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A Biodiversity Assessment of the Utah Point Berth Development, Port Hedland




Prepared for

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1.0 Summary

1.1 Background

Port Hedland Port is the largest bulk port operating in Australia, with over 110 million tonnes of cargo handled in 2005/2006. It operates in the Pilbara region of Western Australia and due to an expected increase in cargo volume over the next five years, the Port Hedland Port Authority (PHPA) has proposed a new port berth at Utah Point on Finucane Island. Its primary role will be to facilitate the export of chromium and manganese and potentially iron ore. In addition to port construction, modifications to the Finucane Island Access Road may be required.

The PHPA is in the process of seeking approval for this port site development within Port Hedland harbour. The referral for the dredging and reclamation component (stage A) has been submitted to the EPA and it has been agreed that this will be approved as an amendment to the existing Fortescue Metals Group (FMG) approval. The Environmental Protection Authority (EPA) set a Public Environmental Review (PER) level of assessment for the construction and operation aspects of the development (stage B) on 11th December 2006 (SKM 2007). PHPA has commissioned Sinclair Knight Merz (SKM) to scope the key environmental issues to be assessed within the PER process. As part of this project, SKM has commissioned Biota Environmental Sciences (Biota) to undertake an assessment of mangrove ecosystems and terrestrial flora and vegetation in the vicinity of the port site and access road, in conjunction with a desktop fauna review.

1.2 Methods

1.2.1 Mangroves

A desktop assessment of mangrove community impacts presented by the proposal, drawing on past field surveys completed by Biota and Dr Eric Paling (Biota and Trudgen 2002, Hope Downs Management Services 2002, Fortescue Metals Group 2004). This includes the Hope Downs port site mangrove community survey, the Fortescue Metals Group survey and earlier, harbour-wide mangrove assemblage mapping and community ecology work completed for BHP Billiton (Halpern Glick Maunsell 1993).

A literature search and consultation on the ecotoxicological effect of chromite and manganese on mangrove systems were also undertaken to assist with the consideration of this factor in the formal environmental assessment. GIS mapping and area calculations of mangrove clearing extents were completed, based on project footprints supplied by SKM. This was placed into proper context consistent with the requirements of EPA Guidance Statements No. 1 (Tropical Arid Zone Mangroves; EPA 2001) and No. 29 (BPPH protection; EPA 2004c).

1.2.2 Terrestrial Vegetation

The study area was surveyed between the 11th and 13th of April in 2007 by two botanists, Rachel Warner and Britta Mathews of Biota. The survey included:

- mapping of vegetation types; and
- systematic searches for rare flora across the area (during which the locations of weed species were also noted).

1.2.3 Fauna

A desktop review of fauna species potentially present within the project area was conducted to determine the conservation significance of the area. This involved a revision of:

- fauna surveys previously completed in the region;

- bird sightings in the Port Hedland area sourced from the Birds Australia Western Australia Bird Sightings Archives;
- previous searches of the Department of Environment and Conservation (DEC) Threatened Fauna database for the Utah Point locality;
- previous searches of the Western Australian Museum FaunaBase to obtain a listing of specimen records from the State's collection for Utah Point.

1.3 Mangroves

Five species of mangrove have previously been recorded from the Utah Point area (Biota and Trudgen 2002; Fortescue Metals Group 2004). *Bruguiera exaristata* was also recently recorded from the area by Semeniuk (2007). The most abundant and widespread species in the study area were *Avicennia marina* (dominant or codominant in most assemblages in the study area) and *Rhizophora stylosa* (which formed dense stands in more seaward areas, either as a monospecific unit or in association with *A. marina*). *Ceriops tagal* was recorded less commonly in small stands within the study area, and *Aegialitis annulata* and *Bruguiera exaristata* typically only occur in localised patches in accreting shoreward areas.

The clearing impact on mangrove Benthic Primary Producer Habitat (BPPH) associated with the Utah Point proposal indicates that the construction of the new port proposal will result in the clearing of 18.7 ha of mangroves.

The scope for this assessment requires the removal of the Hope Downs port proposal for the purposes of these calculations. This effectively reduces the historical cumulative loss for the management unit from 13.3% (EPA 2005) to 10.0%. Adding in the estimated loss of 18.7 ha for the Utah Point proposal then brings the cumulative loss to 10.7%. Viewed in context then, this proposal will actually represent an improvement on the assessment carried out by EPA (2005), with a reduction of approximately 71 ha of mangrove BPPH loss compared to the originally approved Hope Downs port proposal for Utah Point.

1.4 Terrestrial Vegetation

Three terrestrial vegetation types were identified within the study area:

- *Halosarcia indica* subsp. *leiostachya, H. halocnemoides* subsp. *tenuis*, *Muellerolimon salicorniaceum* scattered low shrubs to low open shrubland extending along the mudflats, merging with the mangroves;
- *Triodia epactia*, *Triodia secunda* hummock grasslands over a very open to open tussock grassland on sandy islands scattered within the mudflats;
- *Acacia stellaticeps* low open shrubland over hummock grassland of *Triodia epactia* over *Sorghum plumosum* open tussock grassland with a rich herbland of variable species. This vegetation was found within a small area at the south-eastern end of the corridor, near Wedgefield.

The samphire shrublands were considered to be of moderate conservation significance, as they are restricted to the narrow saline mudflat habitats along the coast, and are susceptible to disturbance. The *Triodia secunda* hummock grasslands were considered to be of moderate conservation significance, as this species has a relatively limited distribution in the Pilbara. The remaining *Acacia stellaticeps* over *Triodia epactia* vegetation type is relatively widespread in the locality and is considered to be of low conservation significance.

The upgrade of the Finucane Island road will result in the clearing of approximately 21.6 ha of terrestrial vegetation. Whilst it is expected that all fill material will be obtained from dredged spoil, borrow pit areas may be required on PHPA land, but will only be needed if future dredge spoil material is unavailable at the time of construction. In the event that the planned borrow pit is constructed, an additional 24.7 ha of terrestrial vegetation will be cleared. Two vegetation types would be affected under either scenario, but both will remain well represented in the Port Hedland locality.

1.5 Terrestrial Flora

A total of 110 taxa of native vascular flora from 77 genera belonging to 35 families was recorded opportunistically whilst conducting searches for rare flora and weed species. Neither of the Declared Rare Flora species that occur in the Pilbara (*Lepidium catapycnon* and *Thryptomene wittweri*) were located during the field survey, and neither would be expected to occur. On the basis of current knowledge, there are thus no flora of significance under the *EPBC Act 1999* in the Utah Point study area.

One Priority flora was recorded during the field survey, which was previously recorded during the rail corridor survey for both Hope Downs (Biota and Trudgen 2002) and Fortescue Metals Group (Biota 2004a):

- *Bulbostylis burbidgeae* (Priority 3) was recorded at two locations within the sandy island vegetation close to the Finucane Island access road.

Five species of introduced flora were recorded: Buffel Grass **Cenchrus ciliaris,* Birdwood Grass **Cenchrus setiger,* Kapok **Aerva javanica,* Feathertop Rhodes Grass **Chloris virgata* and Verano Stylo **Stylosanthes hamata*.

1.6 Fauna

The results of the Level 1 desktop fauna review revealed a total of five Schedule and eight Priority species potentially occurring in the Port Hedland region. After informed consideration of the habitat types within the study area however, only three Priority and six Migratory listed fauna species were considered likely to occur. These were:

- Little North-western Mastiff Bat *Mormopterus loriae cobourgensis* (Priority 1),
- Australian Bustard *Ardeotis australis* (Priority 4),
- Eastern Curlew *Numenius madagascariensis* (Priority 4),
- Oriental Pratincole *Glareola maldivarum* (Migratory),
- Oriental Plover *Charadrius veredus* (Migratory),
- Little Curlew *Numenius minutus* (Migratory),
- Whimbrel *Numenius phaeopus variegatus* (Migratory),
- Common Sandpiper *Tringa hypoleucos* (Migratory),
- Grey-tailed Tattler *Tringa brevipes* (Migratory).

1.7 Management Recommendations

The following management measures are recommended to minimise disturbance and impacts to the environment from the Utah Point development:

1. Clearing of mangrove vegetation and disturbance to this vegetation type, including filling, should be kept to a minimum. Where possible, the proponent should utilise existing cleared and disturbed areas within the mangrove areas.
2. Clearing of terrestrial vegetation should be kept to the minimum necessary for safe construction and operation of the project, particularly in the vicinity of the Priority 3 species *Bulbostylis burbidgeae*. The width of the access road should be kept to the minimum necessary for port operations.
3. A Weed Hygiene and Management Plan should be prepared in consultation with the DEC prior to the commencement of construction work to improve the current vegetation condition

of the area and to prevent the spread of any introduced species, particularly **Stylosanthes hamata*.

4. An environmental offset package should be developed by the PHPA for the proposed project. An example of an appropriate inclusion could comprise contributing funding towards research into mangrove ecology.
5. Ensure that a comprehensive dust monitoring and management programme is developed and implemented. An assessment of current dust levels, combined with predictions of future emissions, will provide key data for designing and implementing appropriate management strategies.
6. Monitor chromium and manganese levels of the water, sediment and mangroves within the harbour. Design and situate the proposed stockpiles to minimise the risk of leaching into marine environments of the harbour.

2.0 Introduction

2.1 Background to the Project and Location of the Study Area

Port Hedland Port is the largest bulk port operating in Australia: with over 110 million tonnes of cargo handled in 2005/2006, it operates in the Pilbara region of Western Australia.

The Port itself consists of a 20 nautical mile dredged channel leading to a dredged basin between Nelson Point and Finucane Island, where five intertidal creeks converge. It lies within the Littoral land system, characterised by bare coastal mudflats with mangroves, samphire flats, sandy islands, coastal dunes and beaches. This environment has been impacted significantly since European settlement, with recent development and expansion arising from growth in the mining industry.

Due to an expected increase in cargo volume, the Port Hedland Port Authority (PHPA) has proposed a new port berth at Utah Point on Finucane Island. The primary role of this new port berth will be to facilitate the export of chromium and manganese and potentially iron ore. It will have the capacity to handle a maximum of 16 million tonnes per annum and will consist of the following components:

- a stockyard area on Finucane Island;
- road access around stockyards;
- seawalls around the road;
- workshops and associated infrastructure;
- conveyor system;
- power supply, potable water, settlement pond etc;
- port berth and wharf;
- access road to Finucane Island, including a causeway over West Creek.

The proposal site is within the Port Hedland Harbour area and lies south of existing facilities. It includes the southern tip of Utah Point and a narrow corridor extending approximately 10 km along the Finucane Island Access Road. Towards the southern tip of the corridor, a 3 km section of the study area with a width of 250 m was fenced and occupied by FMG construction. Here, it was only possible to survey a 20-30 m roadside area (see Figure 2.1).

2.2 Scope and Objectives of this Study

2.2.1 Purpose of this Report

The purpose of this report is to provide baseline fauna, mangrove and terrestrial vegetation and flora data for use in the environmental impact assessment of the Utah Point Berth Development.

This study was planned and implemented as far as practicable according to the Environmental Protection Authority (EPA) position Statement No. 3 "Terrestrial Biological Surveys as an Element of Biodiversity Protection" (EPA 2002), Guidance Statement No. 51 "Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia" (EPA 2004a), Guidance Statement No. 56 "Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia" (EPA 2004b).

