

## 9 RELEVANT FACTORS – IMPACTS AND MANAGEMENT

The environmental risk assessment (refer to **Section 7**) identified the following relevant environmental factors pertaining to the Nelson Point Dredging proposal:

- marine fauna;
- marine pest species;
- coastal processes;
- hydrology;
- terrestrial flora and fauna;
- construction dust;
- construction noise;
- cultural heritage;
- recreational areas;
- visual amenity;
- hydrocarbons and hazardous wastes; and
- solid and liquid waste management.

The environmental objective and potential impact for each environmental factor relevant to the proposed Nelson Point Dredging proposal are discussed in the sections below. Each assessment has demonstrated that the potential impacts can be managed to as low as reasonably practicable through the implementation of BHP Billiton Iron Ore's existing construction EMP (**Appendix B1**) and/or a specific management plan where required.

### 9.1 MARINE FAUNA

#### 9.1.1 Overview

Of the five species of marine turtles known to occur in the Pilbara region, only green and flatback turtles have been recorded as utilising the Port Hedland area. It is unlikely that any nesting areas will be disturbed during dredging activities or the disposal of dredge spoil to DMMA H for the Nelson Point Dredging proposal, as the closest nesting area (Cemetery Beach) is over 3 km from the mouth of the Inner Harbour (Pendoley Environmental 2008). Juvenile green turtles routinely use the waters of the Inner Harbour and the surrounding mangrove creeks for foraging, predominantly accessing the seaward fringes of the mangrove habitat (Pendoley Environmental 2008).

The Port Hedland area is not a known calving or aggregation area, however, humpback whales (*Megaptera novaengliae*) may be encountered offshore during their northern migration, which peaks between late June and mid July. Encounters between these whales and the operating dredging vessel are very unlikely. Large cetaceans are likely to be found in waters deeper than 20 m (Prince 2001).

The depth within the Inner Harbour and Spoil Ground One is approximately -10 to -15 m CD and -11 to -12.2 m CD respectively. Taking into consideration another 5 m depth for spring tides, the maximum depth expected in these areas is approximately -20 m depth within the inner harbour. Given these depth ranges and locations, it is considered very unlikely that large cetaceans will visit these areas.

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

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A number of fish and invertebrate species occur in the creeks in the Port Hedland region. Within the Inner Harbour, 106 species of fish have been identified (Ecoscape 2004). Some of these species such as mullets, gobies and perchlets, are anticipated to occur in the creek systems adjacent to DMMA H.

### 9.1.2 Objective

The EPA objective for marine fauna is to 'maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through avoidance or management of adverse impacts and improvement in knowledge'.

### 9.1.3 Guidance

The relevant policies and standards that need to be addressed for marine fauna include:

- EPA Guidance Statement No. 1: Protection of Tropical Arid Zone Mangroves along the Pilbara Coastline (EPA 2001);
- EPA Guidance Statement No. 8: Environmental Noise (Draft) (EPA 2007); and
- Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives (DoE 2006b).

### 9.1.4 Potential Impacts

Dredging activities have the potential to adversely impact, both directly and indirectly, various species of marine turtles, dugongs, whales and dolphins that have been recorded in the Pilbara region (**Section 4.3**). Potential direct impacts may result from:

- vessel collisions or entrapment;
- underwater noise;
- light spill and disorientation (i.e. marine turtles);
- reduced water quality due to discharges or spills; and
- potential toxicity caused by hydrocarbon spills.

Indirect impacts could occur as a result of loss of mangrove habitat for marine fauna.

#### Direct Impacts

##### *Vessel Collisions or Entrapment*

The physical presence of dredge vessels within the harbour and barges travelling to and from the offshore spoil ground may increase the risk to marine fauna of injury or death from collisions. There is also a risk that marine fauna may become entrapped within the cutter head of the dredge during dredging operations.

Once dredging activities are underway, marine mammals and turtles are expected to exhibit avoidance behaviours and are unlikely to remain in proximity to the dredge due to the noise and vibrations generated. The incremental potential for collisions with marine mammals and turtles is considered low due to the small number of vessel movements compared to existing shipping movements within, and to and from the harbour, as well as the relatively low speeds at which the dredges and associated vessels will be moving.

The disposal of dredged material from Nelson Point at the offshore Spoil Ground One is scheduled to occur for up to 68 weeks duration. Although barges carrying dredge material from Nelson Point to the spoil ground will operate during the humpback whale northern migration (June to July in this region), large cetaceans are only likely to be found in waters deeper than 20 m. As Spoil Ground One lies outside their primary migration route which is in deeper water off the coast, the risk of collision of vessels with humpback whales is considered extremely low.

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Vessels accessing Spoil Ground One will also utilise the Port Hedland Harbour shipping channel for the exiting the harbour.. There have been no recorded collisions with cetaceans as a result of vessels using this channel.

The potential for collisions with cetaceans, dolphins and sea turtles is to be managed in accordance with the DMP (**Appendix B3**). The management measures are described in **Section 9.1.5**.

### *Noise*

Marine fauna are unlikely to be affected by noise and vibration generated by the dredge vessels due to the already high background noise levels created by shipping activity in the harbour and offshore in the Port Hedland shipping channel. Noise levels encountered by fauna are only likely to be above background levels when the fauna are within close proximity to the dredging operation. Noise is therefore not likely to adversely affect migrating whales and cetaceans occurring offshore. Turtles are the main faunal group that may occur inshore, in close proximity to the dredging operation, and therefore may encounter 'above background' noise levels.

### *Light Spill*

Studies have shown that turtle hatchlings have a strong tendency to orient towards the brightest direction, which on natural beaches is typically towards the ocean where the horizon is open and unhindered by dune or vegetation shadows (Pendoley Environmental 2008). Turtle hatchlings can become disorientated on nesting beaches which are exposed to artificial lighting.

Cemetery Beach, Cooke Point and Pretty Pool have been identified as key flatback turtle nesting habitats in the Port Hedland area (refer to **Section 4.3**). These habitats are all sufficiently distant from the construction and related activities that will occur under the Nelson Point Dredging proposal to have any effect on turtle nesting or hatchling orientation.

### *Excess Water Discharge from DMMA*

Excess water discharge from DMMA H has the potential to impact marine fauna, in particular fish, invertebrate species and BPPH that inhabit the creek system in the discharge receiving environment. The main potential impacts to aquatic communities arise from:

- increased turbidity; and
- changes in temperature, salinity, pH, and dissolved oxygen.

Temporary increases in turbidity associated with the discharge of return waters may disorient fish and marine turtles, smother and displace benthic invertebrates, and reduce productivity of BPPH under reduced light conditions. Sedimentation of food sources may also indirectly affect marine fauna by increasing their foraging efforts. It is anticipated that these impacts which are only likely to occur in the immediate vicinity of the discharge area, will be short term, as deposited sediments will ultimately be removed by tidal currents (**Section 8.1**).

Previous studies have shown that fish densities, species type and distribution in tidal estuaries, salt marsh and mangrove areas can be affected by changes in turbidity, temperature, salinity and dissolved oxygen (Cyrus & Blaber 1992; Sheaves 1992; Robertson & Alongi 1992). Therefore, changes in these parameters have the potential to temporarily alter the species composition that occurs in the creeks adjacent to the discharge area during the dredging process. It is anticipated that any changes to these parameters will occur in the immediate vicinity of the activity and will be quickly homogenised within the surrounding environment primarily as a result of tidal action.

Discharge of return water from DMMA H is proposed to be managed in accordance with the DMP (**Appendix B3**) which includes water quality monitoring of the DMMA H discharge, and of BPPH health within the discharge receiving environment. The management measures are described in **Section 8.1**.

### *Hydrocarbon Spills*

Potential impacts to marine fauna as a result of a hydrocarbon spill include:

- physical effects such as smothering/coating that may lead to contamination and mortality; and
- chemical and biological effects including toxicity and bioavailability that may affect feeding, reproduction and growth.

Physical effects such as a severe hydrocarbon coating on wildlife, can restrict vital life functions including the ability to feed and to maintain insulation, respiration and movement/migration. Chemical and biological effects can be caused by water soluble aromatic hydrocarbons and lower molecular PAHs. Sub-lethal effects can limit an organism's capacity to feed, grow and reproduce while chronic exposure at varying concentrations can lead to mortality. Management measures to minimise hydrocarbon spills are described in **Section 9.1.5**.

### **Indirect Impacts**

#### *Impacts on Intertidal and Subtidal BPPH*

Mangroves in the Port Hedland area provide habitat for juvenile fish and crustaceans, and feeding areas for fish, reptiles (such as juvenile green turtles), invertebrate benthos and birds, particularly at high tide. Potential minor impacts include some decreased foraging success as a result of increased turbidity levels from dredging within the harbour and avoidance of areas with elevated turbidity levels. These potential impacts are likely to be relatively minor given that Lumsden Point is not an area of significant nursery habitat for marine fauna and the minimal disturbance proposed to mangrove habitat.

Cyanobacterial mats and salt marsh communities are both considered to be of limited importance to fauna (ENV 2008), primarily because both habitat types occur at levels on the shore where soil salinities are elevated and soil moisture content is low, few organisms can tolerate these physiological stresses. Surveys of representative areas of these habitats (SKM 2008b) revealed a virtual absence of fauna. The crab species *Neosarmatium meinerti* is sometime present in these habitats and bare areas of substrate support the fiddler crab *Uca elegans*. These organisms are present throughout the region and the limited fauna that may depend upon this habitat are able to utilise similar habitats in nearby locations.

Impacts on intertidal BPPH (particularly direct and indirect impacts on mangroves) are proposed to be managed in accordance with the MMP (**Appendix B4**). The management measures are described in **Section 8.2**.

Both direct and indirect impacts on subtidal BPPH within the harbour and at Spoil Ground One, are expected due to dredging (loss), and reduced water quality (reduced productivity) due to both dredging and disposal (see **Sections 8.1** and **8.2** for further detail on water quality and marine habitat, respectively).

The direct impacts to subtidal habitat both within the harbour and at Spoil Ground One will be small. Subtidal BPPH at Spoil Ground One is extremely sparse, constituting only 5% of the area. The direct loss due to dredging of the footprint within the harbour is similarly small, amounting to 2.19% loss of subtidal BPPH (see **Section 8.2** and **Appendix A3** for more detail). For both Spoil Ground One and the harbour, the subtidal BPPH communities that will be lost are well represented in the respective localities. As such, indirect impacts to marine fauna that may be dependent on these BPP communities, either for habitat or as a food source, are unlikely to occur or result in impairment to the ecological function of the management unit and outer marine environment.

The indirect impacts to subtidal BPPH, particularly within the harbour, due to reduced water quality and primary producer productivity, are also unlikely to result in impacts to marine fauna activities. Reduction in primary productivity may result in reduced subtidal BPP biomass however the extent of subtidal BPPH within the harbour will provide alternative food or habitat sources for dependent fauna.

Impacts on subtidal BPPH (particularly direct and indirect impacts within the harbour) are proposed to be managed in accordance with the DMP (**Appendix B3**). The management measures are described in **Section 8.2**.

## 9.1.5 Management of Impacts

### Direct Impacts

#### *Vessel Collisions or Entrapments*

Once dredging activities are underway, marine mammals and turtles are expected to exhibit avoidance behaviour and are unlikely to remain in proximity to the dredge due to noise and vibrations generated. The potential for collisions with marine mammals and turtles is also considered low due to the small number of vessel movements compared to existing shipping movements within, and to and from the harbour, as well as the management measures proposed. These management measures will be implemented during the period of dredging and spoil disposal and are included within the DMP (**Appendix B3**). The likelihood of entrapment of sea turtles or marine mammals in the cutter head is also considered to be minor due to application of these management measures.

Prior to the commencement of dredging activities, the dredging contractor and crew will receive an induction that will include a description of seasonal sensitivities in the region such as turtle breeding times, as well as the location of marine turtle habitat in relation to proposed dredging activities, and marine fauna management measures and procedures. To minimise the risk of impacts on turtles or marine mammals the following management actions will be taken:

- the project will comply with the Australian National Guidelines for Whale and Dolphin Watching 2006;
- where practical the split hopper barges will travel within the defined shipping lanes and will use consistent routes;
- prior to start up of any dredge, a general observation of the water around the dredge will be made. If any sea turtle or marine mammal is sighted within 150 m of the dredge, dredging will not commence until the sea turtle or marine mammal has moved beyond 150 m of the dredge or has not been sighted for 20 minutes; and
- prior to offshore disposal, the crew shall undertake a general observation of the waters around the barge. If any sea turtles or marine mammals are sighted within 500 m of the barge, disposal will not commence until the sea turtle or marine mammal has moved beyond 500 m or has not been sighted for 20 minutes.

The procedure described above will be implemented as the scale of the Cutter Suction Dredge and the length of pipeline require a shutdown sequence, which can take up to one hour from the point at which a turtle or other marine mammal is observed. Failing to follow this sequence can result in equipment damage and pipeline blockages, which in themselves pose safety and environmental issues. The sequence includes a step where the cutter head is raised to intake clean water for the flushing process. This step presents a risk should a sea turtle be in the immediate vicinity as it will be drawn into the point of suction. BHPBIO has reviewed similar issues with other dredging projects and has been advised this risk was reduced by continuing to operate the cutter head on the dredge within the substrate to act as a deterrent to prevent sea turtles from entering this area.

As dolphins are a more mobile and agile species in comparison with large and slower moving cetaceans, they are not considered to be at risk from impact from the disposal activities and as a result will not trigger a 'do not commence' response.

Any incidents that occur during dredging or disposal operations that result in the injury or death of marine mammals or turtles will be reported immediately. Details of the incident including time and date of incident, cause of injury or mortality and the species (if known) will be recorded and reported to the DEC and DEWHA within 24 hours of the incident occurring.

#### *Noise*

Impacts to sea turtles, fish and marine mammals are unlikely to be significant as mobile species will move away from the area. As a precautionary measure to mitigate any noise impacts to sea turtles and dolphins:

- all activities will be conducted in accordance with the construction EMP (**Appendix B1**); and
- appropriate and well maintained equipment will be used.

### *Light Spill*

Lighting for this project may incrementally add to existing light emissions from urban and industrial sources in the Port Hedland region. However, lighting impacts on nesting areas and turtle hatchlings due to the dredging operations are considered to be negligible as these areas are more than 3 km distant to the harbour and are separated by topographical features (e.g. dunal system) and existing residential, commercial and other industrial land uses within the West End of Port Hedland.

The disposal of dredged material to Spoil Ground One will result in additional shipping traffic within the existing Port Hedland Harbour shipping channel. To minimise the impact associated with light emissions from the project on turtle nesting areas at Cemetery Beach, the following management measures will be undertaken:

- lighting will be limited to navigational lights and those lights required for the safe and efficient operation of the dredging vessels;
- where practical, down lights will be used; and
- operational lights will not be shone directly onto the water unless required during operations.

These measures are outlined in the DMP (**Appendix B3**).

### *Excess Water Discharge from DMMA H*

The quality of the excess water discharged from DMMA H will be managed as per the water quality measures described in **Section 8.1** and the DMP (**Appendix B3**). The consequence of impact to marine fauna such as fish and invertebrates is considered to be minor and localised to the immediate vicinity of the discharge point.

### *Hydrocarbon Spills*

Prevention and management of hydrocarbon spills will be achieved by following the construction EMP (**Appendix B1**) as well additional measures as described in **Section 9.13**.

## **Indirect Impacts**

### *Loss of Intertidal and Subtidal BPPH*

Clearing of mangroves will be kept to a minimum within the project footprint and will be managed in accordance with the MMP (**Appendix B4**), and as described in **Section 8.2**.

There is considerable mangrove habitat in surrounding creeks in close proximity to the Nelson Point dredge footprint that marine fauna can utilise. These include South West, South East and Stingray Creeks. Additionally, further east is an extensive mangrove lined creek system, close to Pretty Pool, which is a known nesting beach for green turtles. The impact to juvenile green turtles and fish that may use mangroves within the dredge footprint for foraging is therefore considered minor.

No indirect impacts are considered likely to occur to cyanobacterial mats and salt marsh communities as a result of the proposed activities (see **Section 8.2**).

Small losses of subtidal BPPH are expected at Spoil Ground One and within the harbour, however these losses are not expected to significantly impact on food source or habitat requirements of marine fauna in either locality. Management measures for subtidal BPPH will be in accordance with the DMP (**Appendix B3**), and as described in **Section 8.2**.

## **9.1.6 Outcome**

A summary of the key potential impacts to marine fauna, the associated management measures and the resulting residual risk is provided in **Table 9.1**.

**Table 9.1 – Summary of Potential Impacts to Marine Fauna and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Physical interaction (movements of dredge and support vessels to and from offshore Spoil Ground One).	Injury or mortality to sea turtles (or other marine fauna) resulting from collision with mobile barges.	Implement a Dredging Management Plan including the following management measures: <ul style="list-style-type: none"> <li>marine mammal and turtle observation procedures;</li> <li>ceasing or minimising dredging and disposal activities in the event of an observation; and</li> <li>reporting of all incidents of injury or mortality of sea turtles (or other marine fauna) to the DEC and DEWHA.</li> </ul>	10	0.3	Minor (3)
Noise emissions from dredging and support vessels.	Disturbance to marine fauna and altered behavioural patterns	Implementation of the Construction EMP and the management measures therein including: <ul style="list-style-type: none"> <li>undertaking construction activities in accordance with Environmental Protection (Noise) Regulations 1997; and</li> <li>regular monitoring and maintenance of equipment.</li> </ul>	1	1	Minor (1)
Artificial light from dredging operations.	Altered behavioural patterns.	<ul style="list-style-type: none"> <li>Lighting to be limited to those necessary for navigation and safe operation;</li> <li>Operational lights will not be shone directly on the water unless necessary for operations; and</li> <li>Appropriate type/equipment will be used for dredging activities and will be well maintained.</li> </ul>	1	0.3	Minor (0.3)
Discharges to the environment from: <ul style="list-style-type: none"> <li>Accidental release of hydrocarbons (major spills).</li> <li>Discharge of excess water from DMMA H.</li> <li>Quality of dredge return water.</li> <li>Solid and liquid waste disposal.</li> </ul>	<ul style="list-style-type: none"> <li>Chronic or toxic effects to marine fauna.</li> <li>Impacts to marine fauna from a reduction in water quality resulting in excess water discharge from DMMA H</li> <li>Reduction in dissolved oxygen, increased salinity, increased temperature, potential contamination of seawater.</li> <li>Ingestion of wastes causing injury or mortality.</li> </ul>	Implementation of the DMP and specific measures including: <ul style="list-style-type: none"> <li>Appropriate storage of oil, grease, chemicals and detergents;</li> <li>development of spill contingency plans prior to commencement of works;</li> <li>location of spill response kits in close proximity to dredging operations;</li> <li>waste disposal procedures;</li> <li>water quality monitoring; and</li> <li>additional management measures as described in the DMP.</li> </ul>	10	0.1	Minor (1)
Sea bed disturbance from dredging operations.	<ul style="list-style-type: none"> <li>Indirect impact from loss of seabed foraging habitat within proposed dredge footprint.</li> <li>Impacts to marine fauna from a reduction in water quality due to overall dredging operations.</li> </ul>	<ul style="list-style-type: none"> <li>Dredging activities to remain within designated and approved project area;</li> <li>Develop and implement a Dredging Management Plan; and</li> <li>Environmental Awareness Training for dredging contractor and employees.</li> </ul>	1	1	Minor (1)

## 9.2 MARINE PEST SPECIES

### 9.2.1 Overview

Non-indigenous marine species are organisms that have been introduced into an area beyond their natural range. Invasive Marine Species (IMS) are those that are then capable of establishing a viable population and capable of spreading by either natural or human mediated processes. Past experience has demonstrated the serious environmental, social and economic implications that may result following the introduction of IMS. The pest potential of IMS, however, depends on the species' characteristics.

The DoF has recorded 92 IMS in the waters of Western Australia (DoF 2005). Port Hedland is currently recognised as an 'at risk' port. This assessment is based on the level of activity that occurs within the port environment and is primarily related to vessel mediated incursions. These incursions take one of two common pathways, ballast water or biofouling. The latter includes external hull fouling and internal seawater system fouling.

Considering the level of commercial activity that occurs within Port Hedland the number of known IMS and cryptogenic species is lower than expected (CSIRO 1999). The species that are known to be present are either well known cosmopolitan, common fouling species or species with less obvious impacts or inconspicuous by nature (**Section 4.3.5**).

### 9.2.2 Objective

The environmental objective for IMS is to minimise the risk of IMS introduction, establishment and spread into and within West Australian waters as a result of the dredging, reclamation and disposal activities. The EPA objectives for marine flora and fauna are 'to maintain the abundance, diversity, geographic distribution and productivity of fauna/flora at species and ecosystem levels through avoidance or management of adverse impacts and improvement in knowledge'.

