to ensure the delivery system integrity is maintained at all times
   (iv) systems for determining solids to water ratio or density of dredged material during operations.
(c) Grab Dredge that is equipped, as a minimum, with:
   (i) electronic positioning system for defining the location and depth of dredging activities

Placement of dredge material
W4 Dredging must not start until provision has been made to lawfully place or dispose of the dredge material. Evidence of applicable approvals must be made available to the administering authority when requested.

Placement of dredge material at sea
W5 Material dredged under this permit must not be placed at sea except at a place authorised under an authority, licence or other permit issued by either or both the Commonwealth or Queensland governments to receive the dredged material.

Monitoring for 2010 dredging program
W6 Monitoring must be undertaken and records kept of receiving water quality potentially impacted by the dredging operations for the quality characteristics and not less frequently than specified in Table 1 – Receiving water release limits. All determinations must be made in accordance with methods prescribed in the latest edition of the Department of Environment and Resource Management’s Water Quality Sampling Manual.

Table 1 – Receiving water release limits

<table>
<thead>
<tr>
<th>Quality characteristics</th>
<th>Monitoring point</th>
<th>Units</th>
<th>Release limit</th>
<th>Monitoring frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Turbidity</td>
<td>W1, W2</td>
<td>NTU</td>
<td>-</td>
<td>Either:</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>background plus</td>
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<td></td>
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<td></td>
<td></td>
<td>25% or 62NTU,</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>whichever is the</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>greater value, for a</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>duration of at no</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>more than 72 hours</td>
</tr>
<tr>
<td>W3</td>
<td>(background)</td>
<td>NTU</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1 W1 - The edge of the seagrass beds at Alligator Point
2 W2 - The edge of the seagrass beds at Alligator Point, no closer than 100m from W1
3 W3 - Background: at least 100m up-current of the dredging operations, at a site experiencing similar wind, wave and tidal conditions as W1 and W2. Sampling must be undertaken within 1 hour of sampling from W1 and W2.

W7 If the receiving water release limit in Table 1 is exceeded at either W1 or W2, dredging operations must be amended to achieve compliance with the limit.
W8 Monitoring results must be made available to the administering authority upon request.
W9 Monitoring must be done by a competent person in accordance with methods set out in the latest version of the administering authority’s water quality sampling manual.
Appendix F   Tide Predictions and Priority Sampling Periods

Insert campaign specific details from Tide Tables or Tides website with works and priority sampling periods marked up

Example: