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Section 9

# Terrestrial Impacts and Management

# 9 Terrestrial Impacts and Management

This chapter provides an assessment of the impact that the construction and operation of the proposed Outer Harbour Development Port Hedland will have on the terrestrial environment. The landside components of the Outer Harbour Development include:

- rail connections and spur from the existing BHP Billiton Iron Ore Newman and Goldsworthy mainlines to proposed stockyards at Boodarie;
- rail loops at Boodarie;
- stockyards and associated infrastructure at Boodarie (e.g. car dumpers, stackers, reclaimers and lump rescreening plant);
- an infrastructure corridor (including conveyors, access roadway and utilities) from the stockyards to the proposed marine jetty; and
- a transfer station on Finucane Island.

The disturbance envelope for landside infrastructure and construction activities for the proposed Outer Harbour Development is approximately 4,270 ha, and has been developed to allow for flexibility in locating the infrastructure during detailed design. The disturbance envelope encompasses partially disturbed land and includes existing infrastructure and decommissioned facilities such as BHP Billiton Iron Ore's decommissioned HBI Plant at Boodarie. The areas to be cleared within this disturbance envelope for permanent infrastructure and construction related activities/facilities are smaller. The total area of permanent clearing for the infrastructure footprint is approximately 940 ha.

Operational activities pertinent to the terrestrial environment include:

- noise, light and dust emissions from ore handling activities and infrastructure;
- vehicle and equipment movements;
- storage and transport of chemicals, fuels or other hazardous material; and
- water for dust suppression activities.

Further descriptions of the proposed infrastructure and subsequent operations can be found in **Section 2, Section 8**. The proposed infrastructure has been located to:

- minimise footprint in the floodplain;
- minimise disturbance to vegetation through utilising existing disturbed areas; and
- minimise disturbance to fauna movement by placement adjacent to existing infrastructure where appropriate.

Further detail on project alternatives can be found in **Section 3**.

The impact assessment considers the management objectives for each environmental factor at risk; design, mitigation and management measures proposed to reduce impacts; an evaluation of the significance of the residual impacts in light of the management approach; and the environmental outcomes arising from each of the project aspects evaluated.

**Table 9.1** outlines the terrestrial environmental factors and aspects identified as being relevant to the assessment. A detailed assessment has been conducted for each of the key terrestrial factors. Although relevant to the assessment, short-range endemic fauna, subterranean fauna, surface water and groundwater were determined as not requiring detailed assessment or management measures beyond standard practice (Construction Environmental Management Plan). As such, only a brief description of the potential impacts and proposed management measures are presented for these factors.

**Table 9.1 – Terrestrial Environmental Factors and Aspects**

| Factors | Section | Aspects* |
|---|---|---|
| Key Factor – Terrestrial flora and vegetation | 9.1 | Direct loss of vegetation/habitat(c)<br>Degradation in health of vegetation/habitat (c)<br>Introduction or spread of weeds (c, o)<br>Physical presence (c, o)<br>Physical interaction (c, o)<br>Liquid and solid waste disposal (c, o)<br>Leaks and spills (c, o) |
| Key Factor – Terrestrial fauna | 9.2 | |
| Key Factor – Geology, soils and landforms | 9.3 | |
| Relevant Factor – Short-range endemic fauna | 9.4 | |
| Relevant Factor – Subterranean fauna | 9.5 | |
| Relevant Factor – Surface water | 9.6 | |
| Relevant Factor – Groundwater | 9.7 | |

** c = construction; o = operation*

A terrestrial ecological impact comprises a disturbance (for example, a cyclone) and a biological response (for example, habitat damage or loss). Terrestrial biological responses to natural and anthropogenic disturbances are expected to be common in the Port Hedland area, since this region experiences the effects of tropical cyclones and has been impacted by other large port developments. The potential background influence of these natural and pre-existing anthropogenic disturbances is the context against which potential terrestrial impacts arising from the Outer Harbour Development have been assessed. The ecological significance was assessed by evaluating:

- spatial scales of the impact;
- magnitude or intensity of the impact;
- temporal scales of the impact; and
- the significance of the Outer Harbour Development impact relative to natural impacts and existing levels of disturbance.

The EPBC Act defines a significant impact to Matters of National Environmental Significance as an action where there is a real chance or possibility that it will lead to a long-term decrease in the size of a population and/or reduce the area of occupancy of the organism. In terms of a habitat, a significant impact would be defined by the amount of habitat damaged or how long it would take to recover.

## 9.1 Key Factor – Terrestrial Flora and Vegetation

This section presents the assessment of impacts on terrestrial flora and vegetation associated with the proposed Outer Harbour Development, incorporating design modifications, mitigation and management measures applied to manage predicted impacts.

Potential impacts to vegetation communities located above the high tide mark associated with the project, are discussed in this section. Intertidal areas, such as mangroves and samphires, are specifically dealt with in **Section 10.**

### 9.1.1 Management Objective

The management objectives for terrestrial flora and vegetation are:

- to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge, and to protect Declared Rare Flora and Priority Flora, consistent with the provisions of the WC Act; and
- meet statutory requirements and acceptable standards.

### 9.1.2 Description of Factor

A description of the existing terrestrial flora and vegetation of the terrestrial study area, based on surveys undertaken by ENV in October 2007, May 2008 and October 2008 (ENV 2009a, 2009b, 2009c) is provided in **Section 5**. Key findings relevant to the terrestrial environment include:

- no Endangered or Vulnerable species under the EPBC Act, or Declared Rare Flora species under the WC Act were recorded;
- a search of the EPBC Act database list of threatened species and ecological communities did not identify any listed flora or vegetation;
- ten Priority Flora species are listed as potentially occurring in the study area;
- five Priority Flora species were recorded within the study area including *Tephrosia rosea* var. *venulosa* (Priority 1), *Heliotropium muticum* (Priority 1), *Pterocaulon* sp. A Kimberley Flora (B.J. Carter 599) (Priority 2), *Goodenia nuda* (Priority 4) and *Gymnanthera cunninghamii* (Priority 3);
- four Priority Flora species were recorded within the disturbance envelope, including *Heliotropium muticum* (Priority 1), *Tephrosia rosea* var. *venulosa* (Priority 1), *Pterocaulon* sp. A Kimberley Flora (B.J. Carter 599) (Priority 2) and *Goodenia nuda* (Priority 4);
- one vegetation community associated with South West Creek contains low numbers of *Melaleuca argentea,* a phreatophyte (dependant on groundwater for water uptake);
- eight vegetation communities contain *Eucalyptus victrix*, which is a vadophyte (dependant on saturated layer above groundwater for water uptake);
- no Threatened Ecological Communities were identified as occurring; and
- ten introduced species were recorded, none of which were Declared Plants under the *Agriculture and Related Resources Protection Act 1976* (ARR Act).

### 9.1.3 Assessment Guidance

Guidance on the assessment of impacts to terrestrial flora and vegetation exists at a State and Commonwealth government level. A summary of the assessment guidance documents relating to flora and vegetation considered in this impact assessment is provided in **Table 9.2**.

**Table 9.2 – Guidance Specific to Terrestrial Flora and Vegetation**

| Document | Description |
|---|---|
| National Strategy for the Conservation of Australia's Biological Diversity | Recognises that international activities affect Australia's biodiversity and that central to conservation of biodiversity is the establishment of viable protected areas. |
| National Strategy for Ecologically Sustainable Development | Provides broad strategic directions and framework for governments to direct policy and decision-making. |
| *Wildlife Conservation Act 1950* | The Act provides for taxa (species, subspecies and varieties) of native flora to be specially protected because they are under identifiable threat of extinction, are rare, or otherwise in need of special protection. |
| EPA Position Statement No. 2: Environmental Protection of Native Vegetation in Western Australia (EPA 2000) | Provides an overview of the EPA position on the clearing of native vegetation in WA. |
| EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) | Discusses the principles the EPA would apply when assessing proposals that may have an effect on biodiversity values in WA. |
| EPA Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004a) | Provides guidance on the standard of survey required to assist in collecting the appropriate data for decision-making associated with the protection of WA's terrestrial flora and vegetation and their ecosystems. |

### 9.1.4 Potential Impacts

Potential impacts on terrestrial flora and vegetation resulting from environmental aspects associated with the Outer Harbour Development are discussed below and summarised in **Table 9.3**. The key environmental aspect that impacts flora and vegetation is the proposed clearing and earthworks.

#### Direct Loss of Vegetation

Clearing and earthworks are required as part of site preparation activities for the project. A total area of approximately 940 ha is proposed to be cleared for the construction of the Outer Harbour Development.

Clearing will result in the direct loss of terrestrial vegetation communities, primarily those associated with sandplains, drainage lines, dunal systems, limestone hills and quartz outcrops. None of the vegetation communities to be impacted are considered to be of conservation significance as they are not Threatened Ecological Communities or Priority Ecological Communities; furthermore they are well represented in the local area and Pilbara region (ENV 2009a, 2009b).

The area of vegetation communities that could be impacted (i.e. within the disturbance envelope) is generally relatively small compared with the occurrence of vegetation communities mapped outside of the disturbance envelope during flora and vegetation baseline surveys (ENV 2009a, 2009b). The quartz outcrop, although an uncommon landform in the area, does not support unique or rare vegetation.

#### Direct Loss of Vegetation of Conservation Significance

The proposed clearing will not impact on terrestrial vegetation communities of conservation significance, such as those with restricted distributions or communities that represent Threatened Ecological Communities or Priority Ecological Communities, as no such communities have been identified within the disturbance envelope (ENV 2009a, 2009b) (**Figure 5.13**).

#### Direct Loss of Vegetation Outside of the Disturbance Envelope

Direct loss of vegetation outside of the disturbance envelope may result from fire originating from hot work activities, overheating of vehicles and machinery or personnel smoking on-site. Direct loss of vegetation outside of the disturbance envelope may also result from accidental clearing. The implementation of the Construction Environmental Management Plan will reduce the likelihood of this occurring.

#### Direct Loss of Flora of Conservation Significance

Clearing has the potential to cause a direct impact to four Priority Flora species that were recorded within the disturbance envelope (**Figure 5.14**):

- *Heliotropium muticum* (Priority 1): Three locations, each comprising ten or fewer individual plants, were recorded within the disturbance envelope surrounding the east-west alignment of the Western Spur Railway. This species has been recorded at five other locations outside of the disturbance envelope and therefore the proposed loss through clearing is not likely to reduce the local representation of this species.

- *Tephrosia rosea* var. *venulosa* (Priority 1): This species has been recorded in high numbers (collectively as many as 530 individuals) within the footprint for the proposed transfer station on Finucane Island, the infrastructure corridor, the proposed rail loop and within the proposed rail connection to the existing Goldsworthy Railway. This species has been recorded at four locations outside of the disturbance envelope and has also been recorded in significant numbers (greater than 300 individuals) at Lumsden Point (ENV 2009d) and along sections of the existing Goldsworthy Railway (ENV 2009b, 2009c). Clearing is not likely to reduce the local representation of *Tephrosia rosea* var. *venulosa* as this species has been recorded in abundance elsewhere and is likely to occur within the Port Hedland surrounds, as it appears to favour disturbed areas (ENV 2009a).
- *Pterocaulon* sp. A Kimberley Flora (Priority 2): One individual of this species was recorded within the disturbance envelope associated with the rail loop. This species was also recorded outside of the disturbance envelope, to the east of the stockyards and has also been previously recorded at Lumsden Point (ENV 2009d). Clearing of *Pterocaulon* sp. A Kimberley Flora may reduce the local representation of this species as only a few locations have been recorded to date (ENV 2009a, 2009c). The presence of *Pterocaulon* sp. A Kimberley Flora in the Port Hedland area represents a range extension as this species was previously only recorded within the Kimberley area.
- *Goodenia nuda* (Priority 4): Fifty plants of this species were recorded in the proposed stockyards and rail loop infrastructure footprint and 170 plants were recorded within the disturbance envelope surrounding the east-west alignment of the Western Spur Railway. This species was recorded at one other location outside of the disturbance envelope during the targeted survey. Based on the available records, *Goodenia nuda* has a distribution in the Pilbara covering approximately 175,000 square kilometres. The Port Hedland population sits at the edge of this species range, which likely extends along the Pilbara coast between Shay Gap and Dampier/Onslow. Clearing of *Goodenia nuda* may reduce the local representation of this species as only a few locations have been recorded to date (ENV 2009a, 2009c). The presence of *Goodenia nuda* in the Port Hedland area represents a range extension as this species was previously recorded from inland areas such as Newman.

**Degradation of Vegetation**

Degradation to vegetation and the potential deterioration of vegetation health may occur in the following ways:

- unrestricted access of vehicle or machinery during clearing and earthworks may result in physical damage to vegetation;
- dust has the potential to degrade vegetation due to smothering (this may affect transpiration and photosynthesis). Dust may result from the removal of vegetation and disturbance to the topsoil during construction activities, through vehicle movements on unsealed roads and wind dispersion of stockpile material within the stockyards;
- the physical presence of infrastructure, and diversion of surface water, may alter hydrological regimes and potentially degrade vegetation due to drainage shadow effects or localised flooding. Drainage shadow effects are unlikely to eventuate as the vegetation in the Port Hedland area is generally drought resistant. Water logging may however cause deterioration in plant health; and
- leaks, spills or the incorrect disposal of chemicals, hydrocarbons or wastes has the potential to cause deterioration in plant health due to toxic effects.

**Introduction and Spread of Weeds**

Activities including vegetation clearing, topsoil disturbance (earthworks), the movement of machinery and light vehicles and the importation of fill may promote the dispersion of weeds directly or via their propagules. Whilst none of the ten introduced species recorded during baseline flora and vegetation surveys (ENV 2009a) are Declared Plants listed under the ARRP Act, **Cenchrus ciliaris* (Buffel Grass) and **Aerva javanica* (Kapok) are considered to be serious environmental weeds under the DEC's Environmental Weed Strategy (Conservation and Land Management 1999). Native flora and vegetation within the terrestrial study area may be indirectly impacted by the introduction and spread of weeds through increased rates of competition for light, nutrients, water and space, which may ultimately reduce biodiversity.

**Degradation or Loss of Phreatophytes or Vadophytes**

Groundwater dewatering during the construction of the car dumpers and conveyor tunnels has the potential to cause the deterioration in health of phreatophytes or vadophytes within vegetation communities associated with South West Creek. The phreatophyte *Melaleuca argentea* that is present within the vegetation community associated with South West Creek is highly unlikely to be affected by aquifer drawdown. This vegetation community is located at least 1 km from dewatering and aquifer drawdown is unlikely to eventuate, and is unlikely to impact the water table. Similarly, the vadophyte *Eucalyptus victrix* that is present within vegetation communities associated with South West Creek is unlikely to be impacted by dewatering activities. Groundwater levels in the Port Hedland area have been shown to vary seasonally by up to 2 m (BHP Billiton Iron Ore 2008a) so it is likely that *M. argentea* and *E. victrix* are adapted to short-term variation in groundwater levels.

Groundwater abstracted from shallow bores for use in dust suppression during construction of the Western Spur Railway has the potential to cause deterioration in the health of *E. victrix* within several vegetation communities. Groundwater abstraction will be a short-term activity and if aquifer drawdown does occur it is likely to recover following completion of construction activities. A hydrogeological assessment will be undertaken prior to construction of the railway to ensure groundwater abstraction will be undertaken at rates to sustain local aquifers.

### 9.1.5 Matters of National Environmental Significance

There are no matters of NES directly associated with terrestrial flora and vegetation.

### 9.1.6 Management Measures

The proposed measures applicable to the management of impacts on flora and vegetation arising from the construction and operation of the Outer Harbour Development are summarised in **Table 9.3**.

A Construction Environmental Management Plan (CEMP) will provide a framework for the environmental management of the terrestrial construction activities associated with the Outer Harbour Development (**Section 12.2**). The plan will include detailed strategies, procedures and work practices, to avoid, mitigate or minimise impacts resulting from construction tasks or actions. Key management measures proposed include (but are not limited to):

- no clearing or disturbance outside of the approved disturbance envelope;
- where practicable construction laydown areas will be located in previously disturbed areas and will be rehabilitated or used for other purposes following completion of construction activities, if not required for other purposes, to minimise loss of vegetation;
- dust control measures will be implemented such as regular watering of unsealed roads, exposed surfaces and active construction areas, and progressive rehabilitation of disturbed areas, which are no longer required;
- fill will be acquired from weed-free sources;
- BHP Billiton Iron Ore will develop and implement a Weed Management Program in consultation with DEC; and
- vehicle and equipment access will be restricted to designated access roads where possible.

A Significant Species Management Plan will be implemented to facilitate the management of significant flora species recorded or potentially occurring within the disturbance envelope (**Appendix A6**). The Significant Species Management Plan contains "general" management practices (refer **Table 9.3**) to be implemented to minimise the impact of construction activities on flora, as well as the "specific" management measures for species of conservation significance.

BHP Billiton Iron Ore is undertaking additional flora and vegetation surveys in 2011 around the Port Hedland region, including the project's disturbance envelope. The results from this survey work will be included in the Final PER/EIS, and Response to Submissions, and will also inform the Significant Species Management Plan. The survey results, specifically priority flora, will be considered in the detailed engineering design of the project to minimise potential impacts to significant species.

### 9.1.7 Significance of Residual Impact

Two residual impacts on flora and vegetation are categorised as having a medium level of significance as they involve large scale and or permanent effects. Loss of vegetation communities is one such impact as the area to be permanently cleared and the resulting direct loss of vegetation communities is approximately 940 ha. The clearing of the vegetation communities is not expected to reduce their local or regional representation as the areas proposed to be cleared are small relative to their distribution outside of the proposed disturbance envelope. The direct loss of Priority Flora through clearing is another impact associated with medium level of residual significance as it may compromise the local representation of Priority Flora, in particular *Pterocaulon* sp. A Kimberley Flora and *Goodenia nuda*.

All remaining impacts on flora and vegetation are considered to be of a low significance as they may be avoided through the implementation of the proposed management measures or involve localised or short-term impacts.

### 9.1.8 Predicted Environmental Outcome

Vegetation removal will be confined to the approved disturbance envelope.

The predicted environmental outcomes for flora and vegetation as a result of the proposed Outer Harbour Development are:

- direct disturbance of up to 940 ha;
- direct loss of four Priority Flora species *Heliotropium muticum* (Priority 1), *Tephrosia rosea* var. *venulosa* (Priority 1), *Pterocaulon* sp. A Kimberley Flora (Priority 2), and *Goodenia nuda* (Priority 4); and
- impacts to groundwater dependent vegetation are unlikely due to their distance from de-watering activities, and groundwater abstraction will be a short-term activity and if aquifer drawdown does occur it is likely to recover following completion of construction activities.

The EPBC Act objective to "provide for the protection of the environment, especially those aspects of the environment that are Matters of National Environmental Significance" can be met as no EPBC Act listed flora or vegetation were recorded at the Proposal area.

The EPA's stated objective of maintaining the abundance, diversity, geographic distribution and productivity of flora species and ecosystem levels will be achieved through project design to minimise clearing, rehabilitating disturbed areas where practicable and managing potential construction and operational impacts in accordance with the Significant Species Management Plan (**Appendix A6**).

This objective has also been met through the knowledge of the abundance, diversity and geographic distribution of terrestrial flora and vegetation in the Port Hedland area that has been generated through the surveys conducted as part of this assessment.

**Table 9.3 – Summary of Potential Impacts and Management Measures associated with Terrestrial Flora and Vegetation**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Clearing and earthworks | Construction of terrestrial facilities (transfer station, infrastructure corridor, stockyards, rail loop and rail spur). | Direct loss of vegetation communities due to clearing. | *Avoidance/Mitigation/Management Measures:*<br>► Clearing will be minimised as far as practicable through engineering design.<br>► Planned clearing boundaries will be adjusted where practicable, to avoid clearing of Priority Flora.<br>► Unnecessary disturbance to vegetation or Priority Flora will be minimised through:<br>• clearly demarcating proposed areas to be cleared on construction plans;<br>• surveying and pegging of proposed areas to be cleared, including any nearby locations of Priority Flora;<br>• tracking of clearing and ground disturbance activities using relevant databases; and<br>• restricting vehicle and equipment movements to within project footprint and designated areas.<br>► Construction laydown will be located in previously disturbed areas where practicable and rehabilitated post completion of construction activities, unless required for other purposes.<br>► Regional flora survey inclusive of Port Hedland and the project disturbance envelope undertaken in Autumn 2011, following significant rainfall events.<br>► Existing Priority Flora, significant vegetation types and weed infested areas are to be mapped on relevant databases and access to such areas is to be managed in accordance with BHP Billiton's Iron Ore's Project Environmental Aboriginal Heritage Review (PEAHR) process. These records will be updated as necessary and awareness of these records will be promoted at port planning and operational levels.<br>► Workforce awareness of local flora/fauna species of interest and conservation issues will be raised through a site Environmental Awareness Program including the following:<br>• protection of significant flora and vegetation;<br>• restriction of activities to within approved clearing boundaries;<br>• identification and reporting of weeds;<br>• hot work permit requirements and fire safety; and<br>• hygiene procedures to minimise the introduction and spread of weeds.<br>► Fill required will be acquired from weed-free sources.<br>► All ground engaging and tracked mobile machinery and equipment will be cleaned and inspected for weeds prior to access to the site and issued with a weed hygiene certificate.<br>► A weed management program, developed in consultation with DEC, will be implemented to prevent further spread of weeds. Key measures incorporated into the program include (but are not limited to):<br>• provide facilities for cleaning equipment;<br>• complete and submit a weed hygiene certificate;<br>• dispose material containing weed seeds must be disposed of on advice of Environmental personnel;<br>• identify, record, monitor and notify all contractors of weed risk areas; and<br>• conduct weed control in accordance with the priority determined for each species. |
| | | Direct loss of vegetation of conservation significance. | |
| | | Direct loss of vegetation communities outside of disturbance envelope due to accidental clearing. | |
| | | Disturbance or direct loss of flora of conservation significance (e.g. Priority Flora) due to clearing. | |
| | | Degradation to vegetation due to unrestricted vehicle access. | |
| | Vehicle movements and importation of fill. | Introduction or the spread of weeds resulting in a loss of biodiversity. | |

**Table 9.3 – Summary of Potential Impacts and Management Measures associated with Terrestrial Flora and Vegetation (continued)**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| | | | *Monitoring:*<br>► Regular inspections will be undertaken to ensure that vegetation is being cleared and stockpiled in the appropriate locations, no unnecessary Priority Flora have been impacted and that the relevant databases are updated.<br>► Regular inspections of disturbance areas within the Outer Harbour Development will be undertaken to monitor for the presence of new weed infestation areas or new weed species.<br>*Contingency Measures:*<br>► Topsoil will be stockpiled from cleared areas, including those known to contain Priority Flora, and reused where possible. |
| Fire | Vehicle exhaust and construction and operation of facilities. | Direct loss of vegetation outside of disturbance envelope due to fire caused by construction activities. | *Avoidance/Mitigation/Management Measures:*<br>► Fire hazard awareness and management training will be provided as required to BHP Billiton Iron Ore personnel and contractors, which will include emergency response procedures.<br>► Vehicle and equipment access will be restricted to designated access roads where possible.<br>► Fire fighting equipment will be provided in work areas according to fire hazard, and regularly inspected and maintained.<br>► Spark shields will be used where appropriate.<br>► Fire restrictions will be in place, including hotwork activities in designated areas only.<br>*Contingency Measures:*<br>► Fire-fighting equipment (which will be regularly inspected and maintained) will be provided in work areas according to fire hazard. |
| Particulate emissions | Construction and operation of facilities. | Degradation of vegetation due to smothering of foliage from particulate emissions during construction. | *Avoidance/Mitigation/Management Measures:*<br>► Dust control measures such as regular watering of unsealed roads, exposed surfaces and active construction areas, and progressive rehabilitation of disturbed areas, which are no longer required, will be used to minimise dust generation.<br>► Employees will be made aware of the need to minimise dust generation through a site Environmental Awareness Program.<br>► Vehicle movements and vehicle speeds will be restricted to reduce dust emission. |
| Physical presence | Permanent terrestrial facilities (stockyards, infrastructure corridor, transfer station and rail). | Degradation of vegetation due to drainage shadow effects or localised flooding. | *Avoidance/Mitigation/Management Measures:*<br>► Design of infrastructure will minimise impacts to surface water flows.<br>► Culverts of appropriate capacity will be installed under road and rail infrastructure at creek crossings.<br>► "Environmental culverts" based on hydrological and engineering design will be installed where roads or the infrastructure crosses areas of sheetflow. |
| Groundwater abstraction and dewatering | Construction of the Western Spur Railway and car dumpers. | Degradation of groundwater dependant vegetation communities through aquifer drawdown. | *Avoidance/Mitigation/Management Measures:*<br>► Groundwater abstraction will be undertaken in accordance with the agreed Department of Water (DoW) Licence.<br>► Abstracted groundwater will be re-used or recycled for dust suppression where possible.<br>*Monitoring:*<br>► Groundwater monitoring will be undertaken in compliance with the DoW and DEC requirements, during dewatering to ensure drawdown levels are maintained. |

**Table 9.3 – Summary of Potential Impacts and Management Measures associated with Terrestrial Flora and Vegetation (continued)**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Spills and leaks | | Degradation of vegetation due to soil or surface water pollution. | *Avoidance/Mitigation/Management Measures:*<br>► Hydrocarbons and chemicals will be appropriately stored to minimise potential for contamination.<br>► Hydrocarbon waste will be segregated from stormwater and other water via closed systems.<br>*Contingency Measures:*<br>► Spill contingency plans will be prepared to ensure appropriate measures are taken to manage refuelling, storage and spill management.<br>► Spill response kits will be located in close proximity to work fronts. |
| Solid and liquid waste disposal | Incorrect disposal of wastes. | Degradation of vegetation due to soil pollution or surface water pollution. | *Avoidance/Mitigation/Management Measures:*<br>► Potentially hazardous solid and liquid wastes will be stored within enclosed containers.<br>► Domestic rubbish will be frequently collected from bins and removed to the municipal landfill.<br>► Controlled wastes as defined by the *Environmental Protection (Controlled Wastes) Regulations 2004*, will be properly removed from sites.<br>► On site solid waste disposal will be minimised and properly managed.<br>► Containers will be reuse or recycled where possible. |

## 9.2 Key Factor – Terrestrial Fauna

This section presents the assessment of impacts on terrestrial fauna communities located above the high tide mark associated with the Outer Harbour Development, incorporating design modifications, mitigation and management measures applied to manage the potential impacts. Intertidal areas, such as mangroves and samphires, are specifically dealt with in **Section 10**.

### 9.2.1 Management Objective

The management objectives that will be applied to the environmental factor of terrestrial fauna are to:

- maintain the abundance, diversity, geographic distribution and productivity of fauna species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge;
- provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance; and
- meet statutory requirements and acceptable standards.

### 9.2.2 Description of Factor

The baseline characteristics of the existing terrestrial fauna of the terrestrial study area, based on surveys undertaken by ENV in October and November 2008, are presented in **Section 5**. Key findings relevant to the terrestrial environment include:

- dunal, riverine and sandplain habitats are present in the study area;
- riverine and dunal habitats are considered to be of conservation significance;
- one species, *Aspidites ramsayi* (Woma Python), listed as Schedule 4 under the WC Act and as Priority 1 by the DEC, was recorded in the sandplain habitat outside of the disturbance envelope;
- one additional Priority listed species was recorded in the project area, the Priority 4 listed *Ardeotis australis* (Australian Bustard);
- one bird species, *Merops ornatus* (Rainbow Bee-eater), that is listed as a Migratory species under the EPBC Act was recorded within the project area;
- a further nine Schedule or Priority fauna species are likely to occur within the study area including *Dasycercus blythii* (Brush-tailed Mulgara) (Vulnerable, Schedule 1, Priority 4), *Rhinonicteris aurantia* (Pilbara Leaf-nosed Bat) (Vulnerable, Schedule 1), *Falco peregrines* (Peregrine Falcon) (Schedule 4), *Ramphotyphlops ganei* (Blind Snake) (Priority 1) *Leggadina lakedownensis* (Lakeland Downs Mouse) (Priority 4), *Macroderma gigas* (Ghost Bat) (Priority 4), *Falco hypoleucos* (Grey Falcon) (Priority 4), *Burhinus grallarius* (Bush Stone-curlew) (Priority 4) and *Neochmia ruficauda clarescens* (Star Finch) (Priority 4); and
- Matters of National Environmental Significance that are relevant to the terrestrial environment include fauna listed under the EPBC Act which occur within the study area, such as the migratory species *Merops ornatus* (Rainbow Bee-eater), or those that are likely to occur such as the Vulnerable listed *Dasycercus blythii* (Brush-tailed Mulgara) and *Rhinonicteris aurantia* (Pilbara Leaf-nosed Bat).

**Table 9.4 – Legislation and Guidance Documents Specific to Terrestrial Fauna**

| Document | Description |
|---|---|
| *Environment Protection and Biodiversity Conservation Act 1999* | The Act focuses on the protection of Matters of National Environmental Significance, with the states and territories having responsibility for matters of state and local significance. Threatened terrestrial fauna may be listed under the EPBC Act in any one of the following categories: critically endangered, endangered, vulnerable, conservation dependant or migratory. |
| *Wildlife Conservation Act 1950* | The Act provides for taxa (species, subspecies and varieties) of native fauna to be specially protected because they are under identifiable threat of extinction, are rare, or have high conservation value. |
| EPA Position Statement No.2: Environmental Protection of Native Vegetation in Western Australia (EPA 2000) | Provides an overview of the EPA position on the clearing of native vegetation in WA. |
| EPA Position Statement No.3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) | Discusses the principles the EPA would apply when assessing proposals that may have an effect on biodiversity values in WA. |
| EPA Guidance Statement No.56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004b). | Provides guidance on the standard of survey required to assist in collecting appropriate data for decision-making associated with the protection of WA's terrestrial faunal biodiversity and its habitat. |

### 9.2.3 Assessment Guidance

Guidance on the assessment of impacts to terrestrial fauna exists at a State and Commonwealth government level. A summary of the assessment guidance documents relating to fauna considered in this impact assessment is provided in **Table 9.4**.

### 9.2.4 Potential Impacts

Potential impacts on terrestrial fauna species and habitats resulting from environmental aspects associated with the Outer Harbour Development are discussed below and summarised in **Table 9.5**. The key aspect that impacts fauna and fauna habitats is the clearing and earthworks activities associated with construction.

#### Direct Loss of General Habitat

Clearing and earthworks are required as part of site preparation activities for the project. A total area of approximately 940 ha of fauna habitat is proposed to be cleared for the construction of the Outer Harbour Development, within a disturbance envelope of 4,270 ha.

The proportion of loss of Littoral, River and Uaroo land system habitats is negligible at regional scales. This is a function of both their large extent in the Pilbara Bioregion and the relatively small areas of clearing required for the project. The largest impact on a land system type in regional terms is for the habitats of the Littoral land system (Bare coastal mudflats with mangroves on seaward fringes, samphire flats, sandy islands, coastal dunes and beaches). The clearing associated with the project is less than 0.1% the total extent of this land system within the region (**Section 5.3**).

Habitat loss has also been considered at a local scale using habitat mapping based on vegetation and flora mapping, described in **Section 5.5** (refer **Appendices B14, B15 and B16**).

At the level of broad fauna habitat type, as defined in the fauna survey (**Section 5.5**) and broadly based on vegetation community mapping (**Figure 5.13**), six fauna habitat types occur within the disturbance envelope, all of which will be disturbed to some extent. All of the habitats occur more broadly within the immediate vicinity of the disturbance envelope.

The majority of the disturbance envelope affects the sandplain habitat. Clearing associated with the construction of the proposed rail spur, rail loop and stockyards will result in the direct loss of sandplain habitat. This habitat type is not of conservation significance value, as it is well represented outside the disturbance envelope. As the project will not affect the broad representation of the sandplain habitat in the region and it is unlikely there will be significant reduction in fauna resources through clearing of this habitat. The sandplain habitat occurs in all the Uaroo and Littoral Land System Units (**Section 5.3**), and is well represented in the region and will not be significantly affected by the proposed clearing.

Clearing associated with the construction of the proposed conveyor corridor and transfer pad on Finucane Island will impact upon the Mangroves, Tidal Flats, and Dunal systems within the disturbance envelope and construction of the rail spur will impact on localised areas of riverine habitat. With exception of mangroves, these habitats are generally well-represented in the local Port Hedland area outside of the disturbance envelope. It is unlikely there will be significant reduction in fauna resources through clearing of these habitats. The Mangrove habitat impacts are discussed in more detail in **Section 10**, under the marine environment.

Fauna of conservation significance were recorded within the sandplain habitat during fauna baseline surveys (ENV 2009g, 2009f) such as the Woma Python (*Aspidites ramsayi*) (Schedule 4, Priority 1), Australian Bustard (*Ardeotis australis*) (Priority 4) and Rainbow Bee-eater (*Merops ornatus*) (Migratory – EPBC Act.) These fauna species and fauna in general, are unlikely to be specifically reliant on the sandplain habitat within the disturbance envelope given the local distribution of this habitat and as such, it is unlikely there will be significant reduction in fauna resources through clearing of this habitat.

Clearing will also result in the loss of a quartz outcrop, which is an uncommon landform in the local area. This outcrop is not considered likely to support a unique fauna assemblage and similar formations are also found outside of the disturbance envelope.

#### Direct Loss of Habitat of Conservation Significance

Vegetation clearing will impact two habitat types: dunal systems and riverine areas, considered to be of conservation significance (ENV 2009c, 2009d) (**Figure 5.15**). Clearing associated with the proposed transfer station on Finucane Island will impact the dunal habitat. Clearing associated with the proposed rail loop and Western Spur Railway will impact the riverine habitat. Dunal systems are considered to be of conservation importance as they may support a unique faunal assemblage and riverine habitats may serve as important corridors for fauna movement.

These habitats are generally well-represented in the local Port Hedland area outside of the disturbance envelope. The areas of these habitats that could be

impacted (i.e. within the disturbance envelope) are relatively small compared with the occurrence of these habitats mapped outside of the disturbance envelope during the baseline fauna surveys by ENV (2009e, 2009f). As a result, fauna are unlikely to be specifically reliant on riverine or dunal habitats within the disturbance envelope and it is unlikely there will be significant reduction in fauna caused by clearing of these habitats. As with the sandplain habitat, construction laydown areas within these habitats that are no longer required, will be rehabilitated post-construction.

**Direct Loss of Habitat Outside of the Disturbance Envelope**

Direct loss of habitat outside of the disturbance envelope may result from fire originating from hot work activities, overheating of vehicles and machinery or incorrect disposal of cigarette butts. Direct loss of habitat outside of the disturbance envelope may also result from accidental clearing.

**Degradation of Habitat**

Environmental aspects associated with the Outer Harbour Development that potentially degrade vegetation may also subsequently reduce the quality of fauna habitats. These aspects and their impacts on vegetation are discussed in **Section 9.1.4** and are not discussed further.

**Fragmentation of Habitat**

Vegetation clearing may cause fragmentation of fauna habitat reducing connectivity of fauna populations. Mobile fauna with large home ranges such as ground mammals are likely to be at most risk of impact due to fragmentation of habitat. The construction of the proposed Western Spur Railway may restrict the free dispersal of ground mammals within the sandplain habitat and riverine habitat, thereby fragmenting these habitats to a small degree. The sandplain habitat has previously been fragmented by the presence of the Great Northern Highway, the Fortescue Metals Group (FMG) Railway and the Port Hedland-Newman Railway.

Additional habitat fragmentation is unlikely to result from the construction of the proposed stockyards, rail loop, infrastructure corridor or transfer station on Finucane Island as these infrastructure areas are adjacent to existing infrastructure. These infrastructure areas include the decommissioned HBI Plant at Boodarie, the existing Finucane Island causeway, the existing Boodarie to Finucane Island overland conveyor and the existing operations on Finucane Island.

**Direct Loss of or Injury to Fauna**

Direct loss of, or injury to fauna may occur as a result of clearing and earthworks, fire arising from hot work or overheating of vehicles or machinery and vehicle strikes (physical interaction). The accidental ingestion of solid or liquid waste, chemicals or fuels may also lead to illness or death of individual fauna. In all cases the impact is likely to be localised and restricted to individuals only, thereby not threatening species at the population level. Fauna with limited mobility, including reptiles and small mammals and marsupials, are most susceptible to being injured or killed by clearing or earth-moving machinery during construction.

**Direct Loss of or Injury to Fauna of Conservation Significance**

Direct loss of, or injury to fauna of conservation significance may occur primarily as a result of clearing and earthworks and vehicle strikes (i.e. physical interaction). Fauna of conservation significance with limited mobility that may be at risk of death or injury include Woma Python (*Aspidites ramsayi*) (Schedule 4, Priority 1), Blind Snake (*Ramphotyphlops ganei*) (Priority 1), Lakeland Downs Mouse (*Leggadina lakedownensis*) (Priority 4) and Brush-tailed Mulgara (*Dasycercus blythi*) (Vulnerable, Schedule 1, Priority 4) (refer to **Figure 5.15** for fauna of conservation significance identified within the disturbance envelope). These species may be impacted by heavy machinery or vehicles during construction. The Woma Python may be vulnerable to vehicle strikes as road surfaces can be preferred basking spots for snakes.

The loss of or injury to fauna of conservation significance due to clearing and earthworks or physical interaction is likely to result in only individual deaths, and therefore is unlikely to affect the conservation status of the species involved. The Rainbow Bee-eater (*Merops ornatus*), Australian Bustard (*Ardeotis australis*), Grey Falcon (*Falco hypoleucos*), Peregrine Falcon (*Falco peregrines*), Star Finch (*Neochmia ruficauda clarescens*), Ghost Bat (*Macroderma gigas*) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) are not considered to be at risk of mortality or injury due to construction activities as they are highly mobile species and no nests characteristic of these species were recorded within the study area during baseline fauna surveys (ENV 2009e, 2009f).

**Introduction and Spread of Vermin**

The introduction or spread of vermin may be encouraged through incorrect disposal or storage of organic waste. Whilst none of the seven introduced species recorded during baseline fauna surveys (ENV 2009e, 2009f) are Declared Animals listed under the ARR Act, without appropriate management, the introduction or spread of vermin may indirectly impact native fauna species through increased rates of competition for resources, which may ultimately reduce biodiversity.

**Changes in Fauna Behaviour**

The physical presence of infrastructure, noise emissions, light spill, and vehicular and human traffic associated with construction and operation activities may modify typical fauna behaviour. Such aspects may displace fauna from habitat within the vicinity of the Outer Harbour Development resulting in a local decrease in fauna abundance. Displaced fauna are likely to relocate to other areas of similar habitat as the habitats associated with the Outer Harbour Development are well represented in the local Port Hedland area and are not of conservation significance. The larger and more mobile fauna such as mammals, reptiles, bats and birds will move into the adjacent habitat. The smaller less mobile species such as skinks, geckoes and frogs, are less likely to move and local loss is expected. None of these species surveyed are of conservation significance. Light emissions may cause behavioural changes in localised terrestrial populations. Light sources may attract insect predators such as birds and bats through the attraction and concentration of insects in localised well-lit areas.

It is considered unlikely that the project will affect the conservation status of any fauna species

### 9.2.5 Matters of National Environmental Significance

Under the EPBC Act, an action will require approval from the Minister if it has or will have, or is likely to have, a significant impact on Matters of National Environmental Significance. The potential impacts discussed above may apply to Matters of National Environmental Significance, namely terrestrial fauna species that are listed as Vulnerable or Migratory under the EPBC Act which occur or are likely to occur within the disturbance envelope (refer to **Section 5.5.13**).

The coastal location of the Outer Harbour Development suggests it may encompass portions of 'important populations' or 'important habitats' which can be defined under the EPBC Act as being located 'near the limit of a species range' for the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*), Rainbow Bee-eater (*Merops ornatus*) or Brush-tailed Mulgara (*Dasycercus blythi*). Therefore, significant impact criteria associated with the EPBC Act are relevant.

The Outer Harbour Development is not likely to result in the long-term decrease in the size of the population of *Rhinonicteris aurantia*, *Merops ornatus* or *Dasycercus blythi*. No mortalities are expected for the Pilbara Leaf-nosed Bat as a result from land clearing as there are no roosting sites for the this bat within the disturbance envelope or larger study area. The Mulgara, which may shelter and breed in underground burrows in the sandplain habitat may be vulnerable to mortality through vehicle strikes. The aerial nature and the seasonal occurrence of the migratory species *Merops ornatus*, places it at lower risk of mortality through such land-based activities although nest sites could be disturbed.

Exact population sizes are not known for *Dasycercus blythi* or *Merops ornatus*. However, the population size for the latter is assumed to be large based on its widespread distribution and reporting rates for the species (for example, the Atlas of Australian Birds has received more than 30,000 records of *Merops ornatus* since 1998 [Atlas of Australian Birds, unpublished data]). Should mortalities of *Merops ornatus* occur, they are likely to be restricted to individuals rather than a sizeable proportion of the population which would result in the long-term decline in the population.

The population of *Dasycercus blythi* in Port Hedland is unknown. In a recent trapping study, 50 individuals were caught in a 210 ha area west of South Hedland over 9,900 trap nights (Thompson & Thompson 2008). No individuals were trapped within the Outer Harbour Development surveys. In contrast to *Merops ornatus*, individual mortalities from clearing or vehicle strikes could result in a decline at population level.

It is predicted that the Project may result in the loss of habitat that supports *Dasycercus blythi*, *Rhinonicteris aurantia* or *Merops ornatus* such as foraging, breeding or roosting habitat, through land clearing. As the disturbance envelope encompasses fauna habitats that are well represented outside of the disturbance envelope and previously disturbed areas, the aforementioned fauna are not expected to be specifically dependant on the presence of such habitats within the disturbance envelope for foraging or breeding. Nesting habitat for *Merops ornatus* and *Dasycercus blythi*, namely sandy embankments and sandplain habitat, respectively, are not restricted to the disturbance envelope.

The Outer Harbour Development is unlikely to disrupt the breeding cycle of the *Dasycercus blythi*, *Rhinonicteris aurantia* or *Merops ornatus* through clearing, noise emissions, light spill, or the physical presence of infrastructure. In the case of *Rhinonicteris aurantia*, the study area contains no suitable roosting sites for breeding purposes. The study area has been subjected to previous disturbance through the operation of industrial facilities at Finucane Island and Boodarie, and as such, it is expected fauna will be adapted to disturbance.

In summary, the proposed Outer Harbour Development may impact on Matters of National Environmental Significance through clearing activities resulting in the death of individuals of the Brush-tailed Mulgara, if present. However, it is unlikely that a long term decrease in population levels will occur. Fauna surveys completed for the project area did not trap Mulgara. The habitat Mulgara are associated with in the Boodarie area is regionally widespread, so impacts would be localised. A regional fauna survey inclusive of Port Hedland and the Project disturbance envelope is being undertaken in Autumn 2011 by BHP Billiton Iron Ore.

### 9.2.6 Management Measures

The proposed measures applicable to the management of impacts on fauna and fauna habitats arising from the construction and operation of the Outer Harbour Development are summarised in **Table 9.5**.

The CEMP will provide a framework for the environmental management of the terrestrial construction activities associated with the Outer Harbour Development (**Section 12.2**). The program will include detailed strategies, procedures and work practices, to avoid, mitigate or minimise impacts resulting from construction tasks or actions. Key management measures proposed include:

- no clearing or disturbance outside of the approved disturbance envelope;
- Areas that are used for construction related activities/ facilities such as temporary contractor facilities and equipment laydown areas will be located within the disturbance envelope and will be progressively rehabilitated when they are no longer required to support construction activities, to minimise loss of vegetation;
- vehicle and equipment access will be restricted to designated access roads where possible;
- clearing methods which minimise potential harm to fauna species to be used (i.e. staged clearing to maximise the potential for mobile species to move to adjoining areas, checking for nests or burrows prior to clearing);
- requirements to salvage and temporarily stockpile particular vegetation types or habitat features (i.e. vegetation, stumps, logs, boulders) for use in rehabilitation programs; and
- specific management measures to minimise impacts on species of conservation significance that may occur within the proposed clearing area (i.e. identification of a particular species, protocol for reporting, requirements to avoid/collect/record).

A Significant Species Management Plan will be implemented to facilitate the management of significant fauna species recorded or potentially occurring within the disturbance envelope (**Appendix A6**). The Significant Species Management Plan contains "general" management practices (refer **Table 9.5**) to be implemented to minimise the impact of construction activities on fauna, as well as the "specific" management measures for species of conservation significance.

### 9.2.7 Significance of Residual Impact

The loss of fauna habitat associated with the proposed clearing is not considered significant as the local or regional representation of these communities is not likely to be impacted. The area to be permanently cleared and the resulting direct loss of habitat is approximately 940 ha. The habitats are well represented locally and regionally and as the fauna occurring in the area are not specifically reliant on this habitat within the disturbance envelope, breeding or foraging resources are not likely to be significantly reduced.

All remaining impacts are mitigated through the implementation of the proposed management measures or involve impacts that are localised in nature.

The resulting direct loss of habitat of conservation significance, that is, dunal and riverine habitats, is small relative to the local representation of these habitats. Breeding or foraging resources for fauna are not likely to be significantly reduced.

The direct loss of fauna or fauna of conservation significance due to clearing and earthworks, vehicle strikes or the accidental ingestion of leaked or spilt chemicals or waste is unlikely to threaten fauna at the population level. Changes in fauna behaviour due to the physical presence of infrastructure, increased noise levels, light spill and vehicular and human traffic are also unlikely to threaten fauna at the population level.

The loss of fauna is not considered significant as their local or regional representation will typically not be impacted.

### 9.2.8 Predicted Environmental Outcome

The predicted environmental outcomes for terrestrial fauna as a result of the proposed Outer Harbour Development are:

- direct disturbance of approximately 940 ha of terrestrial fauna habitat;
- the clearing of habitat will result in changes to the localised abundance and distribution of terrestrial fauna. The Outer Harbour Development will not conflict with the intent of the WC Act, as the project will not change the conservation status of any vertebrate or invertebrate fauna species;
- dunal and riverine habitat types likely to be most affected at a local scale, which both represent widespread vegetation communities (and habitat types) in the Pilbara Bioregion; and
- regional terrestrial fauna habitat status and associated biodiversity values are unlikely to be affected by implementation of the project.

The EPBC Act objective to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance can be met by the project.

The EPA's stated objective of maintaining the abundance, diversity, geographic distribution and productivity of fauna species and ecosystem levels will be achieved through designing the project to minimise loss of habitat and managing potential construction and operational impacts in accordance with the Significant Species Management Plan (**Appendix A6**), the proposed management measures outlined in **Table 9.5** and existing standard measures.

This objective has also been met through the knowledge of the abundance, diversity and geographic distribution of terrestrial fauna in the Port Hedland area that has been generated through the surveys conducted as part of this assessment.

**Table 9.5 – Summary of Potential Impacts and Management Measures Associated with Terrestrial Fauna**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Clearing and earthworks | Construction of terrestrial facilities (transfer station, infrastructure corridor, stockyards, rail loop and rail spur). | Direct loss of general fauna habitat used for breeding, nesting or foraging.<br>Direct loss of fauna habitat of conservation significance used for breeding, nesting or foraging.<br>Fragmentation or isolation of habitat leading to reduced connectivity of fauna populations and increased competition for resources.<br>Direct loss of habitat outside of disturbance envelope used for breeding, nesting or foraging due to accidental clearing.<br>Direct loss of, or injury to, fauna.<br>Direct loss of, or injury to, conservation significant fauna (for example, the Woma Python).<br>Degradation of fauna habitat due to vehicle damage. | *Avoidance/Mitigation/Management Measures:*<br>► Clearing will be minimised as far as practicable through engineering design and where there is flexibility with placement of Proposal infrastructure, avoid siting it in any habitat of high conservation significance.<br>► Planned clearing boundaries will consider minimising disturbance to the riverine and dunal habitats.<br>► Unnecessary disturbance to fauna habitats will be minimised by:<br>• clearly demarcating proposed areas to be cleared on construction plans;<br>• surveying and pegging of proposed areas to be cleared;<br>• tracking of clearing and ground disturbance activities using a land use register; and<br>• restricting vehicle and equipment movements to within designated areas.<br>► Areas used for construction laydown will be located in previously disturbed areas where practicable and rehabilitated post completion of construction activities, unless required for other purposes.<br>► A Significant Species Management Plan (refer Appendix A6) is to be implemented to manage potential impacts to significant species recorded or potentially occurring within the proposed disturbance envelope.<br>► Regional fauna survey inclusive of Port Hedland and the project disturbance envelope undertaken in Autumn 2011.<br>► Existing records of fauna of conservation significance and significant habitats are to be mapped on relevant databases and access to such areas is to be managed in accordance with the Project Environmental Aboriginal Heritage Review (PEAHR) process. These records will be updated as necessary and awareness of these records will be promoted at planning and operational levels.<br>► Suitable fauna management requirements will be included in the PEAHR authorisation forms for areas to be cleared. These may include but are not necessarily restricted to:<br>• clearing methods to be used in order to minimise potential harm to fauna species (i.e. staged clearing to maximise the potential for mobile species to move to adjoining areas, checking for nests or burrows prior to clearing);<br>• requirements to salvage and temporarily stockpile particular vegetation types or habitat features (i.e. vegetation, stumps, logs, boulders) for use in rehabilitation programs;<br>• specific management measures to minimise impacts on species of conservation significance that may occur within the proposed clearing area (i.e. identification of a particular species, protocol for reporting, requirements to avoid/collect/record).<br>► Workforce awareness of local flora/fauna species of interest and conservation issues will be raise through a site Environmental Awareness Program.<br>*Monitoring:*<br>► Regular inspections will be undertaken to ensure that fauna habitats are being cleared in the appropriate locations and relevant plans are updated.<br>*Contingency Measures:*<br>► Injured fauna will be reported to the designated BHP Billiton Iron Ore environmental officer who will assess the best course of action.<br>► Appropriate records of impacted fauna will be maintained. |

**Table 9.5 – Summary of Potential Impacts and Management Measures Associated with Terrestrial Fauna (continued)**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Fire | Vehicle exhaust and construction and operation of facilities. | Direct loss of habitat or fauna outside of disturbance envelope due to fire caused by construction activities. | *Avoidance/Mitigation/Management Measures:*<br>► Fire hazard awareness and management training will be provided as required to BHP Billiton Iron Ore personnel and contractors, which will include emergency response procedures.<br>► Vehicle and equipment access will be restricted to designated access roads where possible.<br>► Fire fighting equipment will be provided in work areas according to fire hazard, and regularly inspected and maintained.<br>► Spark shields will be used where appropriate.<br>► Fire restrictions will be in place, including hot work activities in designated areas only.<br>*Contingency Measures:*<br>► Fire-fighting equipment (which will be regularly inspected and maintained) will be provided in work areas according to fire hazard. |
| Particulate emissions | Vehicle movements and construction and operation of the facility. | Degradation of fauna habitat due to dust deposition. | *Avoidance/Mitigation/Management Measures:*<br>► Dust control measures such as regular watering of unsealed roads, exposed surfaces and active construction areas, and progressive rehabilitation of disturbed areas, which are no longer required, will be used to minimise dust generation.<br>► Employees will be made aware of the need to minimise dust generation through site Environmental Awareness Programs<br>► Vehicle movements and vehicle speeds will be restricted to reduce dust emission. |
| Physical presence | Permanent terrestrial facilities. | Degradation of fauna habitat due to drainage shadow effects and localised flooding.<br>Change in fauna behaviour/ movement. | *Avoidance/Mitigation/Management Measures:*<br>► Key infrastructure, such as stockyards, rail loop, infrastructure corridor, transfer station, has been located in or adjacent to previously disturbed areas.<br>► Surface water will be diverted and collected to minimise impacts on fauna habitat.<br>► The use of barbed wire will be avoided, except where necessary (e.g. explosive storage areas).<br>► Where barbed wire must be used due to hazards the use of deflectors to reduce impacts on birds and bats will be considered.<br>► The installation of visual/ sonic deflectors for powerlines associated with the project area as overhead wires, such as powerlines, will be considered. |
| Groundwater dewatering or abstraction | Construction of car dumpers and Western Spur Railway. | Degradation to fauna habitats associated with groundwater. | *Avoidance/Mitigation/Management Measures:*<br>► Undertake groundwater abstraction in accordance with the agreed DoW License.<br>► Re-use or recycle abstracted groundwater for dust suppression where possible.<br>*Monitoring:*<br>► Undertake groundwater monitoring in compliance with the DoW and DEC requirements, during dewatering to ensure drawdown levels are maintained. |
| Leaks and spills | Storage and transport of chemicals, fuels or other hazardous material.<br>Failure of equipment or pipelines. | Degradation to fauna habitats due to deterioration in vegetation health.<br>Direct loss of, or injury to, individual fauna due to accidental ingestion of toxic chemicals. | *Avoidance/Mitigation/Management Measures:*<br>► Hydrocarbons and chemicals will be appropriately stored to minimise potential for contamination.<br>► Hydrocarbon waste will be segregated from stormwater and other water via closed systems.<br>*Contingency Measures:*<br>► Spill contingency plans will be prepared to ensure appropriate measures are taken to manage refuelling, storage and spill management.<br>► Spill response kits will be located in close proximity, for prompt response in the event of a spill or leak. |

**Table 9.5 – Summary of Potential Impacts and Management Measures Associated with Terrestrial Fauna (continued)**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Liquid and solid waste disposal | Domestic waste and treated sewage.<br>Waste chemicals and oil.<br>Construction waste. | Spread of vermin leading to increased competition or predation of native fauna. | *Avoidance/Mitigation/Management Measures:*<br>► Potentially hazardous solid and liquid wastes will be stored within enclosed containers.<br>► Domestic rubbish in bins will be frequently collected and removed to the municipal landfill.<br>► Controlled wastes as defined by the Environmental Protection (Controlled Wastes) Regulations 2004, will be properly removed from sites.<br>► On site solid waste disposal will be minimised and properly managed.<br>► Empty oil and chemical containers such as metal or plastic drums will be returned to the supplier for reuse or recycling where possible.<br>*Monitoring:*<br>► If feral species are identified, management procedures will be implemented as required. |
| Light Spill | Construction activities and permanent terrestrial facilities. | Change in fauna behaviour/ movement. | *Avoidance/Mitigation/Management Measures:*<br>► Lighting required during construction and for security purposes will be minimised where possible whilst maintaining compliance with levels required for safe working conditions.<br>► On Finucane Island and the abutment, flood lights will utilise lighting with an asymmetric distribution (i.e. focused lighting) to avoid unnecessary light spill in fauna habitats. |
| Noise and vibration | Construction and operation of the facilities. | Change in fauna behaviour/ movement. | *Avoidance/Mitigation/Management Measures:*<br>► All construction activities will be undertaken in accordance with the *Environmental Protection (Noise) Regulations 1997*.<br>► Measures put in place to control noise emissions for public amenity will also apply to fauna (refer to Section 11). |
| Physical interaction | Vehicle and equipment movements. | Direct loss or injury of individual fauna.<br>Direct loss of, or injury to, conservation significant fauna (e.g. Woma python). | *Avoidance/Mitigation/Management Measures:*<br>► Designate roads and tracks will be utilised by vehicles where practicable.<br>► A road awareness program for employees will be implemented and strict enforcement of effective vehicle speed limits to minimise impacts on fauna of conservation significance during construction and operation (ideally, suitable speed limits would include 60 km/hr during the day.<br>► Appropriate signage for speed limits will be provided to reduce vehicular collisions with fauna.<br>► Specific trench monitoring and clearing protocols (will be developed to the requirements of DEC).<br>► Windrows on sides of tracks or roads will be retained to deter fauna from accessing these areas, where practicable.<br>► Any fauna mortalities involving significant species will be reported to DEC. |

## 9.3 Key Factor – Geology, Soils and Landforms

This section presents the assessment of impacts on soils and landforms associated with the project, incorporating design modifications, mitigation and management measures applied to manage the potential impacts.