### 9.2.3 Guidance

The relevant policies and guidelines for the management of IMS include:

- Australian and New Zealand Environment and Conservation Council Code of Practice for Anti-fouling and In-Water Hull Cleaning and Maintenance (ANZECC 1997);
- Australian Quarantine and Inspection Service (AQIS) guidelines for ballast water management (AQIS 2008); and
- National Introduced Marine Pest Identification System (NIMPIS) (Hewitt et al. 2002).

### 9.2.4 Potential Impacts

Port environs provide suitable natural and more often suitable artificial substrates (Tyrrell et al. 2007) for IMS establishment. As with any invasive species, suitable habitat to support establishment is only part of the incursion process. Vessel movement also supports the introduction and facilitates the spread of IMS.

Potential environmental impacts that may occur as a result of the introduction of IMS include the following:

- establishment of non-indigenous marine pest species;
- competition for food and space with native species;
- removal of native species;
- predation of native species; and
- introduction of associated pests and disease.

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Potential impacts from invasive species to the ecological balance of existing marine communities include competition for food and space with native species; predation of native species (including commercial species); and possible hybridisation between native and invasive species (Hass & Jones 1999).

### 9.2.5 Management of Impacts

#### Preventative Management

Vessels mobilising to site will be required to comply with BHPBIOs Marine Vessel Pest Inspection and Reporting Procedure (PP-13-027). This procedure includes:

##### *Pre-mobilisation Requirements*

Contractors shall provide the company representative prior to mobilisation, details of the shipping schedule, vessel details and completed vessel risk assessment.

BHPBIO in consultation with DoF shall determine the mobilisation inspection requirements of individual vessels and notify the contractor of these requirements within 48 hours of receiving vessel information. Dependent on the risk calculated, inspection requirements could include port of mobilisation in water inspection and cleaning, dry dock inspection and cleaning, and /or port arrival inspection.

The contractor will ensure the hull of the mobilising vessel has undergone certified anti-fouling treatment as a minimum within the last 2 years. Assessment of the vessels activities and likely state of the antifouling shall determine if the vessel is to be dry-docked and hull treated with antifouling paint.

Certification is required from the anti-fouling paint supplier declaring treatment to be TBT free.

Vessels found to carry marine pests or sediment will be required to be fully cleaned of such material. Once vessel has completed cleaning activities it shall be re-inspected and approved, prior to departure for a BHPBIO port facility.

##### *Arrival on Site*

The contractor's vessel master will have all relevant documentation in order for inspection by the Australian Quarantine and Inspection Service (AQIS), Customs and the relevant port authority. This will include hull anti-fouling and cleaning records, vessel inspection report, ballast tank records, voyage history and any other documentation required to enter West Australian or other Australian waters not covered by this procedure.

All vessel IMS inspections will be undertaken by a qualified marine scientist. The person undertaking the inspections will be required to be experienced in the identification of IMS and the assessment of the risk posed by such species. A detailed description of the inspection requirements is provided in the DMP (**Appendix B3**).

The vessel is required to comply with the AQIS mandatory Australian Ballast Water Management requirements including all necessary supporting documentation.

On arrival to a port, a marine vessel pest inspection may be required to be carried out by a suitably qualified person, this requirement may be waived if determined that it is not required by the risk assessment and in consultation with the DoF.

#### Contingency Measures

In the event that a known or suspected marine pest species has been identified or sediment found on or within the niches of the vessel during a marine vessel pest inspection the following may be instigated:

- If found during pre-mobilisation inspections, the vessel will undergo full cleaning and re-inspected prior to mobilisation. Treatment, cleaning and inspection will be undertaken to the satisfaction of DoF and company representative;

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- If found within WA state waters, during arrival or operations, the vessel will be moved offshore (preferably to waters that are 200m deep) as soon as practically possible;
- A photograph or video image showing the contamination will be taken. A sample of the material or species will be obtained and sent for expert taxonomic identification. In conjunction with the identification process, a monitoring program and control plan (if necessary) will be developed and implemented in consultation with the DEC, DoF and Port Authority with the aim of determining if the marine pest has become established and if measures to control and eradicate are required; and
- The vessel will undergo full cleaning and re-inspection prior to re-entry into a harbour. Treatment, cleaning and inspection will be undertaken to the satisfaction of DoF and company representative.

**Monitoring**

An IMS establishment monitoring program will be developed in consultation with the DEC in the event that IMS are found on a dredging vessel within WA State waters.

**Reporting**

A vessel inspection checklist (field report) will be completed and provided to the DEC and DoF within 48 hours of each pre-mobilisation and arrival inspection.

A vessel inspection report (i.e. more detailed report) detailing the results of any inspection and/or risk assessment will be provided within 14 days of completion of the inspection or assessment. A report will be provided to the DEC and DoF at anytime where suspected IMS are identified.

**9.2.6 Outcome**

Predicted impacts to the marine environment from IMS will be managed in accordance with the DMP (**Appendix B3**). The DMP outlines specific mitigation, management and monitoring measures to limit environmental effects, and will be implemented prior to commencement of dredging activities. Consequently, long term detrimental effects to the marine environment are not anticipated as a result of dredging or additional shipping activity. BHP Billiton Iron Ore expects to meet the EPA objectives to maintain the abundance, biodiversity, productivity and geographic distribution of marine fauna and intertidal and subtidal species.

A summary of the key potential impacts from IMS, the associated management measures and the resulting residual risk is provided in **Table 9.2**.

**Table 9.2 – Summary of Potential Impacts from Marine Pests and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Introduction of marine pests from dredge vessels through dredging and support vessels.	Predation of native species, competition for food and habitat for native species from introduced species.	Develop and implement a Dredging Management Plan including the following management measures: <ul style="list-style-type: none"> <li>• vessel marine pest inspections prior to mobilisation and in compliance with the PHPA requirements;</li> <li>• reporting of suspected marine pests to the DEC and DoF; and</li> <li>• development of marine pest species monitoring program in the event that marine pest species are found.</li> </ul>	30	0.1	Minor (3)

### 9.3 COASTAL PROCESSES

#### 9.3.1 Overview

Dredging activities and the development of DMMA H will alter the existing configuration of the Port Hedland Harbour which has the potential to impact on coastal hydrodynamics and geomorphic processes and on natural sedimentation within the harbour.

#### 9.3.2 Objective

The environmental objective for coastal processes is to maintain the integrity and stability of the coast, seafloor and tidal creeks.

#### 9.3.3 Guidance

The key guideline of relevance to the management of coastal processes is:

- Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives (DoE 2006b).

#### 9.3.4 Potential Impacts

Areas within DMMA H are currently subject to occasional tidal inundation and storm surge flooding events. Construction of DMMA H does not involve reclamation of significant areas of land that are usually under water, and does not involve the construction of rock armoured sea walls or such structures. The potential impact arising from the establishment of bund walls is a minor alteration of coastal hydrodynamic and geomorphic processes in the immediate vicinity at DMMA H. Due to the nature of the works to be undertaken, potential impacts on coastal process at DMMA H are not considered significant.

#### 9.3.5 Management of impacts

BHP Billiton Iron Ore has optimised design and layout of the marine infrastructure, including configuration of DMMA H, to minimise impact on currents within the harbour.

#### 9.3.6 Outcome

The establishment of DMMA H is likely to result in a negligible impact on the hydrodynamic and geomorphic processes on the Port Hedland Inner Harbour.

A summary of the key potential impacts to coastal processes, the associated management measures and the resulting residual risk is provided in **Table 9.3**.

**Table 9.3 – Summary of Potential Impacts relating to Coastal Processes and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Construction of DMMA H and bund walls.	Alteration of coastal hydrodynamic and geomorphic processes. Alteration of natural movement of sedimentation (erosion and deposition rates) potentially leading to enhanced erosion and alterations to the coastline.	Optimise design and layout of the marine infrastructure, including configuration of DMMA H.	1	0.3	Minor (0.3)

## 9.4 HYDROLOGY

### 9.4.1 Overview

Following completion of the dredging and dredge material disposal activities, DMMA H will contain approximately 6.5 Mm<sup>3</sup> of unconsolidated dredged material (maximum 'bulked' volume). Dredged material will be contained by the construction of a perimeter bund up to +9.0 m AHD.

Excess water will be discharged from DMMA H to South East Creek via a non-return water outlet with flows ranging from 2,500 m<sup>3</sup>/hr to 5,500 m<sup>3</sup>/hr for the duration of the project.

Residence time within DMMA H will typically be 48 hours to allow fines to settle to such an extent that the presence of sediments within the water discharge will be minimal (less than 150 mg/L). However, residence time may be adjusted based on monitoring of discharge water.

Water for construction works will be sourced from the existing Wedgefield scheme and requirements are estimated at 56 ML.

### 9.4.2 Objective

The EPA objective relevant to hydrology is 'to maintain the quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected'.

### 9.4.3 Guidance

The following guideline is applicable to hydrology:

- Environmental Water Provisions Policy for Western Australia: Statewide Policy No. 5 (WRC 2000).

### 9.4.4 Potential Impacts

#### Impacts to Surface Water Flows at DMMA H

The construction of DMMA H will have a localised impact on the drainage and surface flow of the surrounding environment. The installation of the bund wall will create an impediment to the natural flow of water around DMMA H. Potential impacts include:

- disruption of natural surface water flows and stormwater runoff from exposed areas;
- unnatural or accelerated erosion of intertidal flats surrounding DMMA H; and

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- increased mosquito breeding areas and incidences of mosquito borne diseases in the local community and workforces.

Studies have indicated that peak freshwater flood levels as a result of significant rainfall events will not impact on Wedgefield as a result of the construction of DMMA H. Furthermore, the construction of DMMA H would provide some protection to Wedgefield from natural storm surge events.

### Impacts from Discharge of Water from DMMA H

Direct mangrove habitat loss is discussed in **Section 8.2**. Indirect impacts on mangroves and other BPPH attributed to water quality are discussed in **Section 8.1**.

The discharge of excess water from DMMA H has the potential to cause:

- minor scouring/erosion of creek bed near excess water discharge point; and
- impacts to localised fauna and habitats.

### Construction Water Use

Potential impacts arising from the use of 56 ML of Wedgefield scheme water for construction activities include an increased pressure on existing water supplies.

#### 9.4.5 Management of Impacts

Erosion and sedimentation impacts will be managed by the implementation of the LMP (**Appendix B5**). Key management measures are included below.

#### Modification of the landform resulting in altered local erosion, stability and drainage

The DMMA H footprint has been designed and located to avoid major drainage channels. Erosion will be managed through the installation of appropriate drainage controls as required.