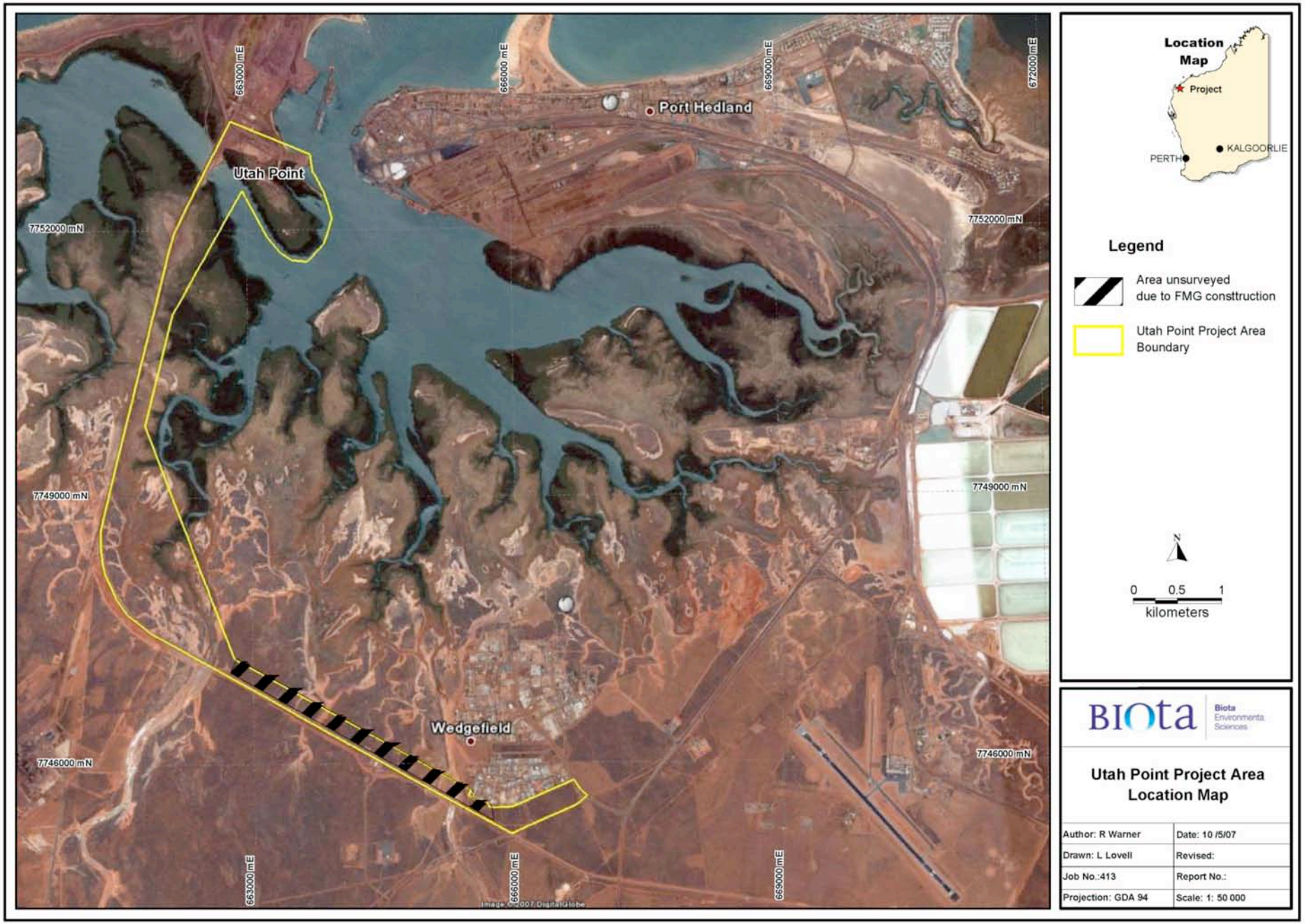

Figure 2.1: Locality map of the Utah Point project area.

As such the study aimed to:

- provide identification of potential mangrove impact mechanisms presented by the proposal, summaries of past field survey results relevant to the project, and GIS-based area calculations of mangrove clearing extents. The latter were then to be placed into proper context with the requirements of EPA Guidance Statements No. 1 "Tropical Arid Zone Mangrove Protection" (EPA 2001) and No. 29 "Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment" (EPA 2004c);
- provide detailed baseline information regarding vegetation and flora values of the study area (this consisted of a field study, utilising techniques generally accepted as standard for the region, which addressed: description and mapping of vegetation types occurring in the study area; identification of any vegetation types of particular conservation significance; collation of information regarding any rare flora or other flora of conservation interest). Past studies in the region, namely the vegetation and flora survey of the proposed FMG Stage A Rail Corridor (Biota 2005), the survey of the proposed Hope Downs Rail Corridor between Port Hedland and Weeli Wolli Creek (Biota and Trudgen 2002) and a botanical survey for the Port Hedland Saltfield Expansion (Biota 2006a) were also examined for relevant contextual information; and
- provide a desktop assessment of fauna impacts presented by the proposal.

2.3 Geological and Physiographic Context of the Study Area

2.3.1 Geology

The Geological Survey of Western Australia 1:500,000 scale mapsheet (Thorne and Trendall 2001) shows two geological types in the vicinity of the survey area. These are:

- **Qm** (Clay, mud, silt and sand: tidal and supratidal deposits, mangroves, lagoons and coastal dunes) – extending from the northern boundary over the majority of the survey area.
- **Qx** (Undivided Quaternary deposits: includes colluvium, reworked alluvium, eolian sand and clay) – occurring at the southern tip of the survey area.

2.3.2 Major Physiographic Units

Beard (1975) identified four major physiographic units within the Fortescue district. The study area lies within the Abydos Plain, which is characterised by alluvial plains, low stony hills and granite outcrops, comprising largely granitic soils with alluvial sands on the coastal portion.

2.3.3 Land Systems (Rangelands)

Land system (Rangelands) mapping covering the project area has been prepared by the Western Australian Department of Agriculture (van Vreeswyk et al. 2004). These are broad units that each consist of a series of "land units" that occur on characteristic physiographic types within the Land System.

One hundred and seven (107) Land Systems occur in the Pilbara bioregion. (This information was obtained by merging the Ashburton Land System mapping (Payne et al. 1988) and Pilbara Land System mapping (van Vreeswyk et al. 2004) and intersecting this with the Pilbara bioregion (Environment Australia 2000) in ArcView 3.2).

The study area includes the following Land Systems:

- **Littoral** Bare coastal mudflats with mangroves on seaward fringes, samphire flats, sandy islands, coastal dunes and beaches; comprising the entire central and northern portion of the study area;
- **Uaroo** Broad sandy plains; a small area at the south-eastern tip of the corridor.

2.4 Biological Context of the Study Area

2.4.1 Pilbara IBRA Bioregion

The study area lies within the Pilbara bioregion, one of 85 bioregions recognised under the Interim Biogeographic Regionalisation for Australia (IBRA; Environment Australia 2000). The Pilbara bioregion has four main components: the Hamersley, Chichester, Fortescue Plains and Roebourne subregions (Environment Australia 2000). These subregions are based largely on the physiographic work of Beard (1975), although the Roebourne subregion comprises only the coastal portion of Beards' Abydos Plains physiographic region, while the remainder of the Abydos Plain is included under the Chichester subregion. The study area lies in the northeastern coastal section of the Roebourne subregion.

The Roebourne subregion of the Pilbara bioregion is described by Kendrick and Stanley (2001) as:

> 'Quaternary alluvial and older colluvial coastal and sub-coastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands. Samphire, *Sporobolus* and mangal occur on marine alluvial flats and river deltas. Resistant linear ranges of basalts occur across the coastal plains, with minor exposures of granite. Islands are either Quaternary sand accumulations, or composed of basalt or limestone, or combinations of any of these three. Climate is arid (semi-desert) tropical with highly variable rainfall, falling mainly in summer. Cyclonic activity is significant, with several systems affecting the coast and hinterland annually. The subregional area is 2,008,983 hectares.'

With increasing survey work in the Pilbara, it is becoming more apparent that the Pilbara bioregion is one of the centres of biodiversity in Western Australia. This appears to be related to the diversity of geological, altitudinal and climatic elements in the region, as well as a function of its location. The Pilbara is located in a transitional zone between the floras of the Eyrean (central desert) and southern Torresian (tropical) bioclimatic regions, and contains elements of both floras (see for example van Leeuwen and Bromilow 2002) for a detailed discussion of the significance of the Hamersley Range). In recognition of this high species diversity and the high levels of endemism in the region, the Pilbara has been nominated as one of 15 national biodiversity "hotspots" by the Minister for the Environment and Heritage (go to www.deh.gov.au/minister/env/2003/mr03oct03.html).

The Pilbara bioregion is listed as a medium priority for funding for land purchased under the National Reserves System Co-operative Program due to the limited representation of the area in conservation reserves. Portions of various pastoral leases in the region have been nominated for exclusion for public purposes in 2015, when the leases come up for renewal. Many of the submissions are from the Department of Environment and Conservation (DEC), with the intention of adding these areas to the existing conservation estate in order to provide a comprehensive, adequate and representative reserve system. None of these proposed exclusions are located in the vicinity of the study area.

2.4.2 Beard's Vegetation Mapping

Beard (1975) mapped the vegetation of the Pilbara at a scale of 1:1,000,000. The study area lies entirely within the Abydos Plain Botanical District of the Eremaean Botanical Province as defined by Beard. The vegetation of this province is typically open, and frequently dominated by spinifex, wattles and occasional Eucalypts.

The Port Hedland study area contains two of Beard's broad mapping units:

- Mangrove; stature variable, normally scrub on this coast; and
- Grass steppe of soft spinifex (*Triodia epactia/T. pungens*).

Given the broad scale of Beard's mapping, these mapping units show only a broad correspondence with the vegetation types identified by the current study (see section 5.0).

2.4.3 Previous Mangrove Studies in the Region

The two principal studies used to provide background information with respect to mangrove assemblages of the area comprised:

- the effect of a harbour development on mangroves in northwestern Australia (Paling et al. 2003); and
- a survey of the proposed Hope Downs rail corridor between Port Hedland and Weeli Wolli Creek (Biota and Trudgen 2002).

2.4.4 Previous Botanical Studies in the Region

Various areas around Port Hedland have been surveyed in the past. In reviewing existing information for context, the following documents were considered:

- a survey of the Abydos-Woodstock Reserve in the late 1980s (Tinley 1991);
- a survey of the proposed Hope Downs rail corridor between Port Hedland and Weeli Wolli Creek (Biota and Trudgen 2002);
- a vegetation and flora survey of the proposed FMG Stage A Rail Corridor (Biota 2004a);
- a flora and vegetation survey of three small areas in the Dampier Salt Port Hedland Salt Operation, conducted by Trudgen (2005); and
- the Port Hedland Solar Saltfield Expansion botanical survey (Biota 2006a).

2.4.5 Previous Fauna studies in the Region

The following fauna surveys were examined as part of the desktop review for the project area:

- the Port Hedland Solar Saltfield Expansion fauna survey (Biota 2006b);
- the vertebrate fauna survey of the proposed Hope Downs Rail Corridor from Weeli Wolli Siding to Port Hedland (Biota 2002); and
- a survey of the fauna habitats and fauna assemblage of the proposed FMG Stage A Rail Corridor (Biota 2004b).

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3.0 Methodology

3.1 Mangroves

Given the relatively recent field surveys completed on mangrove communities in the project area (Biota and Trudgen 2002; Fortescue Metals Group 2004) and the relatively slow rate of change in these systems (Biota 2005), no additional field surveys were carried out on mangrove communities for this exercise. The proposed development footprint is very similar to that of the earlier Hope Downs port proposal (Hope Downs Management Services 2002) and all intertidal areas within the current scope were surveyed as part of this earlier work. In addition to this, further field work was completed by Semeniuk (2007) as part of a wider assessment of the mangroves of Port Hedland harbour.

The methodology for the mangrove assessment therefore comprised:

- Desktop assessment of mangrove community impacts presented by the proposal, drawing on past field surveys completed by Biota and Dr Eric Paling (Biota and Trudgen 2002, Hope Downs Management Services 2002, Fortescue Metals Group 2004). This includes the Hope Downs port site mangrove community survey, the Fortescue Metals Group survey and earlier, harbour-wide mangrove assemblage mapping and community ecology work completed for BHP Billiton (Halpern Glick Maunsell 1993).
- The ecotoxicological effect of chromite and manganese on mangrove systems was also identified as a potential assessment issue by the EPA Service Unit (EPASU). A literature search and consultation exercise was undertaken targeting this issue, to assist with the consideration of this factor in the formal environmental assessment.
- The GIS mapping arising from these earlier studies was rationalised and GIS-based area calculations of mangrove clearing extents were undertaken (using MapInfo Professional v8.5), based on project footprints supplied by SKM. This was placed into proper context consistent with the requirements of EPA Guidance Statements No. 1 (Tropical Arid Zone Mangroves; EPA 2001) and No. 29 (BPPH protection; EPA 2004c).

3.2 Terrestrial Vegetation

3.2.1 Rare Flora Database Searches

Searches of the DEC and Western Australian Herbarium rare flora databases were commissioned to identify Declared Rare and Priority flora species that have been previously recorded from the Port Hedland area. The searches were based on an area that extended approximately 20.5 km west, 28.5 km south and 32.5 km east from Port Hedland. The search area was a rectangle approximately 52 km (in a W-E alignment) by 41 km (in a N-S alignment), bounded by the following coordinates:

- NE corner: 118° 55' 00" E, 20° 12' 00" S; and
- SW corner: 118° 25' 00" E, 20° 34' 00" S.

The search yielded 18 records of seven species: two Priority 1, two Priority 2 and three Priority 3 species (see Section 6.2.4). No records of Declared Rare Flora (DRF) were listed.