### 9.3.1 Management Objective

The EPA's stated objective relevant to soils and landforms is 'to maintain the integrity, ecological functions and environmental values of the soils and landform'.

The specific objective for acid sulphate soils (ASS) is that potentially acid sulphate soil (PASS) disturbing activities are avoided or managed to avoid harm to the surrounding environment (DEC 2009).

### 9.3.2 Description of Factor

The existing geology, soils and landforms are discussed in **Section 5.3**. The occurrence of PASS and potential contamination within the disturbance envelope are based on the findings of preliminary site investigations undertaken by SKM (2009a, 2009b). Relevant key findings include:

- the proposed infrastructure corridor and transfer station are located over land mapped by the DEC (2006a) as medium to high risk of ASS occurring within 3 m of the natural surface;
- the proposed stockyards, rail loop and car dumpers are located over land mapped by the DEC (2006a) as no known risk of ASS occurring within 3 m of the natural surface, although an area of medium to low risk is located 1 to 2 km from these areas;
- the proposed Western Spur Railway is located over land mapped by the DEC (2006a) as no known risk of ASS occurring within 3 m of the natural surface, and as a result, risk of disturbance of ASS is considered very low;
- recent land-based ASS investigations undertaken in the vicinity of the proposed Outer Harbour Development which have identified either PASS or actual acid sulphate soils (AASS) within intertidal areas along the Port Hedland coastline, thereby suggesting ASS may potentially occur on Finucane Island and along the proposed infrastructure corridor;
- further detailed investigations into the presence of ASS at the Outer Harbour Development are being undertaken in areas at risk of disturbing ASS; and
- a preliminary site investigation of the disturbance envelope concluded that there was a low risk of encountering soil or groundwater contamination within the disturbance envelope, with the exception of an area of the proposed stockyards and rail loop, which is undergoing remediation to ensure the site is suitable for future industrial development.

### 9.3.3 Assessment Guidance

Guidance on the assessment of impacts to soils and landforms exists at a State government level. A summary of the assessment guidance documents relating to the management of acid sulphate soils utilised in this impact assessment is provided in **Table 9.6**.

**Table 9.6 – Guidance Specific to Management of Acid Sulphate Soils**

| Document | Description |
|---|---|
| Contaminated Sites Management Series: Assessment Levels for Soil, Sediment and Water, Draft for Public Comment, Version 3, November 2003 (DEC 2003) | Provides information about the assessment levels used by DEC to determine whether a site is potentially contaminated. |
| Identification and Investigation of Acid Sulphate Soils and Acidic Landscapes – Acid Sulphate Soils Guideline Series, Contaminated Sites Branch, Department of Environment and Conservation, May 2009 (DEC 2009a) | Provides practical guidance in relation to the minimum level of investigation required to identify the presence or absence of ASS by a proposed development, and the nature/extent of the ASS, i.e. the amount of existing and potential acidity in order to determine appropriate management measures. |
| Draft Treatment and Management of Soils and Water in Acid Sulphate Soil Landscapes – Acid Sulphate Soils Guideline Series, Contaminated Sites Branch, Department of Environment and Conservation, January 2009 (DEC 2009b) | Provides technical and procedural advice to avoid environmental harm and to assist in achieving best practice environmental management in areas underlain by ASS. |
| Western Australian Planning Commission Planning Bulletin 64: Acid Sulphate Soils, January 2009 (WAPC 2009a) | Provides advice and guidance on matters that should be taken into account in developing land that contains ASS. |

### 9.3.4 Potential Impacts

Potential impacts on geology, soils and landforms resulting from environmental aspects associated with the Outer Harbour Development are discussed below and summarised in **Table 9.7**. Clearing and earthworks and associated excavations are key aspects as they may potentially disturb ASS. In view of the absence of a detailed ASS investigation, a conservative approach has been undertaken in assessing and managing the potential impacts associated with ASS. The presence or absence of ASS will be confirmed during detailed ASS investigations that will commence prior to construction.

#### Acidification of Soils

Clearing and shallow excavations (up to 2 m) are required for construction of the transfer station and infrastructure corridor, which are located in areas mapped as being of high to medium risk of ASS occurring in the top 3 m of the soil surface. This may result in the oxidisation of ASS which in turn may release acid and cause potential leaching of heavy metals into the environment surrounding the transfer station and infrastructure corridor. Acidification of soils in these areas may cause localised loss of mangroves and samphire vegetation.

Construction of the car dumpers and associated conveyor tunnels will require excavations of up to 25 m depth. Subsequent dewatering may reduce the water table level, leading to oxidisation of ASS material if it is present. This may result in the acidification of soil and local groundwater.

The environment in the Port Hedland region has a high assimilative capacity for generated acidity due to the calcareous nature of the soil matrix which has an inherently high acid neutralising capacity. This is likely to assist in the reduction of acidification of soils if oxidation of ASS was to occur.

#### Compromising Infrastructure Integrity

The release of acid through disturbance to ASS, may increase the potential for corrosion which may damage local infrastructure such as roads, concrete and steel pipes, buildings and culverts. This is of particular concern in the area of the proposed infrastructure corridor and transfer station where there is a medium to high risk of ASS occurring in the top 3 m of the natural soil surface and shallow excavations are proposed. The release of acid through disturbance to ASS in these areas may compromise the integrity of existing infrastructure in the vicinity.

The release of acid may also be of concern in the proposed stockyards area. Although mapped as being of no known risk of ASS occurring in the top 3 m of the natural soil surface, medium to high risk areas exist approximately 1 km to the north-east and deep excavations (to 25 m depth) are planned for the construction of car dumpers and conveyor tunnels. The release of acid through disturbance to ASS in the vicinity of the stockyards may compromise existing infrastructure (associated with the decommissioned HBI Plant at Boodarie) and proposed infrastructure (car dumpers, conveyor tunnels, foundations extending below the ground surface and drainage systems).

#### Increased Erosion

Clearing of vegetation may result in the soil profile being more susceptible to erosion from wind or water. During rainfall events, increased surface water run-off may generate erosion features such as rills and gullies and increased turbidity levels in South West Creek. Furthermore, the physical presence of infrastructure such as the infrastructure corridor, rail loops or the Western Spur Railway may interfere locally with surface water flows potentially causing localised areas to be eroded.

#### Loss of Topsoil

Direct loss of topsoil will occur during vegetation clearing as part of site preparation. The loss of topsoil through increased erosion may lead to further erosion of the soil profile beneath.

#### Deterioration of Soil Quality

The repeated movement of heavy machinery or vehicles during earthworks and site preparation may compact the soil profile, which in turn could decrease water infiltration rates, reduce soil moisture and create surface ponding. Vegetation may be indirectly affected through suboptimal conditions for root growth.

#### Soil Contamination

Leaks, spills or the incorrect disposal of chemicals, hydrocarbons or wastes has the potential to contaminate soils. This impact is likely to be localised in nature and restricted to the surface layer of the soil profile.

### 9.3.5 Matters of National Environmental Significance

There are no Matters of National Environmental Significance directly associated with soils and landforms.

### 9.3.6 Management Measures

The proposed measures applicable to the management of impacts on geology, soils and landforms arising from the construction and operation of the Outer Harbour Development are summarised in **Table 9.7**.

The CEMP will provide a framework for the environmental management of the terrestrial construction activities associated with the Outer Harbour Development. The program will include detailed strategies, procedures and work practices, to avoid, mitigate or minimise impacts resulting from construction tasks or actions. Management measures proposed include, but are not limited to:

- erosion control features incorporated into the project design, to manage erosion and sedimentation, topsoil and soil quality (for example, slope stabilisation, diversion of surface run-off);
- soil contamination from leaks and spills of chemicals or hydrocarbons and incorrect solid and liquid waste disposal will be avoided through the proposed management measures. In addition, project design will include features to capture potentially contaminated surface water runoff prior to discharge to the environment in high risk areas; and
- the potential disturbance of ASS will be managed in accordance with an Acid Sulphate Soils Management Plan (Appendix A7) which will be revised following completion of the ASS investigations prior to commencement of construction activities. Further detailed ASS investigations will also be undertaken prior to construction to confirm the presence or absence of ASS within the proposed disturbance envelope.

### 9.3.7 Significance of Residual Impact

Impacts to geology, soils and landforms are not considered significant as the majority of impacts may be minimised or avoided through the management measures proposed or involve short-term or localised effects.

### 9.3.8 Predicted Environmental Outcome

The proposed investigations into the extent of ASS will be undertaken prior to commencing construction activities in accordance with the DEC guideline series. Based on the outcomes of these investigations, BHP Billiton Iron Ore will implement the management measures described in the Acid Sulphate Soil Management Plan (**Appendix A7**). Implementation of these management and monitoring measures will ensure the EPA's objective for soils will be met by the project.

The risks of hydrocarbon spills, or contamination by fire fighting foam, are low, given the use of appropriate management and mitigation measures. The EPA's objective for soil will be met by the project.

**Table 9.7 – Summary of Potential Impacts and Management Measures Associated with Geology, Soils and Landforms**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Clearing and earthworks | Construction of terrestrial facilities (transfer station, infrastructure corridor, stockyards, rail loop and rail spur). | Increased erosion and possible sedimentation through changes in surface water flow regimes. | *Avoidance/Mitigation/Management Measures:*<br>► Clearing will be minimised as far as practicable through engineering design<br>► Project design will incorporate erosion control measures and stormwater drainage.<br>► Further detailed ASS investigations will be undertaken to confirm the presence of ASS within the area proposed for the construction of the transfer pad, infrastructure corridor and car dumpers and conveyor tunnels.<br>► Disturbance to potential areas of ASS is to be managed in accordance with the Acid Sulphate Soils Management Plan (Appendix A7). The Acid Sulphate Soils Management Plan will be updated with the findings from the further detailed ASS investigation.<br>► Project design is to incorporate corrosion resistant design materials based upon field identification of ASS, if required.<br>► Following further detailed ASS investigations, for areas confirmed with ASS present, excavated soil will be treated during construction to prevent acidic fluids leaching into surface water or groundwater.<br>► Groundwater extracted during dewatering will be monitored for water quality.<br>*Monitoring:*<br>► Erosion and sediment control structures will be routinely inspected*, especially* after high rainfall events, to ensure they stay effective.<br>► Captured dewatered effluent during car dumper construction will be monitored for water quality to identify the need for treatment of acidic conditions.<br>► Validation samples will be collected from excavated ASS to determine adequate treatment rates. Post treatment samples will be collected to confirm adequate treatment prior to reuse or disposal.<br>► Groundwater monitoring will be undertaken during construction activities according to regulatory guidelines.<br>*Contingency Measures:*<br>► Following the further detailed ASS investigation, for areas confirmed with ASS present, excavated soil is to be treated during construction to prevent acidic fluids leaching into surface water or groundwater. |
| | | Loss of topsoil resulting in unsuccessful rehabilitation, and potential increase in erosion. | |
| | | Deterioration of soil quality (decreased moisture content, reduced water infiltration capacity, surface ponding). | |
| | | Acidification of soils, surface water and groundwater (including potential metal leaching and contamination) resulting from disturbance of acid sulphate soils. | |
| | | Integrity of infrastructure could be compromised due to exposure to acidic environments due to oxidation of acid sulphate soils. | |
| Physical presence of infrastructure | Permanent terrestrial facilities.<br>Impermeable infrastructure. | Increased erosion and possible sedimentation through changes in surface water flow regimes. | As for clearing and earthworks. |
| Groundwater dewatering | Construction of car dumpers and conveyor tunnels | Acidification of soils and groundwater due to exposure to acid sulphate soils. | As for clearing and earthworks. |

**Table 9.7 – Summary of Potential Impacts and Management Measures Associated with Geology, Soils and Landforms (continued)**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Leaks and spills | Storage and transport of chemicals, fuels and other hazardous materials. Failure of equipment or pipelines. | Potential soil contamination due to leaks and spills from storage, transport and use of fuels, chemical and hazardous materials. | *Avoidance/Mitigation/Management Measures:*<br>► Hydrocarbons and chemicals will be appropriately stored to minimise potential for contamination.<br>► Hydrocarbon waste will be segregated from stormwater and other water via closed systems.<br>*Contingency Measures:*<br>► Spill contingency plans will be prepared to ensure appropriate measures are taken to manage refuelling, storage and spill management.<br>► Spill response kits will be located in close proximity, for prompt response in the event of a spill or leak. |
| Solid and liquid waste disposal | Incorrect disposal of treated sewage, waste chemical or domestic and construction waste. | Potential contamination of soil from incorrect disposal of waste streams. | *Avoidance/Mitigation/Management Measures:*<br>► Potentially hazardous solid and liquid wastes will be stored within enclosed containers.<br>► Domestic rubbish in bins is to be frequently collected and removed to the municipal landfill.<br>► Controlled wastes as defined by the Environmental Protection (Controlled Wastes) Regulations 2004, will be properly removed from sites.<br>► On site solid waste disposal will be minimised and properly managed.<br>► Empty oil and chemical containers such as metal or plastic drums will be returned to the supplier for reuse or recycling where possible. |

## 9.4 Relevant Factor – Short-Range Endemic Fauna

This section presents the assessment of impacts on short-range endemic (SRE) fauna associated with the Outer Harbour Development, incorporating design modifications, mitigation and management measures applied to manage the potential impacts.

### 9.4.1 Management Objective

The EPA's stated objectives for SRE fauna are 'to ensure the protection of key habitats for short-range endemic fauna species, maintain the distribution, abundance and productivity of populations of short-range endemic taxa and ensure that the conservation status of short-range endemic taxa is not adversely changed as a result of development proposals'.

### 9.4.2 Description of Factor

A description of the existing SRE fauna of the terrestrial study area is presented in **Section 5** and is based on surveys undertaken by ENV in June 2008 and October 2008 (ENV 2009g). Relevant key findings include:

- the only potential SRE fauna habitat identified within the project area were limestone rocky outcrops, which were located on the northern side of Finucane Island and within the project footprint of the proposed transfer station; and
- at the species level, no invertebrates considered to be SRE fauna were recorded, as all the invertebrates recorded had widespread geographic distributions.

### 9.4.3 Assessment Guidance

Guidance on the assessment of impacts to short-range endemic fauna exists at a State government level. A summary of the assessment guidance documents relating to short-range endemic fauna considered in this impact assessment is provided in **Table 9.8**.

### 9.5.4 Potential Impacts

Potential impacts to short-range endemic fauna species and habitat resulting from environmental aspects associated with the proposed Outer Harbour Development are discussed below and summarised in **Table 9.9**. The key aspect that impacts short-range endemic fauna is the proposed clearing and earthworks.

#### Direct Loss of Potential Short-range Endemic Fauna Habitat

Clearing associated with the construction of the transfer station on Finucane Island will result in a maximum loss of 2 ha of potential short-range endemic fauna habitat in the form of rocky limestone outcrops. Intensive searches of this potential habitat did not identify short-range endemic fauna species as all invertebrate species collected had widespread geographic distributions. In the local Port Hedland area, approximately 820 ha of similar potential habitat exist. The removal of potential short-range endemic fauna habitat for the construction of the transfer station will not significantly reduce the distribution of potential short-range endemic fauna habitat as rocky limestone outcrops are considered to be well represented locally and regionally based on similar coastal geological profiles that are present.

**Table 9.8 – Guidance Specific to the Management of Short-Range Endemic Fauna**

| Document | Description |
|---|---|
| EPA Guidance Statement No. 20: Sampling of Short-range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia (EPA 2000) | Addresses the general standards and a common framework including risk-based assessment for the sampling and assessment of SRE invertebrate fauna for EIA in WA. It also sets out the EPA's current expectations in respect of the quality and quantity of information derived from these surveys, and the consequent analysis, interpretation and reporting. The Guidance recognises and discusses limitations on current knowledge in respect to this fauna, and how this may affect the EPA's consideration of development proposals. |
| EPA Position Statement No. 2: Environmental Protection of Native Vegetation in Western Australia (EPA 2000) | Provides an overview of the EPA position on the clearing of native vegetation in WA. |
| EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) | Discusses the principles the EPA would apply when assessing proposals that may have an effect on biodiversity values in WA. |
| EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004b) | Provides guidance on the standard of survey required to assist in collecting appropriate data for decision-making associated with the protection of WA's terrestrial faunal biodiversity and its habitat. |

**Fragmentation or Isolation of Potential Short-range Endemic Fauna Habitat**

Clearing activities associated with the construction of the proposed transfer station on Finucane Island may fragment potential short-range endemic fauna habitat (rocky limestone areas). This habitat has previously been fragmented by roads, tracks and the existing port operations on Finucane Island. Rocky limestone areas are well represented outside of the proposed disturbance envelope in the local Port Hedland area and along the Pilbara coast.

**Direct Loss of Potential Short-range Endemic Fauna Habitat outside of the Disturbance Envelope**

Direct loss of potential short-range endemic fauna habitat outside of the proposed disturbance envelope associated with the proposed transfer station may result from fire originating from hot work activities, overheating of vehicles and machinery or personnel smoking on-site. Direct loss of potential short-range endemic fauna habitat outside of the proposed disturbance envelope may also result from accidental clearing. Potential short-range endemic fauna habitat in the Port Hedland area is not confined to Finucane Island.

### 9.4.5 Matters of National Environmental Significance

There are no matters of NES directly associated with short-range endemic fauna.

### 9.4.6 Management Measures

The proposed avoidance, mitigation, monitoring and contingency measures applicable to the management of impacts on short-range endemic fauna arising from the construction of the proposed Outer Harbour Development are summarised in **Table 9.9**.

The CEMP will provide a framework for the environmental management of the terrestrial construction activities associated with the proposed Outer Harbour Development (**Section 12.2.2**). The program will include detailed strategies, procedures and work practices, to avoid, mitigate or minimise impacts resulting from construction tasks or actions. Key management measures proposed include:

- No clearing or disturbance outside of the approved disturbance envelope;
- Vehicle and equipment access will be restricted to designated access roads where possible; and
- Requirements to salvage and temporarily stockpile particular vegetation types or habitat features (i.e. vegetation, stumps, logs, boulders) for use in rehabilitation programs.

### 9.4.7 Significance of Residual Impact

The direct loss of short-range endemic fauna is not considered significant as the majority of impacts may either be minimised or avoided through the management measures proposed or they involve short-term or localised effects.

Loss of short-range endemic fauna habitat through clearing is not considered significant as the regional distribution of potential short-range endemic fauna habitat will not be significantly reduced. Similar habitat based on geological profiles has been shown to be well represented in the Port Hedland region covering an approximate area of 820 ha. The proposed area to be cleared represents less than 1% of this area.

The potential fragmentation of short-range endemic fauna habitat due to construction of the transfer station is not considered significant as it will not contribute to increased fragmentation of habitat in areas of existing roads and port operation.

The direct loss of short-range endemic fauna habitat outside of the proposed disturbance envelope may be avoided through fire prevention and management strategies, the pre-approval of all proposed areas to be cleared, and clear on-site demarcation of all such areas.

### 9.4.8 Predicted Environmental Outcome

The construction and operation of the proposed Outer Harbour Development will not impact key habitat for short-range endemic fauna species as the short-range endemic fauna habitat to be impacted by the project is well represented in the region, nor will the project impact populations of short-range endemic fauna taxa as none were located within the proposed disturbance envelope.

Clearing of short-range endemic fauna habitat has been minimised through the project's design and the measures proposed for the CEMP will ensure that the proposed Outer Harbour Development will pose a low residual risk to short-range endemic fauna. Therefore, the EPA's stated objectives for short-range endemic fauna will be achieved.

**Table 9.9 – Summary of Potential Impacts and Management Measures Associated with Short-Range Endemic Fauna**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Clearing and earthworks | Construction activities on Finucane Island (transfer station and infrastructure corridor). | Direct loss of potential short-range endemic fauna habitat due to clearing and earthworks.<br>Direct loss of potential short-range endemic fauna habitat outside of project footprint due to accidental clearing.<br>Fragmentation or isolation of habitat due to clearing, earthworks and location of infrastructure. | *Avoidance/Mitigation/Management Measures:*<br>► Clearing is to be minimised as far as practicable through engineering design.<br>► Planned clearing boundaries are to consider minimising disturbance to short-range endemic fauna habitat.<br>► Unnecessary disturbance to short-range endemic fauna habitat will be minimised by:<br>• clearly demarcating proposed areas to be cleared on construction plans;<br>• surveying and pegging of proposed areas to be cleared;<br>• tracking of clearing and ground disturbance activities using a land use register; and<br>• restricting vehicle and equipment movements to within designated areas.<br>► Construction laydown will be located in previously disturbed areas where practicable and rehabilitated post completion of construction activities, unless required for other purposes.<br>► Existing records of short-range endemic fauna habitat are to be mapped on relevant databases and access to such areas is to be managed in accordance with the Project Environmental Aboriginal Heritage Review (PEAHR) process. These records will be updated as necessary and awareness of these records will be promoted at planning and operational levels.<br>► Workforce awareness of short-range endemic fauna habitat will be raised through a site Environmental Awareness Program.<br>*Monitoring:*<br>► Regular inspections will be undertaken to ensure that short-range endemic fauna habitat is being cleared in the appropriate locations and relevant plans are updated. |
| Fire | Accidental ignition from machinery and equipment used in earthworks. | Direct loss of potential SRE habitat outside of the disturbance envelope. | *Avoidance/Mitigation/Management Measures:*<br>► Fire hazard awareness and management training will be provided as required to BHP Billiton Iron Ore personnel and contractors, which will include emergency response procedures.<br>► Vehicle and equipment access will be restricted to designated access roads where possible.<br>► Fire fighting equipment would be provided in work areas according to fire hazard, and regularly inspected and maintained.<br>► Spark shields will be used where appropriate.<br>► Fire restrictions will be in place, including hot work activities in designated areas only.<br>*Contingency Measures:*<br>► Fire-fighting equipment (which will be regularly inspected and maintained) will be provided in work areas according to fire hazard. |

## 9.5 Relevant Factor – Subterranean Fauna

This section presents the assessment of impacts on subterranean fauna associated with the proposed Outer Harbour Development, incorporating design modifications, mitigation and management measures applied to manage the potential impacts.

### 9.5.1 Management Objective

The EPA's stated objective for subterranean fauna is to ensure adequate protection of important habitats for these species.

### 9.5.2 Description of Factor

A subterranean fauna risk assessment was undertaken to investigate the potential occurrence of subterranean fauna within the study area and potential risks of stygofauna or troglofauna being impacted by proposed activities (**Section 5**). Relevant key findings from the subterranean fauna risk assessment (Bennelongia 2009) are summarised below.

- Athalassic stygofauna, i.e. those living in groundwater that is not of marine origin, are considered unlikely to occur between the decommissioned HBI Plant at Boodarie and Finucane Island based on the high groundwater salinities in these areas (10 to 60 g/L TDS). Instead, it is possible this area supports marine species of stygofauna, which are typically widespread.
- Marine stygofauna are considered likely to occur on Finucane Island.
- Athalassic stygofauna, which in contrast to marine stygofauna, can have restricted distributions may occur within the southern part of the project area based on geology and records in the vicinity.
- Athalassic stygofauna, if present in the southern extent of the project area, are likely to have relatively large ranges, covering several river catchments based on survey results from nearby catchments and the lack of geographical barriers.
- Troglofauna are unlikely to occur in the colluvial and alluvial soils or sandy/clayey soils found within project area which are considered to be unfavourable troglofauna habitat.
- Troglofauna are unlikely to occur within the coastal margin (including Finucane Island, proposed infrastructure corridor and stockyards) due to the shallow depth to groundwater, but may occur further inland (including the proposed Western Spur Railway) where depth to groundwater is greater.
- No field sampling is required to further investigate subterranean fauna.

### 9.5.3 Assessment Guidance

Proposals incorporating activities that result in the lowering of the water table (groundwater abstraction), pollution of groundwater or disturbance or damage to underground caverns are identified by the EPA Guidance Statement No. 54 as those that may potentially have a significant impact on subterranean fauna and require formal assessment under the EP Act.

Guidance on the assessment of impacts to subterranean fauna exists at a State and Commonwealth government level. A summary of the assessment guidance documents relating to subterranean fauna considered in this impact assessment is provided in **Table 9.10**.

### 9.5.4 Potential Impacts

Potential impacts on subterranean fauna resulting from environmental aspects associated with proposed Outer Harbour Development are discussed below and summarised in **Table 9.11**. The key aspect that impacts subterranean fauna is the abstraction of groundwater.

#### Localised Loss of Stygofauna

The abstraction of groundwater from shallow bores during construction of the proposed Western Spur Railway may result in localised loss of athalassic stygofauna. Survey data from the adjacent coastal plain suggest most species in the southern portion of the project area have relatively large ranges, usually covering several river catchments (Halse *et al.* in prep). Even if species that are restricted to a single catchment occur, the homogeneous geology of the coastal plain makes it unlikely any species could be restricted to a small area. There are no geological barriers or significant features in the project area that might constrain a species range.

**Table 9.10 – Guidance Specific to the Management of Subterranean Fauna**

| Document | Description |
|---|---|
| EPA Guidance Statement No. 54: Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia (EPA 2003). | Addresses the conservation of stygofauna in groundwater systems and troglofauna and stygofauna in subterranean caves. This document provides guidance on the information that the EPA will consider when assessing proposals where the protection of stygofauna or troglofauna is a relevant environmental factor. |
| EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) | Discusses the principles the EPA would apply when assessing proposals that may have an effect on biodiversity values in WA. |

Dewatering associated with the construction of the proposed car dumpers and conveyor tunnels may result in localised loss of marine stygofauna. These stygofauna typically have widespread distributions (Lang 1965; Hartmann-Schroder & Hartmann 1978; Karanovic 2008) and this impact will not compromise the regional representation of marine stygofauna.

Groundwater pollution from leaks or spills of fuels, chemicals or waste material could result in loss of stygofauna, although the sensitivity of stygofauna to water chemistry changes and specific chemicals is currently unknown.

**Loss of Stygofauna Habitat**

Groundwater abstraction from shallow bores during construction of the proposed Western Spur Railway or dewatering associated with the construction of the proposed car dumpers and conveyor tunnels may result in loss of stygofauna habitat through aquifer drawdown. Aquifer drawdown from groundwater abstraction and dewatering is unlikely to result given the volumes of water involved and that groundwater in the vicinity of the car dumpers is tidally influenced. Therefore, any loss of stygofauna habitat is likely to be minimal and localised in nature (Bennelongia 2009).

**Localised Loss of Troglofauna**

Soil excavation associated with construction of the Western Spur Railway in the southern part of the proposed Outer Harbour Development has the potential to result in localised loss of troglofauna. Trapping experience suggests few troglofauna occur at depths less than 5 m (Bennelongia 2009). As the majority of excavation will be confined to the surface layers of the soil profile (approximately 1 to 2 m), with deeper excavation (approximately 5 m) only required in localised areas where ground levelling is required, localised impacts on troglofauna, if any, are expected. The troglofauna species present within the project area are not restricted in distribution.

Soil pollution from leaks or spills of fuels, chemicals or waste material could also result in localised loss of troglofauna, although the sensitivity of troglofauna to particular chemicals is currently unknown. Soil pollution is only likely to impact the surface layers which are typically depauperate in troglofauna (Bennelongia 2009).

**Loss of Troglofauna Habitat**

Deep soil excavations (approximately 5 m) associated with cut and fill earthmoving during construction of the Western Spur Railway, could result in localised loss of troglofauna habitat. Shallow excavation may have indirect effect on deeper subterranean habitats due to altered recharge patterns of water, energy and nutrients. No loss of troglofauna habitat is expected from the deep excavations (approximately 25 m) associated with the car dumpers or conveyor tunnels as the shallow water table and geology of the area are not suitable for supporting troglofauna.

### 9.5.5 Matters of National Environmental Significance

There are no matters of NES directly associated with subterranean fauna.