The potential for increase in mosquito breeding areas and mosquito borne disease will be managed by:

- prevention of ponding of water for prolonged periods of time;
- visual inspection of DMMA H and associated settlement pond for mosquitoes/larvae;
- liaison with ToPH, DoH and other parties with regard to mosquito management programs and training; and
- reporting of all incidences of mosquito borne diseases.

#### Discharge of Water from DMMA H

- excess water will be discharged only on an as needs basis;
- flow rates from DMMA H will be controlled; and
- scour protection will be used in the overflow channel at the DMMA H discharge point.

Discharge of water from DMMA H will be managed through the DMP (**Appendix B3**) for direct impact to surface water drainage and through the MMP (**Appendix B4**) for indirect impacts to mangroves.

#### Construction Water Use

Water use during the dredge material disposal activities at DMMA H are expected to be of a short duration and primarily used for construction of DMMA H. Water use will be minimised where possible and opportunities to utilise alternative water sources (eg salt water) will be investigated where practicable.

**9.4.6 Outcome**

Residual risks associated with hydrology are expected to be minor following the implementation of management measures described above. A summary of the key potential hydrological impacts, the associated management measures and the resulting residual risk is provided in **Table 9.4**.

**Table 9.4 – Summary of Potential Hydrological Impacts and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Modification of the local landform.	Unnatural/accelerated erosion of inter tidal flats (increased runoff, formation of erosion features - gullies and rills) surrounding DMMA H. Disruption of natural surface water flows and stormwater runoff from exposed areas.	DMMA H footprint has been designed to avoid major drainage channels. Implement standard management measures to prevent flooding (including stormwater management), erosion, and maintaining drainage across the landscape.	3	1	Minor (3)
	Increased mosquito breeding areas and incidences of mosquito borne diseases in local community and workforces.	Visual inspections of DMMA H and associated settlement pond for mosquitoes / larvae. Prevention of ponding of water for prolonged periods of time. Report all incidences of mosquito borne diseases, Liaise with ToPH, DoH and other parties with regard to mosquito management programs and training.	1	0.3	Minor (0.3)
Discharge of excess water from DMMA H into South East Creek.	Loss of fringing benthic primary producer habitat (i.e. mangroves). Impacts of fauna and habitats. Increased surface water runoffs. Minor scouring / erosion of creek bed near excess water discharge point. Sedimentation of South East Creek.	Excess water discharged only on an as needs basis. Managed through the DMP for direct impact to surface water drainage and through the Mangrove Management Plan for indirect impacts to BPPH. Scour protection to be used at the DMMA H discharge point.	3	1	Minor (3)
Use of Wedgefield scheme water.	Inappropriate use of scheme water. Increased pressure on existing water supplies.	Implementation of water use efficiency measures.	3	1	Minor (3)

**9.5 TERRESTRIAL FLORA AND FAUNA**
**9.5.1 Overview**

Potential terrestrial flora and fauna impacts are only applicable to DMMA H, as all other land-based areas associated with this project are located within intertidal areas where vegetation is classed as BPPH. DMMA H is located to the south of Lumsden Point in an area characterised by hypersaline, tidal mudflats with scattered terrestrial vegetation.

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DMMA H, inclusive of the construction footprint, will result in the disturbance of 187.9 ha of terrestrial vegetation and habitat (grassland, low sandy islands and supratidal/saline mudflat vegetation communities/ habitats) and 12.1 ha of existing disturbed areas. The remaining 4 ha within DMMA H consists of vegetation considered to be marine in nature and is not considered further in the terrestrial flora assessment.

The total disturbance to terrestrial flora at DMMA H will include:

- clearing for construction of bund walls. which will encompass an uncleared settlement area that will be permanently covered with up to approximately +9 m AHD of dredged material;
- clearing of vegetation within the pipeline corridor and overflow channel to allow for construction; and
- clearing of vegetation for construction laydown areas to provide access for earthmoving equipment required for the construction of the perimeter bunds, pipeline corridor and overflow channel at DMMA H.

Flora surveys recorded a total of 87 taxa in and around DMMA H, from 34 families and 60 genera. No Declared Rare Flora was recorded although priority species *Tephrosia rosea* var. *venulosa* (Priority 1) and *Pterocaulon* sp. A Kimberley Flora (Priority 2) were identified within the DMMA H footprint.

### 9.5.2 Objective

The EPA objective for terrestrial fauna and flora is 'to maintain abundance, diversity, geographic distribution and productivity of flora and fauna at species levels through avoidance or management of adverse impacts and improvement in knowledge'.

### 9.5.3 Guidance

Key EPA Position Statements and Guidelines relevant to the management of terrestrial flora and fauna include:

- EPA Position Statement No. 2: Environmental Protection of Native Vegetation in WA (2000b);
- EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (2002b);
- EPA Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004e); and
- EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004f).

### 9.5.4 Potential Impacts

Factors or activities contributing to impacts on terrestrial flora and fauna include:

- clearing of vegetation;
- earthworks;
- construction of bund walls;
- movement of vehicles; and
- inundation with dredged material.

The potential impacts as a result of these activities are:

- direct loss of vegetation communities and flora within DMMA H;
- introduction and spread of weeds;

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- direct loss of fauna habitat;
- injury and mortality of individual fauna; and
- indirect disturbance effects to fauna from construction activities, such as noise and dust generation.

DMMA H will require the removal of vegetation prior to the construction of the bund walls. The pipeline corridor, overflow channel and construction laydown area will also require the clearing of vegetation. The area cleared for construction laydown will be minimised, where possible.

Vegetation within the footprint of the bund walls (approximately 12.1 ha of existing disturbed area) will be covered by dredge material.

Approximately 32.4 ha of *Triodia* hummock grassland associated with low sandy islands and 31.3 ha of *Acacia* shrubland associated with grasslands will be disturbed within DMMA H (inclusive of bund walls, settlement area, overflow channel, pipeline corridor and construction laydown) (**Appendix A6**) (**Figure 5.4**). In addition, approximately 124.1 ha of samphire shrubland associated with supratidal/saline mudflats will be disturbed. Approximately 12.1 ha of existing disturbed areas will be cleared during construction of DMMA H.

The loss of *Triodia* hummock grasslands associated with low sandy islands through inundation and earthworks represents a 0.0002% loss of Pre-European extent of Hummock grasslands at the Bioregional-scale (ANRA 2008). The loss of *Acacia* shrubs within the grassland vegetation community type through dredge inundation and earthworks represents a 0.008% loss of Pre-European extent of *Acacia* shrublands at the Bioregional-scale (ANRA 2008). The loss of supratidal/saline mudflats through inundation and earthworks represents a 0.061% loss of Pre-European extent of tidal mudflat and samphire areas at the Bioregional-scale (ANRA 2008).

At least 350 individual plants of *Tephrosia rosea* var. *venulosa* (Priority 1, DEC) and two individual plants of *Pterocaulon* sp. A Kimberley Flora (Priority 2 DEC) will be disturbed within DMMA H as a result of dredge spoil deposition (refer to **Figure 5.5**). Both of these Priority Flora species are known to occur elsewhere both in and outside of Port Hedland.

Approximately 1050 individuals of *Tephrosia rosea* var. *venulosa* have been recorded across 16 locations in other surveys undertaken in the Port Hedland region (ENV 2009c, 2009f, 2009h) (**Figure 5.6**). With increased survey effort, it is becoming apparent that *Tephrosia rosea* var. *venulosa* may be more common in the Port Hedland area than originally thought, particularly in disturbed areas which are believed to be preferred habitat owing to a lack of competition with *Triodia* species. *Tephrosia rosea* var. *venulosa* has also been located at Cape Lambert, W.A.

Two individuals of *Pterocaulon* sp. A Kimberley Flora (Priority 2 DEC) have been recorded across two locations in other surveys undertaken in the Port Hedland region (ENV 2009c) (refer to **Figure 5.6**). *Pterocaulon* sp. A Kimberley Flora is also located within the Kimberley region of W.A. and the occurrence of this species at Port Hedland represents a range extension. A voucher specimen has been lodged with the Western Australian Herbarium to confirm if the record obtained during the ENV (2009b) survey constitutes a range extension.

Although a number of listed priority and migratory fauna species may potentially use these areas for habitat and foraging, the development of DMMA H is unlikely to impact significant areas of habitat for these species or impact their conservation status (**Appendix A7**) (also refer to **Section 5**). Furthermore, Priority and Migratory listed species that may occur within DMMA H are not specifically reliant on the habitats located within its boundaries as these species are aerial in nature and habitats present within DMMA H are well-represented in the general vicinity.

Priority and migratory species that may occur in DMMA H, with reference to their preferred habitat and wider regional distribution, are listed below:

- **Little North-Western Bat (*Mormopterus loriae cobourgensis*) – Priority 1 (DEC)**

The Little North-Western Bat is known to occur in mangrove areas in the Port Hedland harbour. It is relatively widespread and well represented in mangroves elsewhere along the Pilbara coast (Churchill 1998), which feature more substantial and better quality habitat than is present in DMMA H.

- **Australian Bustard (*Ardeotis australis*) – Priority 4 (DEC)**

The Australian Bustard has previously been recorded at various locations within the Abydos Plain (within the Pilbara) and has been sighted flying over Acacia low shrubland within approximately 20 km of DMMA H.

- **Eastern Curlew (*Numenius madagascariensis*) – Priority 4 (DEC)**

The Eastern Curlew was sighted during field surveys of DMMA H. However, it is commonly found along tidal mudflats, reef flats and sandy beaches of the Pilbara coast and its distribution is relatively widespread across coastal Western Australia (Johnstone & Storr 1998).

- **Common Sandpiper (*Tringa hypoleucos*) – Migratory (EPBC Act 1999)**

The Common Sandpiper is commonly found on the edge of sheltered waters such as mangrove creeks and estuaries along the West Australian coast and on many islands (Johnstone & Storr 1998). This species has been recorded foraging along the tide margin on mudflats within the Port Hedland area (Biota 2002).

- **Grey-tailed Tattler (*Tringa brevipes*) – Migratory (EPBC Act 1999)**

The Grey-tailed Tattler inhabits tidal mud flats and estuarine sand flats along most of the northwest Australian coastline (Johnstone & Storr 1998).

- **Little Curlew (*Numenius minutus*) – Migratory (EPBC Act 1999)**

The Little Curlew's abundance in the Pilbara region is variable. It prefers short-grass plains as habitat, including sports grounds and tidal mud flats.