Limited systematic flora and vegetation survey work has been completed in the project area. Regional level mapping of broad vegetation units is available from the mapping of Beard (1975) and subsequent work completed on Land Systems by the Western Australian Department of Agriculture (van Vreeswyk et al. 2004). These two references provide information in regards to flora and vegetation in a broad regional context, rather than site-specific information.

3.2.2 Botanical Survey Team and Timing of Field Survey

The terrestrial flora survey work was conducted by Rachel Warner and Britta Mathews, both of Biota, between the 11th and 13th of April in 2007. This survey included:

- mapping of vegetation types; and
- systematic searches for rare flora across the area (during which the locations of weed species were also noted).

The survey followed cyclonic events in early 2007. Port Hedland received 390.8 mm of rain between January 2007 and the April field survey (see Figure 3.1). This was favourable for the collection of ephemeral flora and flowering grasses.

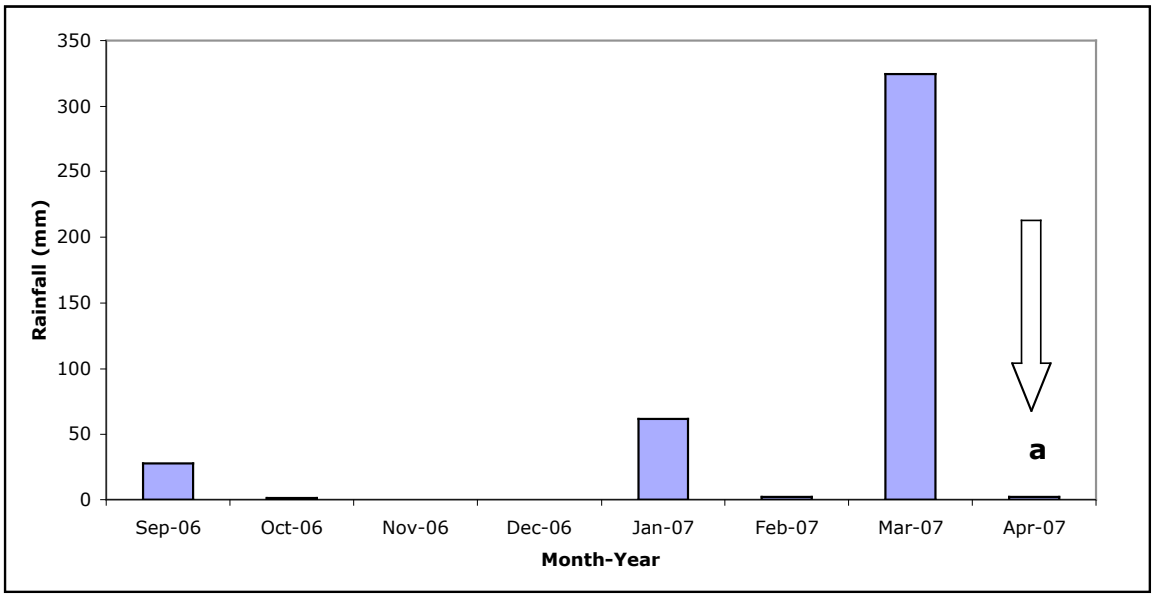

Figure 3.1: Monthly rainfall for Port Hedland from September 2006 to April 10th 2007 (data supplied by Bureau of Meteorology) and timing of the current field survey (a).

3.2.3 Vegetation Description and Mapping

In the current study, terrestrial vegetation descriptions were based on the height and estimated cover of dominant species using Aplin's (1979) modification of the vegetation classification of Specht (1970) to include a hummock grassland category. Descriptions were made as the area was traversed to ground-truth the boundaries of vegetation types. Vegetation condition was also noted (see Appendix 1).

To gather the spatial information, the vegetation descriptions gathered in the field were used in association with digital photography to prepare a draft map of vegetation, using rectified 1:20,000 scale colour digital photography as the background. The vegetation boundaries were subsequently digitised on-screen using the ArcView 3.2 package.

3.2.4 Searches for Rare Flora and Weeds

The rare flora searches were conducted in 50-60 m wide transects throughout the entire survey area. The field botanists were each equipped with a Magellan™ hand-held GPS unit with a polygon overlay of the survey area up-loaded onto the device to ensure the team surveyed the correct area.

Location coordinates in WGS84 datum (zone 50) were recorded using a hand-held GPS for all rare flora and weed species noted. Numbers of individuals were counted or estimated for each location, and other details such as habitat and associated species were also recorded. Voucher specimens were also collected for lodgement with the Western Australian Herbarium. All records

of flora of conservation significance and weed species are presented in Appendix 2. A list of all flora recorded is presented in Appendix 3.

3.2.5 Specimen Identification, Nomenclature and Data Entry

Common species that were well known to the survey botanists were identified in the field. Voucher specimens of all other species were collected and assigned a unique number to facilitate tracking of data. These were pressed in the field, and dried in a drying oven.

These vouchers were then identified by keying out, reference to appropriate publications, use of a reference collection held by ME Trudgen and Associates, and comparison to the collections held at the Western Australian Herbarium. Rachel Warner, Paul Hoffman and Britta Mathews of Biota identified most specimens, with assistance from Malcolm Trudgen (ME Trudgen & Associates) and Paul Wilson (Western Australian Herbarium) for various problematic groups. Specimens will be lodged with the Western Australian Herbarium for all taxa for which suitable material is available.

Nomenclature was checked against the current listing of scientific names recognised by the Western Australian Herbarium and updated as necessary.

Following the identification of the specimens, all data was entered into an Access database.

3.3 Fauna

3.3.1 Rare Fauna Database Searches

Searches of the Birds Australia Western Australia Bird Sightings Archive, the DEC Threatened Fauna database and the Western Australian Museum FaunaBase were conducted to identify Priority or Schedule species previously recorded in the study area (see Appendices 4, 5 and 6). The searches were based on an area that extended approximately 50 km west, 50 km south and 50 km east from Port Hedland. The search area was bound by the following coordinates:

- NE corner: 19° 52'
- SW corner: 119° 12'

The search yielded five Schedule and eight Priority species potentially occurring in the region, along with seven species listed as Migratory under the *EPBC Act 1999*. An examination of the habitat types within the study area was used to determine whether these species were likely to occur. Based on this assessment, three Priority species and six Migratory species are considered likely to occur in the vicinity of the development site at Port Hedland harbour.

3.3.2 Records from Previous Surveys

Data from previous surveys was also collated as part of the process of reviewing likely fauna occurrence. The most relevant studies in this respect were:

- the Port Hedland Solar Saltfield Expansion fauna survey (Biota 2006b);
- the vertebrate fauna survey of the proposed Hope Downs Rail Corridor from Weeli Wolli Siding to Port Hedland (Biota 2002); and
- a survey of the fauna habitats and fauna assemblage of the Proposed FMG Stage A Rail Corridor (Biota 2004b).

3.4 Limitations of this Study

A number of limitations of this ecological review and subsequent conservation assessments are discussed in the following section. These are factors that must be considered when reviewing and applying the results of this study. Despite these limitations, the field study and desktop reviews are

believed to give a good representation of the mangrove, terrestrial flora and vegetation, and fauna values of the survey area.

The main limitations of this study are as follows:

- Fungi and non-vascular flora (eg. algae, mosses, and liverworts) were not specifically sampled.
- Although the 2007 botanical field survey was conducted at an appropriate time for detecting most ephemeral flora, some species (eg. annual daisies that would germinate mostly after late winter rains) would not have been present or identifiable at the time of the survey.
- The fauna review did not include any field component, relying only on database searches and results from past studies. No systematic sampling of fauna or detailed description of fauna habitats was carried out and this report should not be treated as an exhaustive or conclusive account of fauna in the study area.
- The mangrove assessment relied upon a review of previous work in the region (see Biota 2004a). It addresses the potential impact mechanisms presented by the current proposal, however, it must not be considered exhaustive or conclusive.

4.0 Mangroves

4.1 Mangrove Flora

Eight species of mangroves are known to occur in coastal environments in the Pilbara region (Semeniuk et al. 1978, Kenneally 1982, Semeniuk 2007), and six of these are documented as occurring within Port Hedland Harbour (Paling et al. 2001, Biota and Trudgen 2002).

The species present in the Port Hedland area are:

- *Avicennia marina* White Mangrove;
- *Ceriops tagal* Yellow-leaved Spurred Mangrove;
- *Rhizophora stylosa* Stilt-rooted Mangrove;
- *Aegialitis annulata* Club Mangrove;
- *Aegiceras corniculatum* Horned Mangrove; and
- *Bruguiera exaristata* Rib-fruited Orange Mangrove.

Five species of mangrove have previously been recorded from the Utah Point area (Biota and Trudgen 2002; Fortescue Metals Group 2004). *Bruguiera exaristata* was also recently recorded from the area by Semeniuk (2007). The most abundant and widespread species in the study area were *Avicennia marina* (dominant or codominant in most assemblages in the study area) and *Rhizophora stylosa* (which formed dense stands in more seaward areas, either as a monospecific unit or in association with *A. marina*). *Ceriops tagal* was recorded less commonly in small stands within the study area, and *Aegialitis annulata* and *Bruguiera exaristata* typically only occur in localised patches in accreting shoreward areas.

4.2 Mangrove Community Assemblages

The local occurrence of mangrove species and assemblages within the stockpile and port area followed similar patterns to those observed elsewhere in the region in relation to species distribution, local geomorphology and substrate (Paling et al. 2001, Semeniuk 1985, Semeniuk 2007). No areas of cyanobacterial mats (Paling et al. 1989, Paling and McComb 1994) occur in the vicinity of Utah Point itself due the more elevated limestone substrate backing the mangroves.

Mangrove assemblages identified from the development area were categorised as listed below in Table 4.1. The assemblages were divided based on species composition, vegetation structure and physiognomy, substrate and geomorphology. The assemblage types are consistent with those previously applied to the formal environmental assessment of the proposed Hope Downs port (Hope Downs Management Services 2002) and the Fortescue Metals Group (2004) port. These vary somewhat in level of resolution from those categorised by Semeniuk (2007).

Table 4.1: Representation of mangrove associations within Port Hedland Harbour (after Paling et al. 2001).

Association	Area within Port Hedland Harbour (ha)
Closed canopy woodland of *Rhizophora stylosa*	203
Closed canopy woodland of *R. stylosa* and *Avicennia marina*	152
Closed canopy woodland of *A. marina* (seaward fringe)	37
Closed canopy woodland of *A. marina* (landward margins)	451
Low open shrubland of *A. marina* on saline flats with scattered samphires	241
Low, dense *Aegiceras corniculatum*	10
Low open *Ceriops tagal*	3
Aegialitis annulata	11
Total:	**1,108**

The more structurally complex mangal occurred in areas closer to the margins of major and minor creeks, particularly West Creek on the southern margin of Utah Point. In these areas *Rhizophora stylosa* was dominant or codominant with *Avicennia marina*. The denser, taller mangrove associations in these areas typically consisted of pure stands of *R. stylosa*, mixed *R. stylosa* and *A. marina*, or purer tall *A. marina* in a narrow band along the most seaward portions. The majority of the proposed development area was accounted for by structural variants of pure *A. marina* stands, mostly low shrublands to forest backing the taller, more seaward associations towards the hinterland. Other less common species such as *Ceriops tagal, Aegiceras corniculatum* and *Aegialitis annulata* generally formed small mixed stands in localised areas, particularly on accreting sand banks and recent depositional areas.

All the assemblages recorded were in good to very good condition, although those to the north of the proposed development area were notably dust affected by existing iron ore handling operations on Finucane Island. All the associations recorded from the study area also occur elsewhere within Port Hedland Harbour (Paling et al. 2001, Semeniuk 2007). Mangal habitats bordering the southern portion of the study area along the existing Finucane Island access road were typically backed by open to very open samphire and halophyte communities on hypersaline flats (see Section 3.2.3). These largely comprised structural variants of pure *A. marina* stands, mostly low shrublands to forest backing the taller, more seaward associations towards the centre of the harbour.

5.0 Terrestrial Vegetation

5.1 Vegetation Types

Three terrestrial vegetation types were defined from the Utah Point development area. They were:

- ***Halosarcia indica* subsp. *leiostachya, H. halocnemoides* subsp. *tenuis*, *Muellerolimon salicorniaceum* scattered low shrubs to low open shrubland** (Plate 5.1 and Plate 5.2)

This vegetation was commonly encountered in the study area, extending along the saline coastal mudflats bordered by the mangroves (see Section 4.0). Other associated species included *Frankenia ambita, Trianthema turgidifolia*, *Neobassia astrocarpa*, *Calandrinia sp.* Pinga (T.R. Lally TRL 722), *Hemichroa diandra*, *Enchylaena tomentosa* and occasional *Avicennia marina*. This vegetation type was previously recorded from the Hope Downs Rail Corridor survey in the vicinity of Port Hedland and assigned the code **As** (Biota and Trudgen 2002). It was considered to be of moderate conservation significance: despite being widespread in the region, this vegetation is restricted to the mudflats of the littoral fringe along the coast, and is also sensitive to disturbance (Biota and Trudgen 2002).

Plate 5.1: Vegetation of the saline coastal mudflats.

Plate 5.2: *Halosarcia halocnemoides* subsp. *tenuis*.

- ***Triodia epactia*, *T. secunda* hummock grassland over *Eragrostis falcata*, *E. setifolia, Eriachne obtusa* very open tussock grassland to open tussock grassland** (Plate 5.3)

A variety of other species were present including *Commelina ensifolia*, *Hemichroa diandra*, *Cyperus bulbosus, Frankenia ambita, Cassytha capillaris* and *Hybanthus aurantiacus*. This vegetation type occurred on low sandy islands scattered within the saline flats. It was also recorded in the Port Hedland area by Biota and Trudgen (2002) during the Hope Downs rail corridor survey. Identified as vegetation type **Apt1** in the latter report, it was considered to be of moderate conservation significance, as *T. secunda* is not a widespread species in the region (Biota and Trudgen 2002).

- ***Acacia stellaticeps* low open shrubland over *Triodia epactia* hummock grassland over open mixed tussock grassland and closed herbland** (Plate 5.4).

The open tussock grassland included species such as *Sorghum plumosum, *Cenchrus ciliaris, Eriachne obtusa, Aristida holathera* var. *holathera* and *Dactyloctenium radulans*, while the herbland comprised various species, including *Corchorus incanus* subsp. *incanus, Hybanthus aurantiacus, Tephrosia* spp., *Solanum ellipticum, Glycine canescens, Rhynchosia minima, Evolvulus alsinoides* var. *villosicalyx* and *Melhania oblongifolia*. This species rich vegetation type was found in a small area at the south-eastern end of the corridor, near Wedgefield. It is

comparable to the vegetation type **Apt9** recorded from the Hope Downs rail corridor survey (Biota and Trudgen 2002), which was considered to be well represented in the locality and of low conservation significance.

Plate 5.3: Sandy island vegetation occurring within the saline coastal mudflats.

Plate 5.4: *Acacia stellaticeps* low open shrubland over hummock grassland, open tussock grassland and closed herbland.

A map of the distribution of these vegetation types is presented in Figure 5.1.

5.2 Vegetation Condition

The vegetation condition of the majority of the study area was Poor to Good (see Appendix 1). Disturbance was significant as a consequence of the high level of industrial development in the locality. This included infrastructure such as a road, powerlines, drains, buildings and tracks, and considerable rubbish was also present. There was also a number of weed species recorded throughout the area, particularly along the current access road, bordering the project area (see Section 6.3).

Plate 5.5: The weed species **Aerva javanica* was scattered throughout the project area.

Plate 5.6: The condition of vegetation in the project area was poor in some sections.

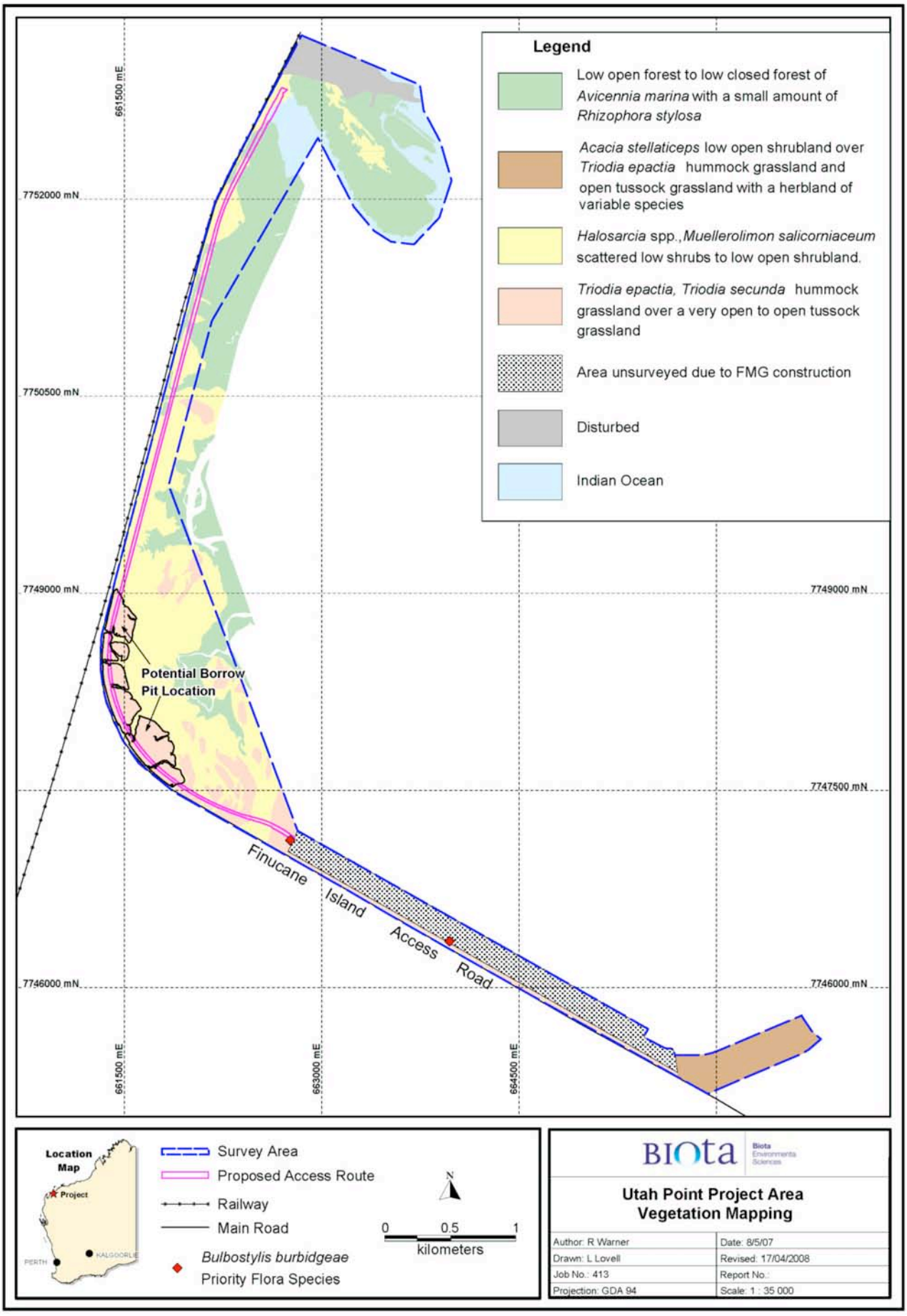

Figure 5.1: Vegetation types of the Utah Point study area, including locations of Priority Flora and showing proposed road upgrade and potential borrow pit outlines. For detailed breakdown of mangrove associations, see Section 4.2 and Figure 8.1.

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6.0 Flora

6.1 Overview of the Flora of the Study Area

A total of 110 taxa of native vascular flora from 77 genera belonging to 35 families was recorded from the study area (see Appendix 3). In addition, five species of introduced flora were recorded (see Section 6.3). The families with the greatest number of native taxa within the study area are shown in Table 6.1. These are all typical dominant plant groups for study sites in the locality.

Table 6.1: Most species rich families within the project area.

Family	Number of Native taxa (No. of Introduced Taxa)
Poaceae (grass family)	13 (3)
Papilionaceae (pea family)	13 (1)
Convolvulaceae (morning glory family)	7
Mimosaceae (wattle family)	7
Malvaceae (Hibiscus family)	7
Chenopodiaceae (samphire family)	6
Cyperaceae (sedge family)	6

6.2 Flora of Conservation Significance

6.2.1 Legislative and Administrative Levels of Flora Protection

While all native flora are protected under the *Wildlife Conservation Act 1950-1979*, a number of plant species are assigned an additional level of conservation significance based on the limited number of known populations and the perceived threats to these populations (Table 6.2). Species of the highest conservation significance are designated Declared Rare Flora (DRF), either extant or presumed extinct. Species that appear to be rare or threatened, but for which there is insufficient information to properly evaluate their conservation significance, are assigned to one of four Priority flora categories.

In addition, the presence of some flora species means that it may be necessary to refer proposals to the Federal Minister for the Environment under the *Environment Protection and Biodiversity Conservation Act 1999*. In the Pilbara, only the two Declared Rare Flora species, Hamersley Lepidium *Lepidium catapycnon* and Mountain Thryptomene *Thryptomene wittweri,* are currently listed under the *EPBC Act 1999*. *Lepidium catapycnon* is typically found on stony hillslopes of the Hamersley Range, while *Thryptomene wittweri* is only known from high altitudes in the Hamersley Range and at Mt Augustus.

Table 6.2: Categories of conservation significance for flora species (Atkins 2006).

R: Declared Rare Flora – Extant Taxa. Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection.
X: Declared Rare Flora – Presumed Extinct Taxa. Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.
1: Priority One – Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.
2: Priority Two – Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.
3: Priority Three – Poorly Known Taxa. Taxa which are known from several populations, and the taxa are not believed to be under immediate threat.
4: Priority Four – Rare Taxa. Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors.

6.2.2 Flora of Conservation Significance Previously Recorded in the Vicinity of Port Hedland

The search of the DEC and WA Herbarium databases for rare flora previously recorded in the Port Hedland area yielded 18 records of seven species:

- two Priority 1 species *(Ptilotus appendiculatus* var. *minor* and *Tephrosia andrewii);*
- two Priority 2 species *(Euphorbia clementii* and *Gomphrena pusilla);* and
- three Priority 3 species *(Acacia glaucocaesia, Goodenia pascua* and *Gymnanthera cunninghamii)*.

Each of these species is described below.

- ***Ptilotus appendiculatus* var. *minor*** **Priority 1**

Ptilotus appendiculatus var. *minor* has, to date, only been recorded as occurring in the Port Hedland, Boodarie area. It is a prostrate to ascending perennial herb or shrub.

- ***Tephrosia andrewii*** **Priority 1**

Although voucher specimens of *Tephrosia andrewii* have only been lodged from two coastal sites in the Dampierland subregion of the Kimberley bioregion, this species has also apparently been recorded at Port Hedland (Atkins 2006). It has orange flowers and a shrubby multi-stemmed growth form to 0.8 m, and grows in pindan country on sandy soils.

- ***Euphorbia clementii*** **Priority 2**

Euphorbia clementii is described as an erect herb to 50 cm high, which occurs on gravelly hillsides and stony ground (Paczkowska and Chapman 2000). This species is known from Yarrie, near Shay Gap and near Port Hedland (Atkins 2006), and was also recorded twice from a survey at Panorama, south-south-east of Port Hedland (Trudgen et al. 2002), and once ~3 km south of Chinnamon Creek during the initial survey of the Hope Downs rail corridor from Port Hedland to near Newman (Biota and Trudgen 2002).

- ***Gomphrena pusilla*** **Priority 2**

Gomphrena pusilla has been recorded within the Pilbara bioregion, as well as the Dampierland subregion of the Kimberley bioregion. It is a slender branching annual herb to 0.2 m high, with white flowers in March-June, which is found growing in fine beach sand behind foredunes, on limestone.

- ***Acacia glaucocaesia*** **Priority 3**

Acacia glaucocaesia has been recorded at a number of sites along coastal and inland regions of both the Dampierland subregion and Pilbara bioregion. It is a dense, glabrous shrub or tree, 1.8–6 m high, flowering in July to September. *A. glaucocaesia* has been recorded on red loam, sandy loam and clay of floodplains.

- ***Goodenia pascua*** **Priority 3**

Goodenia pascua has been recorded along coastal and inland areas of the Pilbara and Carnarvon bioregions. It is described as an ascending to erect herb to 0.5 m high, with yellow flowers in May-August, and is found on red sandy soils and basaltic plains.

- ***Gymnanthera cunninghamii*** **Priority 3**

Gymnanthera cunninghamii is an erect (to 2 m high), multistemmed suckering shrub, which flowers in January-December and typically grows on sandy soils. This species appears to occur as clones of a few stems, but mostly of one individual. Although uncommon in the Fortescue Botanical District, this species is known from several locations in the Pilbara including Boodarie, 80 Mile Beach, the Dampier Archipelago, the Burrup Peninsula (Trudgen 2002), Shaw River (Trudgen et al. 2002), FMG Stage A rail corridor (Biota 2004a) and the initial Hope Downs rail corridor (Biota and Trudgen 2002). It appears to be very widespread, having also been recorded growing in the

Dampierland, Carnarvon and Great Sandy Desert bioregions, as well as the Northern Territory and Queensland (Atkins 2006).

6.2.3 Probability of Declared Rare Flora Occurring in the Study Area

No Declared Rare Flora were recorded from the Utah Point study area. Neither *Lepidium catapycnon* nor *Thryptomene wittweri* would be expected to occur in the area, as it is located well beyond the probable distribution of both species and suitable habitat is absent (see Section 6.2.1).

There are thus no species within the study area currently listed under the *EPBC Act 1999*.

6.2.4 Priority Flora Occurring in the Study Area

One Priority flora species, *Bulbostylis burbidgeae*, was recorded on two occasions during the field survey and is discussed below (see Table 6.3 and Figure 5.1). Of the other Priority flora known to occur in the locality, only *Ptilotus appendiculatus* var. *minor* and *Gomphrena pusilla* would be considered likely to occur in the sorts of habitats encompassed by the Utah Point study area. Neither species was recorded, despite conditions at the time of survey being favourable for the collection of annual flora.

- ***Bulbostylis burbidgeae*** **Priority 3**

This small sedge species was recorded twice within the sandy island vegetation close to the Finucane Island access road, forming dense stands of around 20 individuals. This species was recorded a number of times in association with granitic boulder outcrops on the Abydos Plain during the Hope Downs rail corridor survey (Biota and Trudgen 2002), appearing restricted to these isolated soil pockets. Within the Utah Point project area, *Bulbostylis burbidgeae* occurred in a more general habitat type and in a disturbed environment. This suggests that the distribution of this species may be less restricted than previously documented, and that further populations may be identified with additional collecting through the Pilbara in favourable seasons.

Table 6.3: Locations of *Bulbostylis burbidgeae* at Utah Point.

Easting (mE)	Northing (mN)
663972	7746352
662761	7747121

6.2.5 Geographical Range Extension

Scattered individuals of *Glycine tomentella* were recorded from the *Acacia stellaticeps* low open shrubland found at the southern tip of the study region near Wedgefield. The collection of *Glycine tomentella* represents a range extension to the south of its known distribution. Ranges were established using the distribution maps on Florabase (http:florabase.calm.wa.gov.au). It should be noted that these are based only on specimens vouchered with the Western Australian Herbarium.

6.3 Introduced Flora (Weeds)

Five introduced flora species were recorded from the Utah Point study area (Table 6.2). While none of the species are Declared Plants according to the Department of Agriculture and Food, the **Cenchrus* species and **Stylosanthes hamata* are considered to be serious environmental weeds.

A brief discussion of each species follows:

- Buffel Grass **Cenchrus ciliaris* and the less common Birdwood Grass **C. setiger* were introduced by pastoralists as fodder species. Buffel Grass has demonstrated allelopathic capacities, whereby it releases chemicals that inhibit the growth of other plants, and both

species are aggressive and effective competitors with native flora. These perennial grasses form dense tussock grasslands, particularly along creeklines, floodplains and in sandy coastal areas. Buffel grass was common at Utah Point, occurring predominantly along the roadsides which bordered the study area. Birdwood Grass was encountered less frequently, and was typically found in association with Buffel Grass along roadsides.

- Kapok **Aerva javanica* is a native of northern Africa and South West Asia, which was introduced to assist with rangeland revegetation (Hussey et al. 1997). This perennial shrub is now a widespread weed of arid regions and can be quite invasive in disturbed sandy substrates in the Pilbara. It was recorded occasionally, scattered through the study area.
- Feathertop Rhodes Grass **Chloris virgata* is a tufted perennial. It was encountered less frequently than Buffel Grass and Birdwood Grass, yet did occur along the roadsides in association with these species.
- Verano Stylo **Stylosanthes hamata* is a softly hairy perennial herb with yellow flowers which occurs in disturbed areas, particularly along seepage areas and creeks. It was found bordering the grassland vegetation at the south-eastern end of the corridor. This species forms dense infestations in roadside drains near Karratha, and is considered to be a serious environmental weed.

Table 6.4: Introduced flora species found in the Utah Point study area.

Introduced Flora	Number of Records	Location within Study Area
Poaceae		
**Cenchrus ciliaris*	27	Dense along Finucane Island access road
**Cenchrus setiger*	15	Scattered along the roadside and through sections of the project area
**Chloris virgata*	9	Scattered along the roadside
Amaranthaceae		
**Aerva javanica*	22	Scattered throughout the study area
Papilionaceae		
**Stylosanthes hamata*	3	Bordering the roadside at the south-eastern end of the project area.

7.0 Fauna

7.1 Overview of Habitat Types

After evaluation of the review of mangrove habitat (Section 4.0) and the terrestrial vegetation field survey (Section 5.0), the following habitats of the project area were considered for their potential to support terrestrial fauna:

- **Mangroves and intertidal habitats:** This may be of high fauna conservation significance as it provides foraging, feeding and roosting habitat for several species of birds and bats (Hutchings and Recher 1982; Churchill 1998; Johnstone 1990).
- **Samphire/Mudflats:** The small areas of intertidal samphire/mud flats occurring within the project area may support a high diversity of benthic macroinvertebrates including polychaetes, molluscs and crustaceans (Hutchings and Recher 1982). The areas devoid of vegetation are generally hypersaline and are unlikely to be utilised on a regular basis by terrestrial fauna.
- **Sandy Islands:** The sandy islands scattered within the saline flats were generally small, somewhat isolated and represent a low *Triodia* hummock grass habitat widespread in the locality (Biota 2002).

7.2 Overview of Fauna Potentially Occurring in the Study Area

7.2.1 Vertebrate Fauna

A search of the WA Museum's collection records yielded a total of 160 species of vertebrate fauna vouchered from an approximate 50 km zone extending beyond the project area (Appendix 6). This tally included 88 species of herpetofauna, comprising nine frogs, eight agamid species, five pythons, two turtle species, one sea snake, 15 elapid (front-fanged) snakes, 14 geckos, six pygopodids (legless lizards), 20 skink species, four blind-snakes and four varanid species. The museum search also returned 49 native bird species and 23 mammal species. It is important to note that the bird species generated by the search of the WA Museum database is based on vouchered specimens rather than observations, and is not indicative of the likely avian species richness of the area.

Two of the vertebrate species on the WA Museum collection database for the search area are currently listed as Threatened fauna by DEC and these are addressed further in Section 7.3. The review of the WA Bird Sightings Archives yielded 11 additional species of birds for the immediate Port Hedland vicinity (see Appendix 4). Three of these are listed as 'Migratory' under the *EPBC Act 1999* and are discussed briefly in Section 7.3.

7.2.2 Mangrove Dependent Avifauna

Mangrove systems provide habitat for a group of bird species that appear to be largely restricted to mangal and associated littoral habitats (Johnstone 1990). The avifauna of mangrove habitats in the study area were previously assessed as part of the vertebrate fauna surveys for the Hope Downs project (HDMS 2002) and the FMG port and rail development (Biota 2004). A substantial bird fauna utilised the mangroves at the site, including 12 species which are regarded as effectively restricted to mangrove and associated littoral habitats (Johnstone 1990). These included the Mangrove Golden Whistler, Mangrove Gerygone, Mangrove Robin, Bar-shoulder Dove and the Mangrove Fantail (Biota 2001). A number of wader species were also recorded from the mud-flat habitats associated with West Creek, including the Whimbrel, Eastern Curlew, Common Sandpiper and the Grey-tailed Tattler (Biota 2001).

7.2.3 Mangrove Invertebrate Fauna

A wide range of marine invertebrate fauna may also occur in the mangroves and the samphire mud flats. Invertebrates found in the mangal itself may include mud whelks (*Terebralia* spp.), and a range of grapsid crab species and ocypodid crabs, including the widespread Flamed Fiddler Crab *Uca flammula* and ghost crabs *Ocypode* spp (Hutchings and Recher 1982, Jones and Morgan 2002). Invertebrates commonly found in the mangrove sediment and mudflats include polychaete worms, annelid worms, flat worms and a range of molluscs (Hutchings and Recher 1982). Halpern Glick Maunsell (1993) identified a total of 183 infauna species, of these approximately 55% were polychaete worms, 24% molluscs and 18% crustaceans.

7.3 Fauna Species of Conservation Significance

7.3.1 Legislative and Administrative Levels of Fauna Protection

Native fauna species which are rare, threatened with extinction or have high conservation value are specifically protected by law under the State *Wildlife Conservation Act 1950-1979*. In addition, many of these species are listed under the Federal *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999)*.

1. *EPBC Act 1999*

Fauna species of national conservation significance are listed under the *EPBC Act 1999*, and may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'conservation dependent' (consistent with IUCN categories (IUCN 1996)). Migratory wader species are also protected under this Act. The national List of Migratory Species consists of those species listed under the following International Conventions:

- Japan-Australia Migratory Bird Agreement (JAMBA);
- China-Australia Migratory Bird Agreement (CAMBA);
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

2. *Wildlife Conservation Act 1950-1979*

Classification of rare and endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice 2006* recognises four distinct schedules of taxa:

- Schedule 1 taxa are fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection;
- Schedule 2 taxa are fauna which are presumed to be extinct and are declared to be fauna in need of special protection;
- Schedule 3 taxa are birds which are subject to an agreement between the governments of Australia, Japan and China relating to the protection of migratory birds and birds in danger of extinction which are declared to be fauna in need of special protection; and
- Schedule 4 taxa are fauna that are in need of special protection, otherwise than for the reasons mentioned in paragraphs (1), (2) and (3).

In addition to the above classification, fauna are also recognised under five Priority levels:

Priority One Taxa with few, poorly known populations on threatened lands.
Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Two Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands.
Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Three Taxa with several, poorly known populations, some on conservation lands.
Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Four Taxa in need of monitoring.
Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. Taxa which are declining significantly but are not yet threatened.

Priority Five Taxa in need of monitoring.
Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

7.3.2 Fauna Species of Conservation Significance Potentially Occurring in the Study Area

The following assessment of Threatened Fauna taxa that may potentially occur within the Utah Point project area was based on:

- a review of the broad habitat types present (Section 7.1);
- the results from past surveys associated with the study region (Section 2.4.5);
- the results of a search of Western Australia Recent Bird Sightings Archives for the Port Hedland region (Appendix 4);
- the results of previous searches of the DEC Threatened Fauna database (Appendix 5); and
- fauna specimens lodged with the WA Museum from the region (Appendix 6).

The combined searches yielded a total of five Schedule and eight Priority species potentially occurring in the project area (Appendix 5). A further seven species potentially occurring in the project area are listed as Migratory under the *EPBC Act 1999* (Appendix 5). However, based on preferred habitat type, it is unlikely that all of these species would occur in the proposed project area. Only three Priority species and six Migratory species are likely to rely upon the habitat types present in the study area, and these species are discussed below.

Little North-western Mastiff Bat *Mormopterus loriae cobourgensis* Priority 1

The Little North-western Mastiff Bat has been recorded within the Utah Point area and is assumed to rely, at least partly, on the mangrove habitat for prey foraging (Biota 2002). The bat is listed as a Priority 1 species, with few or poorly known populations on threatened lands along the northwest coast (Churchill 1998). This species has a strong preference for mangal habitat but can be found in adjacent areas as well. It generally roosts in hollows in the mangrove *Avicennia marina* (Churchill 1998). Potential impacts through habitat loss are likely to occur at the local population level, as roosting occurs within the mangrove habitat inside the proposed impact area. However, the species, while restricted to mangroves, is relatively widespread and well-represented in mangroves along the Pilbara coast (Churchill 1998, Biota and Halpern Glick Maunsell 2000). No taxon level changes in conservation status would therefore be expected.

Australian Bustard *Ardeotis australis* Priority 4

This species has previously been recorded at a variety of locations within the Abydos Plain (Biota 2002) and one bird was sighted flying over *Acacia* low shrubland within ~20km of the project area (Biota 2006b). The Australian Bustard occurs over much of Western Australia, with its wider distribution including eastern Australia and New Guinea. The species prefers open or lightly wooded grassy plains including sandplains with spinifex *Triodia* (Johnstone and Storr 1998).

Potential impacts include habitat loss and a risk of mortality through collision with vehicles. However, given that the project area does not intersect its preferred habitat type, it is unlikely that the conservation status of this relatively widespread species will be altered by the proposed development.

Eastern Curlew *Numenius madagascariensis* **Priority 4 ('Migratory' under *EPBC Act 1999*)**

A previous survey of the project area recorded the Eastern Curlew on mudflats adjacent to the mangroves at Finucane Island (Biota 2006b). This species occurs throughout coastal Western Australia, south to Bunbury (Johnstone and Storr 1998), and breeds in northern Asia. It is a summer migrant to Australia and is considered moderately common along the tidal mudflats, reef flats and sandy beaches of the Pilbara coast (Johnstone and Storr 1998). Given its widespread distribution, the proposed project is unlikely to cause significant habitat loss for the Eastern Curlew.

Oriental Pratincole *Glareola maldivarum* **'Migratory' under *EPBC Act 1999***

Large flocks of Oriental Pratincoles have been sighted in the Port Hedland vicinity (Birds Australia, Appendix 4). The species typically roosts on bare ground beside water and feeds at tidal flats and floodwaters (Johnstone and Storr 1998). The proposed Utah Point development is unlikely to cause significant intertidal mudflat habitat loss for this migratory species.

Oriental Plover *Charadrius veredus* **'Migratory' under *EPBC Act 1999***

The Oriental Plover has been sighted within 60 km of the proposed project area (Birds Australia, Appendix 4), typically inhabiting sparsely vegetated plains, beaches and tidal flats. The Oriental Plover is relatively common, and as such, the proposed Utah Point development is unlikely to impact on the conservation status of the species.

Little Curlew *Numenius minutus* **'Migratory' under *EPBC Act 1999***

The Little Curlew's abundance in the Pilbara region is variable. Johnstone and Storr (1998) found it to be scarce south of Port Hedland, however the species has been sighted in the Port Hedland vicinity (Birds Australia, Appendix 4). The Little Curlew prefers short-grass plains as habitat, including sports grounds and tidal mud flats. The proposed project is unlikely to cause significant loss of intertidal mudflat and grassland habitat for this species.

Whimbrel *Numenius phaeopus variegatus* **'Migratory' under *EPBC Act 1999***

The species has been recorded from mudflat habitats within the project area, usually foraging or roosting in moderate sized groups (Biota 2002). The Whimbrel is a migratory species, common on north-west Australian coasts south to Cape Naturaliste (Johnstone and Storr 1998). The proposed project is unlikely to cause the loss of significant intertidal mudflat habitat for this species.

Common Sandpiper *Tringa hypoleucos* **'Migratory' under *EPBC Act 1999***

A few individuals have been recorded foraging along the tide margin on the mudflats within the proposed project area (Biota 2002). The Common Sandpiper is generally found on the edge of sheltered waters such as mangrove creeks and estuaries along the West Australian coast and on many islands (Johnstone and Storr 1998). The proposed project is unlikely to cause significant intertidal mudflat habitat loss for this species.

Grey-tailed Tattler *Tringa brevipes* **'Migratory' under *EPBC Act 1999***

The Grey-tailed Tattler, whilst scarce in the proposed project area, inhabits tidal mud flats and estuarine sand flats along most north-western Australian coasts (Johnstone and Storr 1998). Biota (2002) recorded a few foraging birds in the vicinity of a tidal creek pool on Finucane Island. The proposed project is unlikely to cause significant intertidal mudflat habitat loss for this species.

8.0 Impacts and Management

8.1 Probable Impacts on Mangroves

8.1.1 Potential Impact Mechanisms

Direct clearing is the primary impact on mangroves likely to arise from the development of the Utah Point proposal. This will result from clearing to accommodate the new facilities on Utah Point.

Other potential impacts include those effects that increased port activity will have on nearby mangal and other vegetation communities. These may include:

- Dust deposition: this can affect transpiration and photosynthesis (essential to plant survival);
- Alteration to groundwater regimes: changes to this may impact on the vegetation structure;
- Chromium and manganese toxicity: this may occur via seepage through stockpiles and enter the surrounding environment. Manganese is highly toxic, particularly to shoots where accumulation occurs, and may result in reduced iron uptake by roots and distortion of expanding leaves (Atwell et al. 1999). High chromium levels can also have deleterious effects on plant growth. It has been found to alter the germination process and cause oxidative stress and the breakdown of photosynthetic pigments, leading to a decline in growth (Shanker et al. 2005).

8.1.2 Management Policy Framework

Two EPA Guidance Statements are relevant to the assessment of impacts on mangroves in Port Hedland Harbour:

1. Guidance Statement for the protection of tropical arid zone mangroves along the Pilbara coastline (EPA Guidance Statement No. 1, May 2001).
2. Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment (EPA Guidance Statement No. 29, June 2004).

8.1.2.1 Guidance Statement for the Protection of Tropical Arid Zone Mangroves along the Pilbara Coastline (EPA Guidance Statement No. 1, May 2001)

Port Hedland harbour is not specifically identified as a conservation area in the EPA's "Guidance Statement for the protection of tropical arid zone mangroves along the Pilbara coastline" (EPA 2001). Figure 7 in the Guidance Statement defines an area of coastline approximating the port limits as "Industrial area – Port Hedland". The mangrove systems to the west of this industrial unit are designated as being "regionally significant" and of high conservation value.

The mangroves at Utah Point therefore sit within Guideline 4 of EPA (2001), as: 'All other mangrove areas within designated industrial and associated port areas'. In meeting this, the PER for the Utah Point development needs to apply the principles of this guidance statement in the design of the facilities and planned construction and post-construction management measures.

8.1.2.2 Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment (EPA Guidance Statement No. 29)

EPA Guidance Statement No. 29 sets out a framework for the assessment of proposals that may impact on Benthic Primary Producer Habitats (BPPH). The Guidance considers that BPPs are 'predominantly marine plants (e.g. seagrasses, mangroves, seaweeds and turf algae) but include invertebrates such as scleractinian corals…' (EPA 2004c). The Guidance also applies to habitat areas that can or do support such communities (BPPH).

The EPA Guidance sets out a hierarchy of general principles of assessment in relation to the protection of BPPH (EPA 2004c). The initial three principles require evaluation prior to proceeding the impact assessment and risk based assessment framework set out in the Guidance Statement, and the Utah Point development PER will need to demonstrate that it has addressed:

- Principle 1: Demonstrate consideration of options to avoid damage/loss of BPPH;
- Principle 2: Design to minimise loss of BPPH and justify unavoidable loss of BPPH; and
- Principle 3: Best practicable design/construction/management to minimise BPPH loss.

8.1.3 Evaluation of the Utah Point proposal in accordance with Guidance Statement No. 29

8.1.3.1 Definition of BPPH Management Unit

The Guidance Statement's risk based approach to assessing any implications for BPPH ecosystem integrity sets out several steps. The first is the definition of a 'Management Unit' for the purposes of applying the EPA Guidance. The Guidance suggests the identification of an integrated area of marine habitat in the order of 50 km^2 in size (EPA 2004c).

A process of identifying and assessing potential management units for Port Hedland harbour was carried out as part of the formal assessment of the Fortescue Metals Group port (FMG 2004). After evaluating a range of potential management units in the context of Guidance Statement 29, the EPA concluded in its Report and Recommendations on that proposal that the 'Port Hedland Industrial Area', would constitute the management unit for Port Hedland harbour, setting the precedent for the current assessment (EPA 2005). This unit was estimated to contain an original, pre-European disturbance area of 2,676 ha of mangroves within its 154 km^2 extent (EPA 2005).

8.1.3.2 Analysis of Mangrove BPPH Clearing for the Current Proposal

The scoping document for this proposal indicates that PHPA is not required to take into account the clearing proposed by the currently approved Hope Downs port, even though this was previously approved by EPA. The context for the percentage cumulative loss calculations within the defined management unit is then set by a revision of the framework outlined within EPA (2005) (Table 8.1).

The clearing impact on total mangrove BPPH associated with the Utah Point proposal is shown in Figure 8.1. GIS analysis indicates that the construction of the new port proposal will result in the clearing of 18.7 ha of mangroves. The analysis of mangrove BPPH cumulative loss, consistent with the Guidance Statement 29 framework (EPA 2004c), is provided in Table 8.1. Note that this provides a conservative analysis, as Table 8.1 treats all mangrove units as closed canopy BPPH, although 5 ha of the clearing will affect open shrubland (see Table 8.2).

Table 8.1: Guidance 29 Mangrove BPPH Management Unit Evaluation Context for Port Hedland Harbour (amended from EPA 2005 to adjust for the removal of the Hope Downs port site).

Management unit	Current mangrove BPPH area in unit *	Original mangrove extent	Loss	Cumulative loss due to existing and approved developments
Port Hedland Industrial Area – current (EPA 2005)	2,408 ha	2,676 ha	BHP East Creek Cargill Salt ponds FMG Port** (Total of 267.8 ha)	10.0%
Port Hedland Industrial Area – with implementation of the Utah proposal	2,408 ha	2,676 ha	BHP East Creek Cargill Salt ponds FMG Port** + Utah Point (18.7 ha) (Total of 286.5 ha)	10.7%

* Subtracting historical losses as outlined column 4.

** Excludes the previously approved Hope Downs port.

The scope for this assessment requires the removal of the Hope Downs port proposal for the purposes of these calculations (row 1 of Table 8.1). This effectively reduces the historical cumulative loss for the management unit from 13.3% (EPA 2005) to 10.0% (Table 8.1). Adding in the estimated loss of 18.7 ha for the Utah Point proposal then brings the cumulative loss to 10.7% (row 2 of Table 8.1). Viewed in context then, this proposal will actually represent an improvement on the assessment carried out by EPA (2005), with a reduction of approximately 71 ha of mangrove BPPH loss compared to the originally approved Hope Downs port proposal for Utah Point (cf. Hope Downs Management Services 2000).

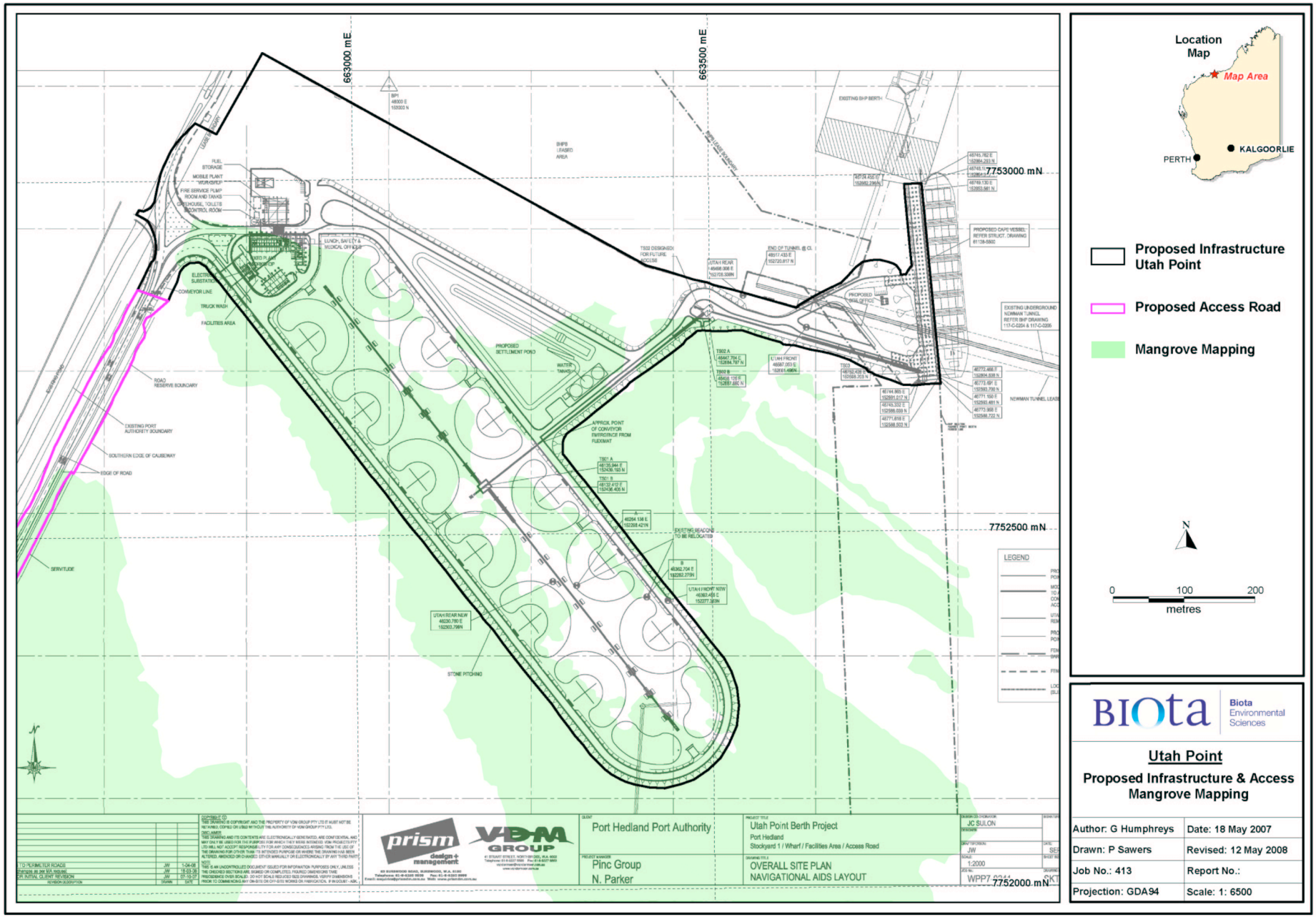

Figure 8.1: Analysis of mangrove clearing impacts associated with the Utah Point proposal.