### 9.5.6 Management Measures

The proposed avoidance, mitigation, monitoring and contingency measures applicable to the management of impacts on subterranean fauna arising from the construction of the proposed Outer Harbour Development are discussed below and summarised in **Table 9.11**:

- No clearing or disturbance outside of the approved disturbance envelope;
- Hydrogeological investigations will be undertaken to ensure groundwater abstraction or dewatering is undertaken at rates to sustain local aquifers;
- Groundwater abstraction will be undertaken in accordance with the agreed DoW license; and
- Abstracted groundwater will be re-used or recycled for dust suppression where appropriate.

### 9.6.7 Significance of Residual Impact

The direct loss of subterranean fauna is not considered significant as the majority of impacts may be minimised or avoided through the management measures or involve short-term or localised effects.

The loss of stygofauna or associated habitat due to aquifer drawdown will be localised in nature and will not affect the regional representation of stygofauna. Aquifer drawdown and any resulting localised loss of habitat will be temporary in nature as groundwater abstraction will be confined to the construction phases of the project.

The loss of troglofauna or associated habitat due to soil excavation is unlikely as the majority of excavation proposed for the Western Spur Railway is within the first 5 m of the soil profile which is typically depauperate in troglofauna.

### 9.5.8 Predicted Environmental Outcome

The EPA's stated objective of ensuring adequate protection of important habitats for subterranean fauna will be met as the habitats present within the project area are not unique or restricted in distribution.

Proposed groundwater dewatering and abstraction activities are unlikely to permanently impact stygofauna habitat and deep soil excavations are planned in coastal areas which are unlikely to support troglofauna. Impacts to groundwater and the soil profile will be managed in accordance with existing standard measures implemented through the CEMP and the measures summarised in **Table 9.11**.

**Table 9.11 – Summary of Potential Impacts and Management Measures Associated with Subterranean Fauna**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Groundwater abstraction | Construction of the Western Spur Railway. | Localised loss of stygofauna or habitat. | *Avoidance/Mitigation/Management Measures:*<br>► Undertake groundwater abstraction in accordance with the agreed DoW license.<br>► Re-use or recycle abstracted groundwater for dust suppression where possible.<br>*Monitoring:*<br>► Undertake groundwater monitoring in compliance with the DoW and DEC requirements, during dewatering to ensure drawdown levels are maintained. |
| Groundwater dewatering | Construction of the car dumpers and conveyor tunnels. | Localised loss of stygofauna or habitat. | As for groundwater abstraction. |
| Clearing and earthworks | Construction of the Western Spur Railway. | Localised loss of troglofauna or habitat through soil excavation. | *Avoidance/Mitigation/Management Measures:*<br>► Minimise soil excavation volumes and depth of excavation where possible during construction of the Western Spur Railway. |
| Leaks or spills | Storage and transport of chemicals, fuels of other hazardous material. Failure of equipment or pipelines. | Localised loss of stygofauna through groundwater pollution.<br>Localised loss of troglofauna through soil pollution. | *Avoidance/Mitigation/Management Measures:*<br>► Hydrocarbons and chemicals will be appropriately stored to minimise potential for contamination.<br>► Hydrocarbon waste is to be segregated from stormwater and other water via closed systems.<br>*Contingency Measures:*<br>► Spill contingency plans prepared to ensure appropriate measures are taken to manage refuelling, storage and spill management.<br>► Spill response kits will be located in close proximity, for prompt response in the event of a spill or leak. |
| Liquid and solid waste disposal | Incorrect disposal of wastes. | Localised loss of stygofauna through groundwater pollution.<br>Localised loss of troglofauna through soil pollution. | *Avoidance/Mitigation/Management Measures:*<br>► Potentially hazardous solid and liquid wastes are to be stored within enclosed containers.<br>► Domestic rubbish in bins is to be frequently collected and removed to the municipal landfill.<br>► Controlled wastes as defined by the Environmental Protection (Controlled Wastes) Regulations 2004, will be properly removed from sites.<br>► On site solid waste disposal will be minimised and properly managed.<br>► Return of empty oil and chemical containers such as metal or plastic drums to the supplier for reuse or recycling where possible. |

## 9.6 Relevant Factor – Surface Water

This section presents the assessment of impacts on surface water associated with the proposed Outer Harbour Development, incorporating design modifications, mitigation and management measures applied to manage the potential impacts.

### 9.6.1 Management Objective

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

### 9.6.2 Description of Factor

Baseline surface water information is provided in **Section 5.4**. Infrastructure and operations associated with the proposed Outer Harbour Development may impede, disrupt or pollute surface drainage systems and impact on the surrounding environment. Key findings relevant to the terrestrial environment include:

- South West Creek and South Creek are the two dominant water courses in the vicinity of the proposed Outer Harbour Development;
- the construction of the FMG Railway to the west of South West Creek and east of South Creek has reduced flood overflow from South Creek into South West Creek;
- the existing Goldsworthy Railway embankment blocks inland penetration of ocean flooding during storm surge events, but compounds riverine flood levels due to the insufficient hydraulic capacity of culverts for the peak catchment discharges;
- the stockyards and infrastructure corridor are located in areas vulnerable to storm surge;
- the east-west alignment of the proposed Western Spur Railway intersects with South West Creek and South Creek; and
- the proposed rail loop is located immediately west of South West Creek which discharges to the north through a diversion channel under the existing Goldsworthy Railway and to the west through a diversion channel under the existing causeway.

Potential impacts of the proposed Outer Harbour Development on tidal flushing in West Creek are discussed in **Section 10**.

### 9.6.3 Assessment Guidance

Guidance on the assessment of impacts to surface water exists at State and Commonwealth government levels. A summary of the assessment guidance documents relating to surface water considered in this impact assessment is provided in **Table 9.12**.

### 9.6.4 Potential Impacts

Potential impacts on surface water resulting from environmental aspects associated with the proposed Outer Harbour Development are discussed below and summarised **Table 9.13**.The key aspects that impact surface water are clearing and earthworks.

#### Erosion and Sedimentation

The clearing of vegetation associated with the Western Spur Railway, rail loop and car dumpers has the potential to increase soil erosion during rainfall events due to increased surface water run-off, which if directed to South West Creek, may increase turbidity levels.

The physical presence of infrastructure with impermeable surfaces may also cause an increase in the volume of surface water and a decrease in infiltration rates into the groundwater. Increased levels of surface run-off into South West Creek from the proposed rail loop may cause erosion of the creek bed and destabilisation of riparian vegetation.

**Table 9.12 – Guidance Specific to the Management of Surface Water**

| Document | Description |
|---|---|
| Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) | Provides an assessment framework for protecting the uses of water through conservation of ambient water quality in aquatic environments. |
| Department of Water Stormwater Management Manual for Western Australia 2004-2007 | Provides policies and planning principles, as well as on-ground bets practice advice. Supports and provides information on WAPC and EPA environmental policies specific to Western Australian guidance and national guides. |
| Water and Rivers Commission. Environmental Water Provisions Policy for Western Australia: Statewide Policy No. 5 (WRC 2000) | Describes principles and processes to be applied by the Commission in determining how much water should be retained for the environment when allocating and reviewing water use rights. It also identifies important linkages to the State's statutory framework. |

**Acidification of Surface Water**

Disturbance of acid sulphate soils during construction may acidify soils and subsequently, surrounding surface water bodies. The potential occurrence of acid sulphate soils in the proposed Outer Harbour Development project area and associated potential impacts are discussed in **Section 9.3.4**.

**Flooding**

The physical presence of infrastructure may impede surface water flows resulting in localised flooding or contribute to flooding through increased surface run-off. Localised flooding is likely to result where the east-west alignment of the proposed Western Spur Railway intersects with South West Creek and South Creek as surface water flowing from the south will be blocked by the railway embankment. Preliminary hydrological modelling indicates flooding may arise to the east and north of the proposed rail loop due to increased surface run-off. The modelling predicted greatest increases in peak flood levels for a 1 in 50 and 1 in 100 year ARI (increase of at least 0.11 m) at the intersection of the Western Spur Railway with South Creek and South West Creek, and at the decommissioned HBI Plant diversion channel. All other areas of infrastructure were predicted to have minimal effect on existing flood levels (BHP Billiton Iron Ore 2008b).

**Deterioration of Water Quality**

The spillage, leaking or disposal of fuels, chemicals or waste materials has the potential to enter surface water pathways and deteriorate surface water quality. Given the close proximity of South West Creek to the proposed stockyards and rail loop, the risk of pollution via surface water run-off is increased.

Potential polluting sources include run off from refuelling stations, workshops, loading and off-loading areas, vehicle and locomotive yards and iron ore stockpiles. The likelihood of pollution or contamination from areas other than the proposed stockyards and rail loop are considered to be low due to the lack of potential polluting sources, site storage facilities (e.g. bunded areas), proposed stormwater management, slurry re-capture sumps and established chemical and waste handling procedures.

### 9.6.5 Matters of National Environmental Significance

There are no matters of NES directly associated with surface water.

### 9.6.6 Management Measures

The proposed measures applicable to the management of impacts on surface water arising from the construction and operation of the proposed Outer Harbour Development are summarised in **Table 9.13**.

Stormwater will be collected via on site drains located on roads and culverts. Water from areas such as workshops and maintenance facilities will be collected through a triple interceptor. The slurry formed by dust suppression at the stockyards will be collected through sumps, which will pump the slurry to the Fresh Water Recovery Plant for re-use. Where appropriate the plant will be designed with sumps to capture slurry.

Disturbance to acid sulphate soils during construction and subsequent acidification of surface water will be managed in accordance with an Acid Sulphate Soils Management Plan (**Appendix A7**) should the proposed detailed acid sulphate soils investigations identify the presence of acid sulphate soils (refer to **Section 9.3.5**).

BHP Billiton iron Ore will undertake a more detailed surface water study and design evaluation during detailed engineering design.

### 9.6.7 Significance of Residual Impact

Impacts to surface water are considered to be of low significance as the majority of impacts may be minimised or avoided through the management measures proposed, and design of infrastructure to manage surface water flows.

Erosion and sedimentation will be avoided or managed through the inclusion of erosion control features in the project design (for example, rock armouring, and capture of surface run-off within settlement ponds). Chemicals or hydrocarbons will be stored in bunded areas and contaminated surface water run-off will be captured and treated prior to discharge to the environment.

Flooding due to the physical presence of infrastructure will be avoided or managed through the inclusion of drainage features in the project design (e.g. culverts, diversion channels). The specific location of areas vulnerable to flooding and requiring drainage features will be defined following further hydrological investigations undertaken in the detailed design phase.

### 9.6.8 Predicted Environmental Outcome

The EPA's stated objective of maintaining the quality of surface water so that existing and potential environmental values, including ecosystem maintenance, are protected will be achieved through managing construction and operational impacts in accordance with existing standard measures, an Acid Sulphate Soils Management Plan, and the proposed Construction Environmental Management Plan.

**Table 9.13 – Summary of Potential Impacts and Management Measures Associated with Surface Water**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Clearing and earth works | Clearing of land, earthworks. | Erosion and sedimentation (rills and gullies) due to changes in natural drainage patterns. | *Avoidance/Mitigation/Management Measures:*<br>► Clearing is to be minimised through engineering design.<br>► Areas used for construction laydown will be located in previously disturbed areas where practicable and rehabilitated post completion of construction activities, unless required for other purposes.<br>► Project design will incorporate erosion and sediment controls to minimise erosion.<br>► Cleared surfaces should be sealed where practicable to prevent erosion. |
| | Dewatering during car dumper construction. | Acidification of soils and surface water due to disturbance of ASS. | *Avoidance/Mitigation/Management Measures:*<br>► Undertake groundwater abstraction in accordance with the agreed DoW license.<br>► Re-use or recycle abstracted groundwater for dust suppression where possible.<br>*Monitoring:*<br>► Undertake surface water monitoring in compliance with the DoW and DEC. |
| Physical presence | Permanent terrestrial facilities. | Erosion and sedimentation (rills and gullies) due to changes in natural drainage patterns.<br>Freshwater flooding due to impediment of surface water flows or increased surface water run-off. | *Avoidance/Mitigation/Management Measures:*<br>► Project design will incorporate erosion and sediment controls to minimise erosion and the potential for changes in natural drainage patterns.<br>► Install suitable sized culverts or widen diversion channels, in accordance with hydrological modelling, in designated areas to maintain surface water flows across the landscape.<br>► Detailed engineering design to ensure culverts along railway line maintain surface water flows and minimise impacts to surface water dependant vegetation.<br>► All project infrastructure should be designed to minimise the risk of inundation during flood conditions,<br>► Settlement ponds and controlled drainage basins will be used where appropriate.<br>► Install slurry capture sumps where appropriate on plant.<br>*Monitoring:*<br>► During construction, water drainage will be regularly inspected in accordance with the CEMP to confirm water drainage systems are effective and water flow pathways are maintained as expected. |
| Leaks and spills | Storage and transport of chemicals, fuels or other hazardous materials. | Deterioration of water quality in nearby streams and creeks due to accidental spills and leaks of hydrocarbons or hazardous materials. | *Avoidance/Mitigation/Management Measures:*<br>► Hydrocarbons and chemicals will be appropriately stored to minimise potential for contamination.<br>► Hydrocarbon waste is to be segregated from stormwater and other water via closed systems.<br>*Contingency Measures:*<br>► Spill contingency plans prepared to ensure appropriate measures are taken to manage refuelling, storage and spill management.<br>► Spill response kits will be located in close proximity, for prompt response in the event of a spill or leak.<br>► To prevent surface water contamination, storm water is to be diverted around the boundary of the stockyards with the use of cut-off drains to collect and divert surface flows. Where possible drainage networks within the proposed Outer Harbour Development will be connect to Controlled Discharge Basins for storage and release.<br>*Monitoring:*<br>► Surface water monitoring will be undertaken in accordance with the CEMP. |

**Table 9.13 – Summary of Potential Impacts and Management Measures Associated with Surface Water (continued)**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Solid and liquid waste disposal | Incorrect disposal. | Deterioration of water quality in nearby streams and creeks due to solid or liquid waste. | *Avoidance/Mitigation/Management Measures:*<br>► Potentially hazardous solid and liquid wastes are to be stored within enclosed containers.<br>► Domestic rubbish in bins is to be frequently collected and removed to the municipal landfill.<br>► Controlled wastes as defined by the *Environmental Protection (Controlled Wastes) Regulations 2004*, will be properly removed from sites.<br>► On site solid waste disposal will be minimised and properly managed.<br>► Return of empty oil and chemical containers such as metal or plastic drums to the supplier for reuse or recycling where possible.<br>► Waste management structures to be installed to minimise potential contamination of nearby streams or creeks.<br>*Monitoring:*<br>► During construction and operations, water drainage will be regularly monitored to confirm water drainage systems are effective and water flow pathways are maintained as expected. |

## 9.7 Relevant Factor – Groundwater

This section presents the assessment of impacts on groundwater associated with the proposed Outer Harbour Development, incorporating design modifications, mitigation and management measures applied to manage the potential impacts.