- **Oriental Plover (*Charadrius veredus*) – Migratory (EPBC Act 1999)**

The Oriental Plover typically inhabits sparsely vegetated plains, beaches and tidal flats (Johnstone & Storr 1998). It has been sighted within approximately 60 km of DMMA H.

- **Oriental Pratincole (*Glareola maldivarum*) – Migratory (EPBC Act 1999)**

The Oriental Pratincole typically roosts on bare ground beside water and feeds in tidal flats and floodwaters (Johnstone & Storr 1998). Large flocks of this species have been sighted within the Port Hedland area.

- **Rainbow Bee-Eater (*Merops ornatus*) – Migratory (EPBC Act 1999)**

The Rainbow Bee-Eater occurs in habitats that provide suitable soil for nesting and a tall stratum of vegetation for perching. It nests in small holes excavated in sandy banks or flat sandy surfaces. Four individuals were recorded within DMMA H (Biota 2008). The Rainbow Bee-Eater is found widely across Australia.

- **Whimbrel (*Numenius phaeopus variegates*) – Migratory (EPBC Act 1999)**

The Whimbrel was recorded in site surveys of DMMA H. However, it has also been recorded elsewhere within the Port Hedland area, usually foraging or roosting in moderate sized groups. The Whimbrel is also common on northwest Australian coasts and south to Cape Naturaliste (Johnstone & Storr 1998).

## 9.5.5 Management of Impacts

### Worker Awareness

BHP Billiton Iron Ore will notify all personnel involved in clearing activities of any nearby protected areas (flora, fauna, heritage areas and other features), and the conditions that apply to each area. BHP Billiton Iron Ore will ensure all employees are competent in managing risks around these sensitive areas.

### Minimising Areas to be Cleared

Clearing of vegetation will be kept to the minimum necessary for the safe and efficient construction of DMMA H. The construction boundary will be demarcated by temporary fencing and/or flagging so as to avoid unnecessary clearing. Monitoring of clearing activities will be undertaken to avoid clearing of vegetation outside designated areas. Construction machinery and vehicles will be restricted to the construction boundary and designated access tracks.

### Management of Weeds

Weed management measures detailed in the construction EMP (**Appendix B1**) include cleaning of all earthmoving and tracked equipment prior to arrival on site and departure; immediate reporting of any new weeds; and appropriate handling of removed weeds to prevent the spread of weed species.

### Management of Removed Vegetation

Due to the characteristics of the areas to be disturbed, it is considered that there will be limited value in stockpiling removed vegetation for future use. However, as a minimum, topsoil from areas where the species *Tephrosia rosea* var. *venulosa* has been recorded will be recovered and suitably stockpiled for use in rehabilitation of disturbed areas no longer required for operational activities. Topsoil management measures are detailed in the construction EMP (**Appendix B1**).

### Significant Species Management

Field surveys have identified the locations of Priority Flora that will be impacted through the construction and operation of DMMA H (refer to **Figure 5.5** for locations). These species are also known to occur outside of the DMMAH footprint and their locations shown in **Figure 5.6**. Once clearing activities have been completed BHP Billiton Iron Ore will report the location and number of species impacted by the project to DEC. Topsoil from these locations will also be recovered and stockpiled for use in rehabilitation activities.

### Fauna Management

To avoid injury and/or mortality of fauna, vehicle speed restrictions will be applied in construction areas and approach roads. In the event of road kill, remains are to be removed from the road to avoid attracting other species (such as birds of prey). Road kills will be monitored with particular attention to the deaths of any significant species.

Driver awareness training will also be conducted prior to and during construction. Dust suppression techniques will be utilised during construction to minimise impacts on surrounding fauna habitats and their inhabiting fauna. Noise emissions will be controlled and monitored to minimise disturbance to fauna in the surrounding area.

#### 9.5.6 Outcome

Based on the studies of the area (**Appendix A6**, **Appendix A7**; and ENV 2009b) it is not expected that the development of DMMA H (inclusive of the construction footprint) will have a significant impact on terrestrial flora and fauna. In the localised area, the clearing and resultant loss of 187.9 ha of terrestrial vegetation and habitat and 12.1 ha of disturbed area is not expected to adversely affect the community and the species dependent on the area for habitat and foraging. The clearing of the remaining 4 ha of mangroves is addressed in **Section 8**. Two Priority Flora species will be impacted as a result of the project, however these species are also found elsewhere in the Port Hedland area.

A summary of the key potential impacts to terrestrial flora and fauna, the associated management measures and the resulting residual risk is provided in **Table 9.5**.

**Table 9.5 – Summary of Potential Impacts to Terrestrial Flora and Fauna and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Vegetation clearing and earthworks and deposition of dredge spoil.	Direct loss of vegetation and fauna habitat within DMMA H. Direct loss of priority flora ( <i>Tephrosia rosea</i> var. <i>venulosa</i> and <i>Pterocaulon</i> sp. A Kimberley Flora). Direct loss of fauna with limited mobility.	DMMA H designed to minimise disturbance footprint. Minimise disturbed footprint through the clear demarcation of vegetated areas marked for clearing. Recovery and reuse of topsoil resource potentially containing <i>Tephrosia rosea</i> var. <i>venulosa</i> seed stock.	1	3	Minor (3)
Fauna collisions with vehicles and earthmoving machinery.	Injury and mortality of fauna from collisions with moving vehicles / equipment.	Restrict vehicle speeds within the construction area and on approach roads. Vehicles restricted to designated tracks.	1	0.3	Minor (0.3)
Introduction of weeds through vehicles and earthmoving machinery and use of weed contaminated land fill.	Introduction and/or spread of weed species may result in increased competition with native species.	Vehicles restricted to designated tracks. Implementation of weed management measures. Adoption of the weed hygiene procedures in the existing BHP Billiton Iron Ore Construction Environmental Management Plan.	1	1	Minor (1)
Dust deposition from vehicles and earthmoving machinery.	Reduced health of terrestrial fauna habitat (e.g. dust deposition).	Dust suppression techniques to be used during construction to minimise disturbance to surrounding fauna habitats.	1	0.3	Minor (0.3)
Noise during construction phase.	Stress to fauna due to noise.	Noise emissions to be controlled and monitored to minimise disturbance to fauna in the general area.	1	0.3	Minor (0.3)

## 9.6 CONSTRUCTION DUST

### 9.6.1 Overview

Dust generated during construction and use of DMMA H has the potential to impact on the health, welfare and amenity of people and the surrounding environment, including mangroves (refer to **Section 8.2**). However, appropriate site management for the project, including the use of dust suppression measures, will minimise potential impacts to people and the surrounding environment.

### 9.6.2 Objective

The EPA objective relevant to construction dust is 'to ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards'.

### 9.6.3 Guidance

The following guidelines are applicable to air quality management:

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- National Environment Protection Goals as defined in the National Environment Protection (Ambient Air Quality) Measure (NEPM) (EPHC 2003); and
- EPA Guidance Statement No. 18 Prevention of Air Quality Impacts from Land Development Sites (EPA 2000c).

### 9.6.4 Potential Impacts

Dust emissions may be generated during dredging and reclamation through a number of activities, including:

- clearing and site levelling;
- earthmoving activities;
- vehicular movement on unsealed tracks; and
- wind erosion on cleared areas of DMMA H.

Dust emissions arising as a result of all or some of the above mentioned activities have the potential to adversely impact on human health, visual amenity, and the surrounding vegetation and fauna. Dust also has a nuisance value.

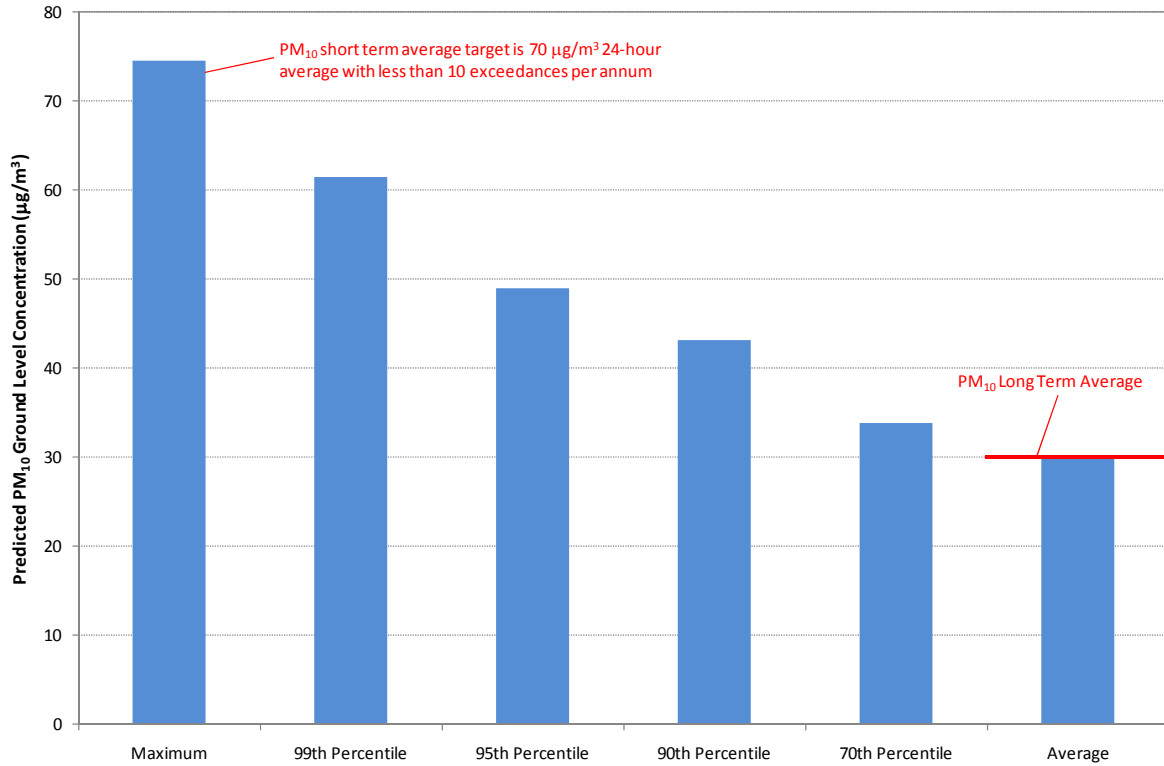
Management of dust generated by BHP Billiton Iron Ore's Port Operations was originally bound by environmental conditions set in Ministerial Statement 433 *Upgrade Dust Management at Finucane Island and Nelson Point, Port Hedland (955)*, issued in 1996 (BHP Iron Ore 1996). The environmental commitments were revised by BHP Billiton Iron Ore and superseded with Ministerial Statement 740 issued in 2007. In terms of monitored levels of dust, the approval requires that incremental progress is made towards achieving the performance targets in **Table 6.1**, with achievement no later than 31 December 2012.