The potential impact of clearing was also considered at the level each mangrove association present in the project area (Section 4.2). This is provided in Table 8.4 below. Due to limitations on historical data in this area (previously recognised by EPA (2005)), it is not possible to complete pre-European cumulative loss figures at the level of each association. These calculations are presented for closed canopy mangrove BPPH in Table 8.1.

Table 8.2: Predicted loss of individual mangrove BPPH associations arising from the Utah Point development (associations after Paling et al. 2001; amended from EPA 2005 to adjust for the removal of the Hope Downs port site).

Association	Current area in mgt unit (ha) *	Loss (ha)	Loss (%) **
1. Closed canopy woodland of *Rhizophora stylosa*	203	1.5	0.7
2. Closed canopy woodland of *R. stylosa* and *Avicennia marina*	152	0.3	0.2
3. Closed canopy woodland of *A. marina* (seaward fringe)	37	0.5	1.3
4. Closed canopy woodland of *A. marina* (landward margins)	451	11.5	2.6
5. Low open shrubland – scattered *A. marina* on saline flats with scattered samphires	241	5.0	2.1

* from Paling et al. 2001.

** of current extent (not pre-European extent as identified in Guidance Statement 29 as no data are available to map at this level of resolution (EPA 2005)).

No cyanobacterial mat BPPH would be affected as a result of the Utah Point proposal.

8.2 Probable Impacts on Terrestrial Flora and Vegetation

8.2.1 Clearing

Direct clearing for the upgrade of the current access road to Finucane Island and the requirement for material sourcing are the primary impacts on terrestrial vegetation likely to arise from the Utah Point Berth development. Based on the current design and planned borrow pit location, a total of 46.3 ha of terrestrial vegetation would be cleared in the event that both the road upgrade and proposed borrow pit are developed.

The impact of the proposed clearing is presented for the scenario of road construction only in Table 8.3, with the clearing associated with construction of the road and the borrow pit in Table 8.4. Both tables also indicate the mapped representation of each vegetation type in the portion of the Port Hedland locality mapped by Biota and Trudgen (2002).

Table 8.3: Areas of terrestrial vegetation types to be cleared to accommodate the proposed Utah Point port and road upgrade, with their wider representation within the Port Hedland vicinity.

Vegetation Type	Area to be cleared for the Utah Point port and road upgrade (ha)	Area mapped within Utah Point study area (ha)	Area mapped in the locality (Biota and Trudgen (2002)) (ha)	% of mapped area affected
Halosarcia indica subsp. *leiostachya*, *H. halocnemoides* subsp. *tenuis*, *Muellerolimon salicorniaceum* scattered low shrubs to low open shrubland	17.0	193.6	570.4	3.0%
Triodia epactia, *T. secunda* hummock grassland over *Eragrostis falcata, E. setifolia, Eriachne obtusa* very open tussock grassland to open tussock grassland	4.6	70.53	398.5	1.2%
Acacia stellaticeps low open shrubland over *Triodia epactia* hummock grassland over open mixed tussock grassland / closed herbland	0.0	28.4	903.2	0.0%
Unsurveyed	0.0	57.2		
Total	**21.6**	**349.7**	**1,872.1**	

Table 8.4: Areas of terrestrial vegetation types to be cleared to accommodate the proposed Utah Point port, road upgrade and borrow pit, with their wider representation within the Port Hedland vicinity.

Vegetation Type	Area to be cleared for the Utah Point port, road upgrade and borrow pit (ha)	Area mapped within Utah Point study area (ha)	Area mapped in the locality (Biota and Trudgen (2002)) (ha)	% of mapped area affected
Halosarcia indica subsp. *leiostachya*, *H. halocnemoides* subsp. *tenuis*, *Muellerolimon salicorniaceum* scattered low shrubs to low open shrubland	17.0	193.6	570.4	3.0%
Triodia epactia, *T. secunda* hummock grassland over *Eragrostis falcata, E. setifolia, Eriachne obtusa* very open tussock grassland to open tussock grassland	29.3	70.53	398.5	7.3%
Acacia stellaticeps low open shrubland over *Triodia epactia* hummock grassland over open mixed tussock grassland / closed herbland	0.0	28.4	903.2	0.0%
Unsurveyed	0.0	57.2		
Total	**46.3**	**349.7**	**1,872.1**	

Under either development scenario, the proposed clearing will affect small percentages of two of the three vegetation types identified within the survey area (see Section 5.1).

8.2.2 Weeds

Five introduced flora species were recorded from the project area, some of which are considered to be serious environmental weeds. These were widespread within the project area, occurring predominantly along the existing roadside. The saline mudflats are relatively resistant to weed invasion, whilst the sandy island vegetation occurring within the flats provides a more suitable habitat for introduced species and is thus more susceptible to invasion. Further earthworks within the project area have the potential to spread existing populations and/or introduce additional weed species.

8.2.3 Dust Deposition

Dust generated during the construction, operation and maintenance of the port has the potential to negatively affect surrounding terrestrial vegetation, but this is considered likely to be a minor impact provided standard dust suppression measures are implemented.

8.2.4 Hydrological Changes

Any alteration to groundwater regimes or existing surface water flows is unlikely given that the development comprises an upgrade of an existing road structure, provided that appropriate culverting is installed at surface drainage features.

8.3 Probable Impacts of the Proposal on Terrestrial Fauna

Loss of mangrove habitats utilised by terrestrial fauna is the major potential impact on fauna values predicted for this proposal. Mangrove habitats support the Priority 4 species, the Little North-western Mastiff Bat *Mormopterus loriae cobourgensis*, in addition to providing habitat for mangrove dependent bird species. It is likely that there will also be some direct loss of individual fauna due to construction of the new stockpiles and load out facilities, and that others that move into adjacent undisturbed habitats would be impacted subsequently due to competition,

displacement from home range and overlaps with existing fauna occupying equivalent ecological niches.

The species which occur in the proposed development area are, however, known more widely from the mangroves that will remain in the harbour (around 1,000 ha; Paling et al. 2003) and from other similar systems in the locality and the region (Johnstone 1990; EPA 2001). There appears to be a low risk of any changes to the conservation status of the mangrove dependent species present in Port Hedland harbour as a result of this proposal.

Impacts on terrestrial fauna in other habitats are likely to be minimal and comprise removal of habitat that is widespread in the locality and the region. No impacts on Threatened fauna taxa would be expected as a result of this.

9.0 Management Recommendations

The following recommendations arise from this study:

1. Clearing of mangrove vegetation and disturbance to this vegetation type, including filling, should be kept to a minimum. Where possible, the proponent should utilise existing cleared and disturbed areas within the mangrove areas.
2. Clearing of terrestrial vegetation should be kept to the minimum necessary for safe construction and operation of the project, particularly in the vicinity of the Priority 3 species *Bulbostylis burbidgeae*. The width of the access road should be kept to the minimum necessary for port operations.
3. A Weed Hygiene and Management Plan should be prepared in consultation with the DEC prior to the commencement of construction work to improve the current vegetation condition of the area and to prevent the spread of any introduced species, particularly **Stylosanthes hamata*.
4. An environmental offset package should be developed by the PHPA for the proposed project. An example of an appropriate inclusion could comprise contributing funding towards research into mangrove ecology.
5. Ensure that a comprehensive dust monitoring and management programme is developed and implemented. An assessment of current dust levels, combined with predictions of future emissions, will provide key data for designing and implementing appropriate management strategies.
6. Monitor chromium and manganese levels of the water, sediment and mangroves within the harbour. Design and situate the proposed stockpiles to minimise the risk of leaching into marine environments of the harbour.

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10.0 Acknowledgements

We wish to thank the following people for their generous assistance with this study:

- Mr Malcolm Trudgen (ME Trudgen and Associates) assisted with the identification of various difficult flora groups, particularly *Tephrosia,* Malvaceae and Convolvulaceae.
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Appendix 1

Vegetation Condition Scale and Structural Classes

Vegetation Structural Classification and Condition Scale used for the current survey

Vegetation Structural Classes*

Stratum	70-100% cover	30-70% cover	10-30% cover	2-10% cover	<2% cover
Trees over 30 m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland	Scattered tall trees
Trees 10-30 m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
Trees under 10 m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Shrubs over 2 m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
Shrubs under 1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
Grasses, Sedges, Herbs	Closed tussock grassland / sedgeland / herbland	Tussock grassland / sedgeland / herbland	Open tussock grassland / sedgeland / herbland	Very open tussock grassland / sedgeland / herbland	Scattered tussock grasses / sedges / herbs

* Based on Aplin's (1979) modification of the vegetation classification system of Specht (1970):
Aplin T.E.H. (1979). The Flora. Chapter 3 In O'Brien, B.J. (ed.) (1979). Environment and Science. University of Western Australia Press; Specht R.L. (1970). Vegetation. In The Australian Environment. 4th edn (Ed. G.W. Leeper). Melbourne.

Vegetation Condition Scale*

E = Excellent (=Pristine of BushForever) Pristine or nearly so; no obvious signs of damage caused by the activities of European man.
VG = Very Good (= Excellent of BushForever) Some relatively slight signs of damage caused by the activities of European man. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds such as **Ursinia anthemoides* or **Briza* spp., or occasional vehicle tracks.
G = Good (= Very Good of BushForever) More obvious signs of damage caused by the activities of European man, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones such as **Ehrharta* spp.
P = Poor (= Good of BushForever) Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of activities of European man, such as grazing, partial clearing (chaining) or frequent fires. Weeds as above, probably plus some more aggressive ones such as **Ehrharta* spp.
VP = Very Poor (= Degraded of BushForever) Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species including very aggressive species.
D = Completely Degraded (= Completely Degraded of BushForever) Areas that are completely or almost completely without native species in the structure of their vegetation; ie. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

* Based on Trudgen M.E. (1988). A Report on the Flora and Vegetation of the Port Kennedy Area. Unpublished report prepared for Bowman Bishaw and Associates, West Perth.

Appendix 2

Locations of Rare Flora and Weeds Within the Utah Point Project Area

Records of *Bulbostylis burbidgeae* (Priority 3) from the project area.

Easting	Northing	No. of Individuals
663972	7746352	20
662761	7747121	30

Records of **Cenchrus ciliaris* from the Utah Point project area.

Easting	Northing	No. of Individuals
663282	7752821	scattered
663266	7752861	scattered
662669	7752848	scattered
662377	7752310	dense
662206	7751870	dense
662139	7751667	scattered
666064	7745285	scattered
665983	7745264	dense
665867	7745256	dense
665457	7745475	dense
661516	7748651	scattered
661425	7748953	scattered
661331	7748518	dense
661751	7747994	dense

Easting	Northing	No. of Individuals
661332	7743579	scattered
662132	7747374	150
662753	7747095	50
662729	7747046	200
662683	7747049	dense
662451	7747178	scattered
662415	7747202	dense
664226	7746193	dense
663661	7746502	dense
663555	7746590	very dense
662747	7752935	scattered
662648	7752791	dense
661999	7747434	dense

Records of **Cenchrus setiger* from the project area.

Easting	Northing	No. of Individuals
666669	7745699	dense
666163	7745350	dense
666100	745485	scattered
662377	7752310	dense
662104	7751606	scattered
662001	7751216	dense
666074	7745460	very dense
665983	7745264	scattered

Easting	Northing	No. of Individuals
665867	7745256	dense
665457	7745475	dense
661425	7748953	scattered
661371	7748703	dense
661331	7748518	dense
661751	7747994	scattered
663758	7746452	dense

Records of **Aerva javanica* from the project area.

Easting	Northing	No. of Individuals
663195	7752899	50
662698	7752804	10
662301	7752160	1
665457	7745475	10
661751	7747994	10
662264	7747391	30
662446	7747381	100
662415	7747202	2
663661	7746502	5
663555	7746590	20
662747	7752935	scattered

Easting	Northing	No. of Individuals
662938	7752961	30
662632	7752774	scattered
661826	7750538	2
662047	7749210	50
661796	7747918	50
662317	7747519	4
662241	7747541	4
662239	7747736	100
665356	7745543	scattered
665312	7745556	scattered
665215	7745614	scattered

Records of **Chloris virgata* from the project area.