### 9.7.1 Management Objective

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

### 9.7.2 Description of Factor

Baseline groundwater information is available in **Section 5.4.2**. Key findings include:

- seventy-one registered bores exist within the vicinity of the proposed Outer Harbour Development of which the majority are owned by industry and used for livestock purposes;
- no proclaimed drinking water sources occur within the project area;
- recharge of aquifers is tidal-dominated close to the coast and dependant on surface water infiltration following rainfall events for aquifers located further inland; and
- groundwater in the proposed stockyards and rail loop areas varies in depth between 3 to 5 m AHD and 2 to 3 m AHD for areas closer to the ocean and may fluctuate seasonally by up to 2 m.

BHP Billiton Iron Ore will undertake a detailed hydrogeological assessment to determine the dewatering volumes, flows and duration prior to the commencement of construction, in conjunction with the detailed acid sulphate soil site investigation once access to the car dumper area is gained.

### 9.7.3 Assessment Guidance

Guidance on the assessment of impacts to groundwater exists at a State government level. A summary of the assessment guidance documents relating to groundwater in this impact assessment is provided in **Table 9.14**.

### 9.7.4 Potential Impacts

Potential impacts on groundwater resulting from environmental aspects associated with the proposed Outer Harbour Development are discussed below and summarised in **Table 9.15**. The key aspect that impacts groundwater is groundwater dewatering and abstraction.

#### Aquifer Drawdown

Aquifer drawdown may subsequently impact, to varying degrees, groundwater dependant vegetation and fauna habitats (refer to **Section 9.1.4** and **Section 9.2.4**), soils (refer to **Section 9.3.4**) and stygofauna (refer to **Section 9.5.4**). Aquifer drawdown may also impact other groundwater users such as those in the pastoral industry who use groundwater from registered bores for watering of livestock.

Aquifer drawdown may result from dewatering during construction of the car dumpers and associated conveyor tunnels. It is considered unlikely that permanent aquifer drawdown will result as groundwater recharge in the area of the car dumpers and conveyor tunnel is dominated by tidal influences and dewatering activities will be confined to the construction phase of the project.

The abstraction of groundwater for dust suppression during the construction of the Western Spur Railway may also result in aquifer drawdown. Groundwater abstraction will occur through a number of shallow temporary bores and confined to the construction phase of the project, rendering permanent aquifer drawdown unlikely.

**Table 9.14 – Guidance Specific to the Management of Groundwater**

| Document | Description |
|---|---|
| Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) | Provides an assessment framework for protecting the uses of water through conservation of ambient water quality in aquatic environments. |
| *Environmental Protection (Unauthorised Discharges) Regulations 2004* | Makes provisions for minor pollution offences. Prohibits discharge of certain harmful materials and wastes into the environment. |
| Water and Rivers Commission 2000. Environmental Water Provisions Policy for Western Australia: Statewide Policy No. 5 (WRC 2000) | Describes principles and processes to be applied by the Commission in determining how much water should be retained for the environment when allocating and reviewing water use rights. It also identifies important linkages to the State's statutory framework. |

**Acidification of Groundwater**

Disturbance of ASS during construction may expose potential acid sulphate soils to aerobic conditions leading to the acidification of soils and subsequently, groundwater (refer to **Section 9.3.4**).

**Reduced Infiltration Rates**

Decreased infiltration rates may result due to the presence of impermeable surfaces associated with infrastructure and subsequently result in localised lowering of groundwater levels. The stockyards will be lined with a layer of compacted fill and/or a geotechnical barrier indicating that infiltration rates in this area may be reduced.

**Groundwater Pollution**

Incorrect disposal of solid wastes (for example, putrescible waste) or liquid wastes (for example, sewerage), and leaks and spills of hydrocarbons or hazardous materials may cause a deterioration in groundwater quality. The risk of pollution is greatest around the proposed stockyards and rail loop where workshops, loading and off-loading areas and vehicle yards may be present. Surface water containing iron ore fines is unlikely to infiltrate the layer of compacted fill that will form the base of the stockyards and pollute the groundwater.

### 9.7.5 Matters of National Environmental Significance

There are no matters of NES directly associated with groundwater.

### 9.7.6 Management Measures

The proposed avoidance, mitigation, monitoring and contingency measures applicable to the management of impacts on groundwater arising from the construction and operation of the proposed Outer Harbour Development are summarised in **Table 9.15**.

Disturbance to acid sulphate soils during construction and subsequent acidification of groundwater will be managed in accordance measures proposed in **Section 9.3**.

The CEMP will provide a framework for the environmental management of the terrestrial construction activities associated with the proposed Outer Harbour Development. The program will include detailed strategies, procedures and work practices, to avoid, mitigate or minimise impacts resulting from construction tasks or actions. Management measures proposed include, but are not limited to:

- soil contamination from leaks and spills of chemicals or hydrocarbons and incorrect solid and liquid waste disposal will be avoided through the management measures proposed. In addition, project design will include features to capture potentially contaminated surface water runoff prior to discharge to the environment in high risk areas; and
- the potential disturbance of acid sulphate soils will be managed in accordance with an Acid Sulphate Soils Management Plan (Appendix A7) which will be revised following completion of the acid sulphate soils investigations prior to commencement of construction activities. Further detailed acid sulphate soils investigations will also be undertaken prior to construction to confirm the presence or absence of acid sulphate soils within the proposed disturbance envelope.

BHP Billiton Iron Ore proposes to undertake a dewatering assessment for the installation of the car dumpers prior to commencement of construction. The outcomes of this assessment will inform the proposed dewatering requirements (volumes to be abstracted) and schedule (duration of pumping). This information will inform the CEMP, Acid Sulphate Soil Management Plan and Mangrove Management Plan.

BHP Billiton Iron Ore will seek all required approvals through DoW for the site investigation and dewatering activities.

### 9.7.7 Significance of Residual Impact

The significance of impacts to groundwater are considered low as the majority of impacts may be minimised or avoided through the management measures proposed or involve short-term or localised effects.

Permanent changes to groundwater levels through dewatering, groundwater abstraction or reduced infiltration rates are unlikely to occur due to the temporary nature of these activities or the tidal recharge of the aquifers involved.

Based on the hydrogeological investigations, groundwater abstraction will be undertaken at rates to sustain local aquifers. It is not expected that other groundwater users such as the pastoral industry which currently extracts water for livestock watering purposes, will be negatively impacted by abstraction or dewatering planned for the proposed Outer Harbour Development. Furthermore, negative impacts to vegetation, fauna habitats or stygofauna are not considered likely.

Groundwater pollution is unlikely to occur as surface water contamination, and hence groundwater contamination, will be avoided through project design controls and existing operational controls. Furthermore, surface water containing iron ore fines is unlikely to infiltrate the layer of compacted fill that will form the base of the stockyards and pollute the groundwater.

### 9.7.8 Predicted Environmental Outcome

Although the construction of the proposed Outer Harbour Development will involve groundwater dewatering and abstraction activities, these activities are unlikely to result in permanent aquifer drawdown. No non-BHP Billiton Iron Ore groundwater users will be impacted.

The EPA's stated objective of maintaining the quality of groundwater so that existing and potential environmental values, including ecosystem maintenance, are protected will be achieved through managing construction and operational impacts in accordance with existing standard measures in the CEMP and the Acid Sulphate Soils Management Plan.

## 9.8 Summary

Terrestrial environmental factors which may experience potential impacts of noteworthy importance are summarised below.

- **Flora and Vegetation:** The project will not reduce the local or regional representation of the vegetation communities present within the 940 ha to be permanently cleared. The project will result in the loss of four Priority Flora species, which may compromise the regional distribution of two of these species which have few records in the Port Hedland area. Measures in the Significant Species Management Plan will be implemented to minimise this impact. The project's groundwater dewatering or abstraction activities will not impact phreatophytic or vadophytic flora species due to their location and the unlikely chance of permanent aquifer drawdown eventuating.
- **Fauna:** The project will partially clear habitats of conservation significance, however, the project is unlikely to reduce the local or regional representation of the fauna habitats present or significantly reduce fauna resources. The project is unlikely to result in the loss of fauna at the population level or reduce their local or regional representation. Measures in the Significant Species Management Plan **(Appendix A6)** will be implemented to minimise impacts to fauna of conservation significance that exist or potentially occur in the project area. Impacts to the Brush-tailed Mulgara, considered to be a Matter of National Environmental Significance, may result from clearing activities if not appropriately managed.
- **Geology, Soils and Landforms:** Excavations and dewatering during construction of the project may disturb acid sulphate soils, potentially causing acidification of soil. This will be minimised or avoided through further investigations to delineate definite areas of acid sulphate soils and the implementation of an Acid Sulphate Soils Management Plan **(Appendix A7**). Until further investigations are undertaken to delineate the presence of acid sulphate soils, the potential disturbance of acid sulphate soil during construction has been assessed conservatively. Remaining impacts to soils can be avoided through effective management. The project will not affect the local or regional representation of landforms in the project area.

Terrestrial environmental factors which may experience potential impacts of minimal or negligible consequence are summarised below.

- **Short-range Endemic Fauna:** The loss of rocky limestone outcrops on Finucane Island through clearing within the proposed disturbance envelope will not reduce the local or regional representation of short-range endemic fauna habitat or jeopardise populations of short-range endemic fauna.
- **Subterranean Fauna:** The project will not compromise the local or regional representation of subterranean fauna species or their habitat through dewatering or groundwater abstraction or soil excavation. The potentially occurring species are unlikely to be restricted in distribution and the habitat present is not unique to the project area.
- **Surface Water:** Although project infrastructure intersects with the tributaries of South Creek and South West Creek, alteration to surface water flows and deterioration in water quality can be avoided through effective management.
- **Groundwater:** The project will not significantly impact local and regional groundwater resources as permanent aquifer drawdown is unlikely to occur as a result of dewatering or construction water abstraction activities and deterioration in water quality can be avoided through effective management. No non-BHP Billiton Iron Ore groundwater users or groundwater dependant ecosystems will be significantly impacted by the project.

It is considered that the potential impacts from the proposed Outer Harbour Development can be managed in accordance with the comprehensive measures contained in the Significant Species Management Plan, Acid Sulphate Soils Management Plan and the proposed Construction Environmental Management Plan.

**Table 9.15 – Summary of Potential Impacts Associated with Groundwater**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Groundwater abstraction | Water for dust suppression during rail construction. | Reduction in resource for other groundwater users due to drawdown of aquifer level. | *Avoidance/Mitigation/Management Measures:*<br>► Hydrogeological investigations will be undertaken to ensure groundwater abstraction or dewatering is undertaken at rates to sustain local aquifers.<br>► Groundwater abstraction will be undertaken in accordance with the agreed DoW license.<br>► Abstracted groundwater will be re-used or recycled for dust suppression where possible.<br>*Monitoring:*<br>► Where acid sulphate soils are identified groundwater will be monitored prior to construction, on a monthly basis during construction.<br>► Groundwater monitoring will be undertaken in compliance with the DoW and DEC requirements, during dewatering to ensure drawdown levels are maintained. |
| | Dewatering during car dumper construction. | Reduction in resource for other groundwater users due to drawdown of aquifer level. | |
| | | Acidification of soils and groundwater due to disturbance of ASS. | |
| Physical presence | Impermeable infrastructure. | Reduced groundwater infiltration rates. | *Avoidance/Mitigation/Management Measures:*<br>► Design of infrastructure will minimise impacts to groundwater flows.<br>*Monitoring:*<br>► During construction, groundwater will be regularly monitored in accordance with the CEMP to confirm groundwater infiltration rates are maintained as expected. |
| Leaks and spills | Storage and transport of chemicals, fuels or other hazardous material. | Pollution of groundwater due to accidental leaks and spills. | *Avoidance/Mitigation/Management Measures:*<br>► Hydrocarbons and chemicals will be appropriately stored to minimise potential for contamination.<br>► Hydrocarbon waste is to be segregated from stormwater and other water via closed systems.<br>*Contingency Measures:*<br>► Spill contingency plans prepared to ensure appropriate measures are taken to manage refuelling, storage and spill management.<br>► Spill response kits will be located in close proximity, for prompt response in the event of a spill or leak.<br>*Monitoring:*<br>► Groundwater monitoring will be undertaken in accordance with the CEMP.<br>► Bunded areas will be regularly inspected and cleaned out as required. |

**Table 9.15 – Summary of Potential Impacts Associated with Groundwater (continued)**

| Environmental Aspect | Source | Impacts | Management |
|---|---|---|---|
| Liquid and solid waste disposal | Incorrect disposal of wastes. | Pollution of groundwater due to liquid wastes. | *Avoidance/Mitigation/Management Measures:*<br>► Potentially hazardous solid and liquid wastes are to be stored within enclosed containers.<br>► Domestic rubbish in bins is to be frequently collected and removed to the municipal landfill.<br>► Controlled wastes as defined by the *Environmental Protection (Controlled Wastes) Regulations 2004*, will be properly removed from sites.<br>► On site solid waste disposal will be minimised and properly managed.<br>► Return of empty oil and chemical containers such as metal or plastic drums to the supplier for reuse or recycling where possible.<br>► Waste management structures are to be installed around the stockyards and rail loop to recover spills and allow treatment of contaminants prior to discharge.<br>*Monitoring:*<br>► Groundwater monitoring will be undertaken in accordance with the CEMP.<br>► Groundwater will be monitored prior to construction, on a monthly basis during construction and bi-annually during operations. |