Modelling of wind-generated dust emissions from DMMA H has been undertaken by SKM (**Appendix A8**). Dust emissions are calculated for the worst-case scenario at DMMA H, when the dredge spoil area is at capacity and dry. Combined impacts of RGP5 and the proposed DMMA H have been assessed.

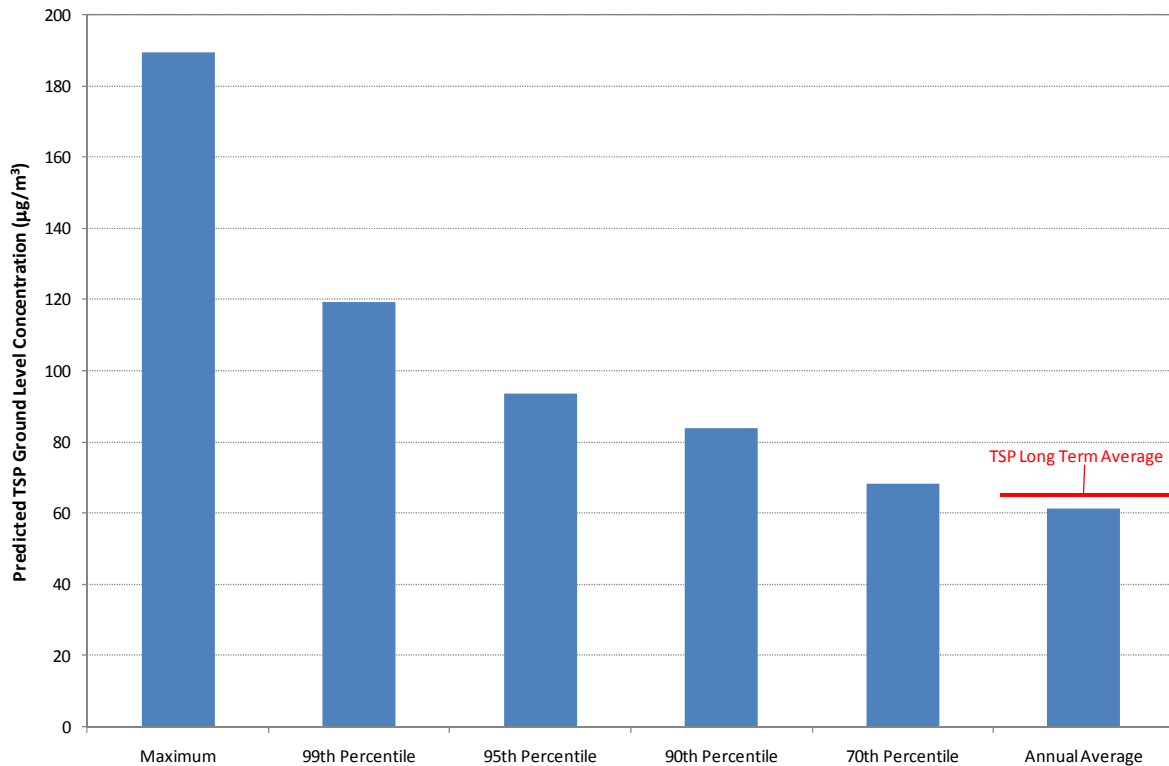
Modelling predicts (refer to **Table 6.1** for short and long-term targets):

- that there will be no change in the PM<sub>10</sub> or TSP annual average ground level concentrations at the Hospital when compared to that predicted to occur from RGP5 alone;
- the PM<sub>10</sub> long term average target is predicted to be achieved at the Hospital monitoring location for combined RGP5 and DMMA H;
- the PM<sub>10</sub> short term average target is predicted to be achieved at the Hospital monitoring location for combined RGP5 and DMMA H; and
- the TSP long term average target is predicted to be achieved at the Hospital monitoring location for combined RGP5 and DMMA H.

Results are outlined below in **Figure 9.1** and **Figure 9.2**.



**Figure 9.1 – Predicted PM<sub>10</sub> 24-hour Ground Level Concentrations for RGP5 and RGP6 at the Hospital**



**Figure 9.2 – Predicted TSP 24-hour Ground Level Concentrations for RGP5 and RGP6 at the Hospital**

### 9.6.5 Management of Impacts

The dust management actions included in the project construction EMP (**Appendix B1**) will be implemented through the duration of the project. Particular measures to reduce ambient dust levels during construction include:

- an induction program will ensure that all employees are made aware of the need to minimise dust generation;
- regular watering of unsealed roads, exposed surfaces and active construction areas;
- restriction of vehicle movements and vehicle speeds to reduce dust emissions;
- use of environmentally safe dust suppressants where applicable; and
- reporting of any community complaints regarding dust levels.

To assist in dust management, daily monitoring of weather / wind conditions will be undertaken. Daily inspection of site conditions and dust suppression measures will also be undertaken to ensure dust control measures are effective.

Due to the formation of a salt crust, minimal ongoing dust suppression is anticipated after the construction period is completed. BHP Billiton Iron Ore will continue to implement standard dust management measures at DMMA H where required.

### 9.6.6 Outcome

By implementing the dust management measures described in the construction EMP (**Appendix B1**) and outlined above, the generation of construction dust from DMMA H will be minimised. **Table 9.6** summarises impacts and management measures for dust, and the associated severity, likelihood and residual risk.

**Table 9.6 – Summary of Potential Impacts from Dust and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Excessive generation of dust during earthworks and preliminary construction activities at onshore DMMA H.	Impact on health and amenity. Deterioration of local air quality. Degradation to flora, fauna habitats due to smothering.	Dust suppression management program during construction. Dust suppression management program for the DMMA H reclaimed area. Complaints management procedure in place. Ongoing stakeholder engagement and communications for dust management.	1	1	Minor (1)
Generation of dust from exposed reclaimed surface area at DMMA H (following completion of dredging).		Published dust reporting. Continue engagement with Community, industries and government. Real time dust monitoring at Port Hedland.			

## 9.7 CONSTRUCTION NOISE

### 9.7.1 Overview

Dredging and dredge material management activities which generate noise have the potential to impact the amenity of nearby residents and/or sensitive receptors located in close proximity to the proposed dredging footprint and DMMA H. However, given existing background noise levels in the Port Hedland area, dredging and dredge material management activities for the project are expected to have minimal impact.

### 9.7.2 Objective

The EPA objective for construction noise is 'to protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards'.

### 9.7.3 Guidance

The following guidelines are applicable to the management of noise:

- Draft Statement of Planning Policy: Road and Rail Transport Noise (WAPC 2005);
- Preliminary Draft Guidance Statement No. 14: Road and Rail Transport Noise (EPA 2000d);
- Environmental Protection (Noise) Regulations 1997 (WA); and
- Guide to Noise Control on Construction, Maintenance and Demolition Sites—AS 2436—1981.

### 9.7.4 Potential Impacts

Construction, dredging and dredge disposal activities will generate noise that may interfere with the amenity of nearby residents. Activities associated with the Nelson Point Dredging proposal that have the potential to impact on the local community include:

- earthworks related to the construction of DMMA H;
- dredging using Backacter and Cutter Suction Dredges;
- pipe laying; and
- general construction traffic.

Given that mobile equipment used for spoil management will move infrequently out of the spoil management area, it is considered that construction traffic moving out of the spoil management area on public roads will not have an impact on any sensitive receptors.

Noise emissions from earthworks activities within DMMA H and dredging activities have been modelled (**Appendix A9**). A noise model has been developed for two different scenarios. The noise sources in the model were arranged so that they would provide the worst case noise impacts for either Port Hedland or for Wedgefield.

The two scenarios modelling inputs are outlined below:

- the Backacter and the Cutter Suction Dredges operating in the southern part of the Nelson Point dredge footprint with the landside construction equipment operating in the southern part of DMMA H (Scenario 2 and worst case scenario for Wedgefield and South Hedland); and
- the Backacter and the Cutter Suction Dredges operating in the northern part of the Nelson Point dredge footprint with the landside construction equipment operating in the northern part of DMMA H (Scenario 3 and worst case scenario for Port Hedland).

The sound power levels for each noise source were obtained from the SVT database and are based on measured data for similar equipment. The noise modelling calculates noise levels at different

receivers, and was used to determine noise control recommendations. Modelled noise levels are shown in **Table 9.7**.

**Table 9.7 – Modelled Noise Levels for Dredging Activities at Sensitive Receptor Locations**

Receptor ( <sup>1</sup> )	LA <sub>10</sub> Assigned Noise Levels (dB(A))		LA <sub>10</sub> Modelled Noise Levels (dB(A))	
	Evening	Night	Scenario 1: BD and CSD and construction in southern part of DMMA H	Scenario 2: BD and CSD and construction in northern part of DMMA H
Brearley St	42	37	25.8	26.1
Hospital	42	37	34.9	35.0
Police Station	57	52	38.0	38.1
Pretty Pool	40	35	15.3	15.3
South Hedland	40	35	17.1	15.4
Wedgefield Industrial Estate	65	65	40.9	33.1
Wedgefield Industrial Estate North	65	65	54	40.2

(1) location details are provided in Appendix A9

Assigned LA<sub>10</sub> noise levels will not be exceeded under any of the three scenarios at any sensitive receptor in Port Hedland, South Hedland or Wedgefield. Noise generated from the project is not anticipated to have a significant impact on the local community.

### 9.7.5 Management of Impacts

The noise and vibration management actions included in the construction EMP (**Appendix B1**) will be implemented throughout the duration of the project. In particular, noise impacts on the local community from dredging and dredged material management will be minimised by:

- all construction activities, including dredging, being undertaken in accordance with Environmental Protection (Noise) Regulations 1997;
- selection of equipment to reduce noise; and
- regular monitoring and maintenance of equipment so that equipment remains in good working condition and noise emissions are kept to a minimum.

As dredging and reclamation activities will occur 24 hours a day, 7 days a week, a Noise Management Plan will be developed to manage construction noise, in accordance with the Environmental Protection (Noise) Regulations 1997.

Prior to the commencement of dredging and other construction activities, BHP Billiton Iron Ore will inform the local community of these activities, including the proposed schedule and/or hours of construction works, and potential noise impacts to nearby sensitive receptors. Noise concerns raised by the local community will be addressed through existing BHP Billiton Iron Ore existing community response mechanisms.

### 9.7.6 Outcome

A summary of the key potential impacts from noise, the associated management measures and the resulting residual risk is provided in **Table 9.8**.

**Table 9.8 – Summary of Potential Impacts from Noise and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Construction equipment including dredge.	Reduced amenity for residents and sensitive receptors. Noise impacts on Wedgefield. Potential non-compliance with Noise Regulations.	Compliance with existing Noise Reduction Management Plan. Selection of equipment to reduce noise. Ongoing consultation with stakeholders. Complaints management procedure in place. Implementation of the Construction EMP and the management measures therein including: <ul style="list-style-type: none"> <li>undertaking construction activities in accordance with Environmental Protection (Noise) Regulations 1997; and</li> <li>regular monitoring and maintenance of equipment.</li> </ul>	1	3	Minor (3)

## **9.8 CULTURAL HERITAGE**

### **9.8.1 Overview**

The proposed Nelson Point Dredging proposal falls within the Kariyarra Native Title Claim. On 3 December 2007 BHP Billiton Iron Ore entered into an agreement with the Kariyarra (Heritage Agreement), through a corporate entity MPL, to survey the project area and other areas both ethnographically and archaeologically.

An archaeological survey of the project area (Jackson, Stedman, Fry & Ibbotson 2008) identified 25 archaeological sites within the reclamation area and its vicinity. An ethnographic survey of the project area (Anthropos Australis 2008) in December 2007 identified one potential ethnographic site.

### **9.8.2 Objective**

The EPA objective for indigenous heritage is ‘to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation’.

### **9.8.3 Guidance**

Applicable State and Commonwealth legislation and guidelines for heritage management include:

- *Aboriginal Heritage Act 1972*; and
- EPA Guidance Statement No. 41: Assessment of Aboriginal Heritage 2004;

### **9.8.4 Potential Impacts**

Potential impacts on indigenous heritage as a result of the Nelson Point Dredging Project include:

- disturbance of culturally significant heritage sites;
- impacts on cultural associations to the site and surrounding areas.

A total of 25 archaeological sites were identified within the reclamation area and its surrounds. Only 9 of these sites are within the proposed disturbance area.

### 9.8.5 Management of Impacts

BHP Billiton Iron Ore has applied to the Minister for Indigenous Affairs and obtained a consent under section 18 of the *Aboriginal Heritage Act* that will permit the works to proceed. The process for obtaining the Minister's consent included consideration by the Minister and the Aboriginal Cultural Material Committee of the potential impacts on indigenous heritage.

All concerns raised by the Kariyarra have been considered by BHP Billiton Iron Ore in its management of environmental impacts as they affect heritage matters.

BHP Billiton Iron Ore has agreed to implement the recommendations of the Kariyarra's archaeological consultant, concerning a mitigation and salvage program for archaeological sites that will be disturbed by the project. The salvage program will consist of archaeological excavations, radiocarbon dating and laboratory analysis. No further archaeological recording is required for those archaeological sites which will be avoided by the project.

BHP Billiton Iron Ore has developed a Cultural Heritage Management Plan (CHMP) for the management of sites in the port area. The CHMP sets out the practices by which sites within the vicinity of BHP Billiton's operations in the port will be protected where practicable and the practices which will be used to manage sites that cannot be practicably avoided. The Kariyarra have been invited to participate in the implementation of the CHMP.

Before any ground disturbance activities will be permitted within the project area the proposed activity will be considered as part of an internal Project Environmental and Aboriginal Heritage Review (PEAHR) process. The PEAHR process ensures that all heritage sites located in the project area and within the vicinity of the project area are identified and avoided where practicable. If any additional survey work is warranted the results would be incorporated into and updated in the CHMP.

### 9.8.6 Outcome

A summary of the key potential impacts relating to cultural heritage, the associated management measures and the resulting residual risk is provided in **Table 9.9**.

**Table 9.9 – Summary of Potential Impacts Relating to Cultural Heritage and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Footprint of DMMA H. Insufficient review/ surveys of heritage sites.	Direct loss of indigenous heritage site and/or artefacts.	Desk top study completed and discussions with traditional owners.  Design of DMMA H will avoid cultural heritage sites where practical.  Archaeological and ethnographic surveys have been undertaken for disturbance areas.  Approval under S 18 of the <i>Aboriginal Heritage Act 1972</i> has been obtained.  A CHMP has been developed that sets out the practices by which sites are avoided where practicable and managed if they cannot practicably be avoided.	3	1	Minor (3)
	Direct loss of European heritage site.	If necessary, a referral to the DEWHA will be submitted regarding the proposed disturbance.	3	0.3	Minor (0.9)

**REFERRAL DOCUMENT**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Footprint of DMMA H. Insufficient consultation with Indigenous groups with cultural values of the area of development.	Loss of cultural heritage values of the area and surrounds, i.e. harbour mythical values, tidal creek system. Reduced access to sites of heritage and cultural significance, including access to tidal creek fishing areas.	A CHMP has been developed that sets out the practices by which sites are avoided where practicable and managed if they cannot practicably be avoided. Representatives of the Kariyarra have been invited to participate in implementation of the CHMP.	3	1	Minor (3)

## 9.9 RECREATION AREAS

### 9.9.1 Overview

Dredging activities and disposal at DMMA H have the potential to impact recreational uses of these areas and the surrounding environment by the local community, including the Kariyarra people.

### 9.9.2 Objective

The EPA objective for recreation is 'to ensure that existing and planned recreational uses are not compromised'.

### 9.9.3 Guidance

The following guideline is applicable to recreation:

- Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives (DoE 2006b).

### 9.9.4 Potential Impacts

Potential impacts to recreation resulting from the project include:

- short-term restricted access and exclusion of boating and fishing activities within the harbour during dredging activities;
- long-term restricted access to DMMA H and surrounding areas; and
- reduced amenity of immediate surrounding environment for recreational uses.

A marine construction exclusion zone will be established during dredging operations to ensure activities can be undertaken in a safe manner with minimal interactions with other marine traffic within the harbour. The marine exclusion zone will be implemented in consultation with the PHPA.

Reduced amenity of the surrounding environment for recreational uses may result from the project if aspects such as excess water discharge, dust, noise, waste, hydrocarbons and hazardous materials are not appropriately managed and directly impact the surrounding environment. However, the management measures outlined for each of these aspects in the respective sections are expected to minimise potential impacts to the surrounding environment and subsequently recreation.

### 9.9.5 Management of Impacts

BHP Billiton Iron Ore is committed to ensuring that impacts on recreational activities are managed appropriately. BHP Billiton Iron Ore recognises the local community has a connection to the Inner and Outer Harbour through regular recreational activities, such as boating and fishing.

Prior to the establishment of a marine construction exclusion zone and the commencement of construction of DMMA H and dredging operations, BHP Billiton Iron Ore will inform the local community of the scheduling of these activities and of restrictions to the harbour. Scheduling of construction and dredging impacts will take into consideration potential impacts to the local recreational activities where practicable. Restricted access to the harbour area within the marine exclusion zone will be maintained for the duration of construction and dredging activities for public safety.

In recognition of the loss of access to DMMA H, BHP Billiton Iron Ore will work with the community to identify opportunities for maintaining and/or enhancing coastal access for recreational use. BHP Billiton Iron Ore will also continue to work with and support the Town of Port Hedland and Port Hedland Port Authority through the Community Partnership Program.

Appropriate management of aspects which may impact the surrounding environment and recreation, including excess water discharge, noise, dust, waste, hydrocarbons and hazardous materials, will be implemented through the DMP (**Appendix B3**), construction EMP (**Appendix B1**) and as detailed within the respective sections of the ERD for each of these factors. In particular, BHP Billiton Iron Ore will comply with Pilbara Coastal Water Environmental Quality Objectives (DoE 2006b) to ensure that marine water quality is maintained and is safe for recreational activities in and on the water, including swimming, boating and fishing.

### 9.9.6 Outcome

A summary of the key potential impacts relating to recreation, the associated management measures and the resulting residual risk is provided in **Table 9.10**.

**Table 9.10 – Summary of Potential Impacts Relating to Recreation and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Physical presence - Offshore dredge spoil disposal General dredge and vessel movements associated with construction.	Loss of access to recreational areas used for fishing (including Indigenous access) due to dredging and future shipping activities.  Reduced short-term and long-term access to recreational areas due to dredging (establishment of exclusion zone) and future increased shipping activities.  Inappropriate scheduling and management of dredging activities and exclusion zone.  Turbidity caused by dredging operations and spoil disposal.	BHPBIO will continue to work with and support the Town of Port Hedland and PHPA through the Community Partnership Program.  Community consultation and engagement, including informing local community of dredging timelines and exclusion zone.	3	0.3	Minor (0.9)

**REFERRAL DOCUMENT**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Physical presence - Onshore dredge spoil disposal Reclamation of DMMA H resulting in loss of public access to area. Permanent loss of access to recreational areas used for fishing and land based activities. Public access to dangerous or restricted areas.	Community complaints. Loss of local fishing ground. Loss of recreational area, amenity values and opportunities for local community for prolonged period of time.	Current community investment in recreational areas. Project footprint to consider community access. Community consultation and engagement, including informing local community of dredging timelines and exclusion zone. Fencing to restrict public access to unsuitable areas.			

## 9.10 VISUAL AMENITY

### 9.10.1 Overview

The proposed development has the potential to impact visual amenity values at receptor locations within the Port Hedland area, including residential areas, parks and recreational areas. However, given that the existing Port Hedland landscape is largely characterised by port infrastructure and operations, impacts to visual amenity values as a result of the proposed works are considered to be minor.

### 9.10.2 Objective

The environmental objective for visual amenity is to ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape to as low as reasonably practicable.

### 9.10.3 Guidance

Applicable standards and guidelines for the assessment and management of visual impacts include:

- Guidelines for Landscape and Visual Impact Assessment (LI & IEMA 2002);
- Visual Landscape Planning in Western Australia: a Manual for Evaluation, Assessment, Siting and Design (WAPC 2007); and
- Guidance on the New Approach to Appraisal (Department of the Environment, Transport and the Regions 1998)

### 9.10.4 Potential Impacts

The physical presence of DMMA H and the associated change to the landscape has the potential to affect the public visual amenity of the project area. The potential impact of topographic features has been assessed using a viewshed analysis from computer modelling (**Appendix A10**). GIS based viewshed analysis was undertaken of the proposed DMMA H in the context of the surrounding landform.

The most visual impacts are likely from the northern and peripheral parts of Wedgefield (an area zoned as light industrial) and from the water tower in Port Hedland (**Table 9.11**).

Photomontages of areas likely to have visual impacts are included in **Plate 9.1**.

Table 9.11 – Potential Visual Impacts

Receptor	Visual Conditions Incorporating DMMA H	Impact Rating
Port Hedland residential properties	Views from the town of Port Hedland will be blocked by obscuring vegetation and buildings.	No impact
South Hedland residential properties	Views from the town of South Hedland will be blocked by obscuring vegetation and buildings.	No impact
Water Tower lookout	From the water tower in Port Hedland sections of the DMMA H bund wall and some dredge material will be visible; however, these views will be from a distance of 5 km and will be viewed within the context of existing industrial developments and iron ore export facilities, thereby reducing the visual prominence of the proposed development.	Slight – moderate adverse
Red Bank Bridge lookout	Multi-story buildings and vegetation up to 10 m tall inhibit views in the direction of DMMA H. Partial views of the DMMA H bund walls will be possible.	Neutral
Wedgefield light industrial area	From northern and peripheral parts of Wedgefield, there will be clear views of the proposed DMMA H bund walls that will be adjacent to the boundary of the suburb. Views of DMMA H from residential areas will be obscured by buildings and vegetation within Wedgefield and existing BHPIO infrastructure at Nelson Point.	Moderate adverse
Great Northern Highway	From Great Northern Highway, transient and intermittent views of the DMMA H bund walls will be possible. Views from here will be obscured by existing vegetation along the highway and buildings and vegetation within Wedgefield.	Slight – adverse
Finucane Rd	Finucane Road is not heavily used by the general public.	No impact
Port Hedland Rd	For the majority of Port Hedland Road DMMA H will be obscured; however, at the section of the road between Great Northern Highway and Red Bank Bridge, the flat terrain and low-lying vegetation will facilitate views of the bund walls in the background.	Neutral – slight adverse

Plate 9.1 – Photomontage views of DMMA H



Left: from Wedgefield looking north, Right: from Great Northern Highway looking west

### 9.10.5 Management of Impacts

To minimise impacts to visual amenity from the construction of DMMA H, the appropriate design including configuration, land forming of bund walls and localised use of vegetative screening will be utilised where applicable. Large scale planting of native vegetation is not considered to be beneficial due to the low, sparse nature of native vegetation and would require a high degree of maintenance, including watering.

BHP Billiton Iron Ore will investigate possible re-use of the dredged material. In the event that the material is not utilised within a five year timeframe (following completion of dredging) the area will be rehabilitated in accordance with the long-term guiding principles outlined LMP (**Appendix B5**). In order to minimise potential impacts to visual amenity priority will be given to screening and revegetation of surfaces that are adjacent to sensitive receptors such as Wedgefield.

### 9.10.6 Outcome

Impacts to visual amenity values from the proposed development are expected to be minor as the development of DMMA H is consistent with the existing port and industrial landscape. Management measures will further reduce impacts to visual amenity values. **Table 9.12** summarises the impacts and management of visual amenity values, including the severity, likelihood and residual risk.

**Table 9.12 – Summary of Potential Impacts to Visual Amenity and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Development of +9.0 m AHD surrounding perimeter earth bunds at DMMA H.  Movement of dredge/support vessels.	Loss of visual amenity from sensitive receptor locations, including Wedgefield and Port Hedland.	Appropriate design including configuration and land forming of bund walls.  Implementation of the Land use Management Plan.  Investigate possible re-use of the dredged material. In the event that the material is not utilised within a five year timeframe the area will be rehabilitated.  Priority for screening and revegetation are the surfaces adjacent to the Wedgefield community.	1	3	Minor (3)

## 9.11 HYDROCARBONS AND HAZARDOUS WASTE

### 9.11.1 Overview

Hydrocarbons and hazardous wastes have the potential to impact the surrounding environment, including marine water quality, mangroves, and marine and terrestrial fauna, as a result of leaks, spills and incorrect storage and disposal of these materials. Appropriate management of dredging activities for the project, including dredging vessel operations and the construction and management of DMMA H, will reduce the risk of hydrocarbons and hazardous materials impacting the surrounding environment.

### 9.11.2 Objective

The environmental objective for hydrocarbons and hazardous wastes is to ensure hydrocarbons and any other hazardous wastes are handled and stored in a manner that minimises the potential for impact on the environment through leaks and spills.

### 9.11.3 Guidance

The following guidelines are applicable to hazardous waste:

- Guideline No. 1: Controlled Waste Generators March 2004 (DoE 2004c);
- Guideline No. 2: Controlled Waste Carriers March 2004 (DoE 2004d);
- Guideline No. 3: Controlled Waste Treatment or Disposal Sites March 2004 (DoE 2004e);
- User Guide No. 4: Controlled Waste Tracking System October 2007 (DEC 2007);
- User Guide No. 5: Paper Tracking Forms March 2004 (DoE 2004f); and
- Landfill Waste Classification and Waste Definitions 1996 (as amended) (DoE 2005).

#### 9.11.4 Potential Impacts

Diesel fuel, oil and grease will be handled on a regular basis during dredging and dredged material management activities. The handling of hydrocarbons creates a potential risk to the environment in the event that spillage occurs. These spills may lead to atmospheric, ground or water contamination generating damage to intertidal marine habitats and subsequent mortality of sensitive biota. Such spills also have the potential to disrupt recreation activities and generate reduced aesthetics.

The main areas of risk during dredging and dredged material management operations are:

- refuelling of the dredge (bunkering);
- storage and handling of oils, grease and chemicals;
- equipment failure such as burst hydraulic oil hoses; and
- breakdown of grease on moving parts such as the cutter ladder and spud carriage.

#### 9.11.5 Management of Impacts

The management of hydrocarbons and hazardous materials is addressed within the construction EMP (**Appendix B1**) and the DMP (**Appendix B3**).

Particular measures to manage hydrocarbons during the dredging activities include implementation of:

- appropriate storage and handling procedures;
- segregation of hydrocarbon waste from stormwater and other water via closed systems;
- environmentally acceptable recycling and/or disposal of captured waste. Oily wastes generated at site will be collected and disposed of in accordance with the Environmental Protection (Controlled Waste) Regulation, 2004. An approved contractor will be used for the removal of waste oil for recycling;
- spill contingency plans prepared to ensure appropriate measures are taken to manage:
  - refuelling of the dredge (bunkering);
  - storage and handling of oils, grease and chemicals; and
  - management of oil spills in accordance with the construction EMP (**Appendix B1**); and
- spill response kits will be located in close proximity to storage areas for prompt response in the event of a spill or leak.

The dredging and dredged material management activities will be managed in accordance with the above measures, including maintaining the requirements for all hazardous wastes to be removed from site.

#### 9.11.6 Outcome

A summary of the key potential impacts relating to hydrocarbons and hazardous wastes, the associated management measures and the resulting residual risk is provided in **Table 9.13**.

**Table 9.13 – Summary of Potential Impacts Relating to Hydrocarbons and Hazardous Wastes and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Machinery fuel/oil spills during construction phase.	Soil contamination	Environmental awareness training to incorporate spill response processes in construction and operations phases	1	0.1	Low (0.01)
Accidental release of hydrocarbons (major spills).	Toxic effects to marine fauna.	Implementation of the Dredge Management Plan and specific measures including: <ul style="list-style-type: none"> <li>• Appropriate storage of oil, grease, chemicals and detergents;</li> <li>• Development of spill contingency plans prior to commencement of works; and</li> <li>• Location of spill response kits in close proximity to dredging operations.</li> </ul>	3	0.03	Low (0.09)

## 9.12 SOLID AND LIQUID WASTE MANAGEMENT

### 9.12.1 Overview

Solid and liquid wastes generated during dredging activities and construction of DMMA H have the potential to negatively impact the surrounding environment if not managed and disposed of correctly.

Solid and liquid wastes that may be generated by the project include:

- packaging material (plastic wrapping, pallets, etc);
- concrete;
- scrap metal;
- recyclable materials (paper, cardboard, aluminium);
- general food packaging and scraps; and
- domestic sewage.

### 9.12.2 Objective

The environmental objective for solid and liquid waste is to ensure that wastes do not adversely affect health, welfare and amenity of people and land uses and is managed in accordance with waste hierarchy.

### 9.12.3 Guidance

The following guideline is applicable to solid and liquid waste management:

- Landfill Waste Classification and Waste Definitions 1996 (as amended) (DoE 2005).

### 9.12.4 Potential Impacts

If not handled correctly, domestic and hazardous solid waste and sewage produced during the dredging activities have the potential to contaminate marine, ground and surface waters, impact upon marine fauna and pose a risk to human health. Furthermore, unnecessary wastes result in increased landfill requirements.

### 9.12.5 Management of Impacts

Waste management is addressed within the construction EMP (**Appendix B1**). Particular measures to reduce waste generation include:

- a waste hierarchy program;
- clear signage and coverage of wastes;
- collection of domestic rubbish in bins and recycled or disposed of by a licensed contractor at the municipal landfill;
- storage of recyclable materials in a designated area until their removal from site;
- return of empty oil and chemical containers such as metal or plastic drums to the supplier for reuse or recycling where possible; and
- the use of absorbent material to mop up minor oil or chemical spills and disposed of appropriately as contaminated material.

BHP Billiton Iron Ore will ensure that the generation of waste is minimised and that any waste products are handled and disposed of in an acceptable manner.

During dredging operations, no sewage from dredging or support vessels will be disposed to the marine environment while operating in the port. Sewage from the vessels will either be discharged outside of Western Australia Coastal Waters (>12 nm) in accordance with the MARPOL Convention 1973/1978 and the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*, or will be transferred and disposed of at onshore facilities.

There will be no discharge of materials, including liquid or solid wastes, into the marine environment unless approved. Any equipment or items that accidentally enter marine waters will be recovered as soon as practicable.

### 9.12.6 Outcome

A summary of the key potential impacts relating to solid and liquid wastes, the associated management measures and the resulting residual risk is provided in **Table 9.14**.

**Table 9.14 – Summary of Potential Impacts Relating to Solid and Liquid Wastes and the Associated Management Measures, Severity, Likelihood and Residual Risk**

Causes	Impacts	Management Measures	Residual Risk		
			S	L	RRR
Incorrect disposal of solid and liquid waste.	Impacts to the surrounding environment, health, welfare and amenity of people and land uses as a result of incorrect management and disposal of solid and liquid waste.	Recycling program in place. Clear signage of bins. Segregation of waste types. Coverage of waste materials. Reporting of waste removed from site. Develop waste management strategies in accordance with BHP Billiton Iron Ore's standard operating procedures.	3	0.03	Low (0.09)