Easting	Northing	No. of Individuals
663195	7752899	scattered
662016	7751276	5
661349	7748707	5
661331	7748518	10
661332	7743579	75

Easting	Northing	No. of Individuals
661365	7748779	20
661414	7748941	100
662582	7747103	50
661999	7747434	scattered

Records of **Stylosanthes hamata* from the project area.

Easting	Northing	No. of Individuals
666100	7745485	100
666191	7745527	dense
665819	7745442	dense

Appendix 3

List of Vascular Flora Recorded from the Utah Point Project Area

* denotes introduced (weed species).

Aizoaceae (110)
Trianthema triquetra
Trianthema turgidifolia
Amaranthaceae (106)
Gomphrena canescens subsp. *canescens*
Hemichroa diandra
Ptilotus exaltatus
Ptilotus polystachyus var. *arthrotrichus*
**Aerva javanica*
Anthericaceae (54F)
Tricoryne corynothecoides
Asteraceae (345)
Flaveria australasica
Pluchea ferdinandi-muelleri
Pluchea tetranthera
Pterocaulon sphaeranthoides
Avicenniaceae (312)
Avicennia marina
Boraginaceae (310)
Ehretia saligna
Heliotropium conocarpum
Byblidaceae (154)
Byblis filifolia
Caesalpiniaceae (164)
Senna notabilis
Chenopodiaceae (105)
Enchylaena tomentosa
Halosarcia indica subsp. *leiostachya*
Halosarcia halocnemoides subsp. tenuis
Neobassia astrocarpa
Suaeda arbusculoides
Salsola tragus
Commelinaceae (047)
Commelina ensifolia
Convolvulaceae (307)
Bonamia media var. *? media*
Bonamia rosea
Evolvulus alsinoides var. *decumbens*
Evolvulus alsinoides var. *villosicalyx*
Ipomoea muelleri
Ipomoea pes-caprae subsp. *brasiliensis*
Polymeria ambigua
Cucurbitaceae (337)
Mukia maderaspatana
Cyperaceae (032)
Bulbostylis barbata
Bulbostylis burbidgeae
Cyperus bulbosus
Cyperus cunninghamii subsp. *cunninghamii*
Cyperus squarrosus
Fimbristylis microcarya
Euphorbiaceae (185)
Euphorbia aff. *australis*
Euphorbia australis
Euphorbia coghlanii
Euphorbia tannensis subsp. *eremophila*
Frankeniaceae (236)
Frankenia ambita
Goodeniaceae (341)
Goodenia forrestii
Scaevola spinescens
Lauraceae (131)
Cassytha capillaris
Malvaceae (221)
Abutilon aff. *lepidum* (4)
Abutilon otocarpum
Hibiscus leptocladus
Lawrencia viridigrisea
Sida aff. *fibulifera*
Sida pilbarensis (ferruginous form)
Sida sp.
Mimosaceae (163)
Acacia ancistrocarpa
Acacia colei var. *colei*
Acacia elachantha
Acacia inaequilatera
Acacia stellaticeps
Acacia trachycarpa
Neptunia dimorphantha
Molluginaceae (110A)
Mollugo molluginis
Myoporaceae (326)
Myoporum montanum
Nyctaginaceae (107)
Boerhavia coccinea
Boerhavia repleta
Papilionaceae (165)
Cajanus cinereus
Crotalaria cunninghamii
Glycine tomentella
Indigofera colutea
Indigofera linnaei
Indigofera monophylla
Indigofera trita
Rhynchosia minima
Sesbania cannabina
**Stylosanthes hamata*
Tephrosia aff. *bidwillii* (HD153-5)
Tephrosia leptoclada
Tephrosia phaeosperma
Vigna aff. *lanceolata*
Plumbaginaceae (294)
Muellerolimon salicorniaceum
Poaceae (031)
Aristida holathera var. *holathera*
**Cenchrus ciliaris*

**Cenchrus setiger*
**Chloris virgata*
Dactyloctenium radulans
Digitaria brownii
Eragrostis falcata
Eragrostis setifolia
Eriachne obtusa
Panicum decompositum
Paspalidium rarum
Sorghum plumosum
Sporobolus mitchellii
Triodia epactia
Triodia lanigera
Triodia secunda
Polygalaceae (183)
Polygala linariifolia
Portulacaceae (111)
Calandrinia sp. Pinga (T.R. Lally TRL 722)
Portulaca pilosa
Rhizophoraceae (269)
Rhizophora stylosa
Santalaceae (092)
Santalum lanceolatum
Scrophulariaceae (316)
Stemodia grossa
Solanaceae (315)
Solanum diversiflorum
Solanum ellipticum
Solanum phlomoides
Sterculiaceae (223)
Melhania oblongifolia
Waltheria indica
Thymelaeaceae (263)
Pimelea ammocharis
Tiliaceae (220)
Corchorus incanus subsp. *incanus*
Triumfetta aff. *chaetocarpa* (H123-10)
Violaceae (243)
Hybanthus aurantiacus

Appendix 4

Birds Australia Western Australia Bird Sightings Archive Search

Date	Observer/s	Species (Number)	Location
04/02/2006	George Swann	Oriental Pratincole (15,000+)	Great Northern Highway, Port Hedland
09/11/2005	Frank O'Connor Brian Little (UK)	Little Curlew (6)	Sports Oval (Port Hedland)
08/11/2005	Frank O'Connor Brian Little (UK)	Star Finch (30+)	South Hedland Sewage Ponds (Port Hedland)
08/11/2005	Frank O'Connor Brian Little (UK)	Barn Swallow (1)	South Hedland Sewage Ponds (Port Hedland)
02/11/2005	Chris Hassell	Red-necked Phalarope (14)	Port Hedland Salt Works (Port Hedland)
02/11/2004	Adrian Boyle Chris Hassell	Red-necked Phalarope (38)	Salt works (Port Hedland)
08/08/2004	Michael Nield Ada Nield	Flock Bronzewing (3)	De Grey Station (Port Hedland)
08/08/2004	Michael Nield Ada Nield	Flock Bronzewing (3)	Balla Balla Creek (Port Hedland)
02/08/2004	Michael Nield Ada Nield	Brolga (10)	De Grey Station (Port Hedland)
01/08/2004	Michael Nield Ada Nield	Australian Bustard (11)	De Grey Station (Port Hedland)
01/01/2003	Roy Teale Karen Edward	Plumed Whistling-Duck (8)	billabong, Mundabullangana Station (Port Hedland)
01/01/2003	Roy Teale Karen Edward	Pink-eared Duck (3)	billabong, Mundabullangana Station (Port Hedland)
01/01/2003	Roy Teale Karen Edward	Black-necked Stork (2)	billabong, Mundabullangana Station (Port Hedland)
01/01/2003	Roy Teale Karen Edward	Banded Stilt (1)	billabong, Mundabullangana Station (Port Hedland)
01/01/2003	Roy Teale Karen Edward	Red-necked Avocet (15)	billabong, Mundabullangana Station (Port Hedland)
27/12/2002	Roy Teale Karen Edward	Oriental Plover (12)	Cowrie Creek, Mundabullangana Station (Port Hedland)
27/12/2002	Roy Teale Karen Edward	Australian Pratincole (1)	Cowrie Creek, Mundabullangana Station (Port Hedland)

Appendix 5

DEC Threatened Fauna Search

Threatened and Priority Fauna Database

19.86667 °S 119.2 °E / 20.84167 °S 118.1833 °E Dampier Salt works near Port Hedland

*	Date	Certainty	Seen	Location Name	Method

Schedule 1 - Fauna that is rare or is likely to become extinct

Lagostrophus fasciatus fasciatus **Banded Hare-wallaby** *1 records*

This small macropod occurs in low shrubland and extant populations occur on Bernier and Dorre islands in Shark Bay. An attempted reintroduction to Peron Peninsula showed that the species is highly vulnerable to predation from cats as well as foxes. The record for Port Hedland is historical. The species is unlikely to occur in the area today.

	2		Port Hedland	Day sighting

Schedule 4 - Other specially protected fauna

Aspidites ramsayi **Woma (southwest pop)** *2 records*

A nocturnal species of python restricted to arid areas.

2001	1	1		Day sighting
2001	1	1		Day sighting

Priority One: Taxa with few, poorly known populations on threatened lands

Mormopterus loriae cobourgiana **Little North-western Mastiff Bat** *3 records*

This species occurs along the northwest coast and is known to roost in mangroves.

2001	2	0		Heard
2001	2	0		Heard
2001	2	0		Heard

Aspidites ramsayi **Woma (southwest pop)** *2 records*

A nocturnal species of python restricted to arid areas.

2001	1	1		Day sighting
2001	1	1		Day sighting

Priority Four: Taxa in need of monitoring

Macroderma gigas **Ghost Bat** *1 records*

This species is Australia's only carnivorous bat and has a patchy distribution across northern Australia. It shelters in caves, mine shafts and deep rock fissures and is sensitive to disturbance.

2001	2	0		Scats

Pseudomys chapmani **Western Pebble-mound Mouse (Ngadji)** *2 records*

This species is well-known for the characteristic pebble-mounds which it constructs over underground burrow systems. These mounds are most common on spurs and lower slopes of rocky hills.

1994	1		Cookes Hill	
1996	2	0	Whim Creek	

Ardeotis australis **Australian Bustard** *1 records*

This species is uncommon and may occur in open or lightly wooded grasslands.

2001	1	1		Day sighting

Numenius madagascariensis **Eastern Curlew** *1 records*

This species is a migratory visitor and has been observed on reef flats and sandy beaches along the West Australian coast and in coastal estuaries.

1975	1	2	North Turtle Island Nature Reserve	Day sighting

Thursday, 13 October 2005 **Department of Conservation and Land Management**

Threatened and Priority Fauna Database

19.86667 °S 119.2 °E / 20.84167 °S 118.1833 °E Dampier Salt works near Port Hedland

*	*Date*	*Certainty*	*Seen*	*Location Name*	*Method*

* Information relating to any records provided for listed species:-
Date: date of recorded observation
Certainty (of correct species identification): 1=Very certain; 2=Moderately certain; and 3=Not sure.
Seen: Number of individuals observed.
Location Name: Name of reserve or nearest locality where observation was made
Method: Method or type of observation

Appendix 6

Western Australian Museum FaunaBase Search Results

Amphibians collected between 19.86667°S, 119.2°E and 20.84167°S, 118.1833°E.

Hylidae
Cyclorana australis
Cyclorana maini
Litoria rubella

Myobatrachidae
Limnodynastes spenceri
Neobatrachus aquilonius
Notaden nichollsi
Uperoleia glandulosa
Uperoleia russelli
Uperoleia sp

Reptiles collected between 19.86667°S, 119.2°E and 20.84167°S, 118.1833°E.

Agamidae
Ctenophorus caudicinctus caudicinctus
Ctenophorus isolepis
Ctenophorus isolepis isolepis
Ctenophorus nuchalis
Diporiphora winneckei
Lophognathus longirostris
Pogona minor
Pogona minor mitchelli

Boidae
Antaresia perthensis
Antaresia stimsoni
Antaresia stimsoni stimsoni
Aspidites melanocephalus
Aspidites ramsayi

Cheloniidae
Chelonia mydas
Eretmochelys imbricata bissa

Colubridae
Fordonia leucobalia

Elapidae
Acanthophis pyrrhus
Brachyurophis approximans
Demansia psammophis cupreiceps
Demansia reticulata
Demansia rufescens
Disteira stokesii
Ephalophis greyae
Furina ornata
Hydrelaps darwiniensis
Hydrophis elegans
Pseudechis australis
Pseudonaja modesta
Pseudonaja nuchalis
Simoselaps anomalus
Suta punctata

Gekkonidae
Diplodactylus ciliaris
Diplodactylus conspicillatus
Diplodactylus stenodactylus
Gehyra pilbara
Gehyra punctata
Gehyra purpurascens
Gehyra variegata
Hemidactylus frenatus
Heteronotia binoei
Nephrurus levis pilbarensis
Rhynchoedura ornata
Strophurus ciliaris aberrans
Strophurus elderi
Strophurus jeanae

Pygopodidae
Delma butleri
Delma haroldi
Delma pax
Delma tincta
Lialis burtonis
Pygopus nigriceps

Scincidae
Carlia triacantha
Cryptoblepharus carnabyi
Cryptoblepharus plagiocephalus
Ctenotus duricola
Ctenotus grandis titan
Ctenotus helenae
Ctenotus pantherinus ocellifer
Ctenotus piankai
Ctenotus rufescens
Ctenotus saxatilis
Ctenotus serventyi
Ctenotus sp
Lerista bipes
Lerista muelleri
Menetia greyii
Morethia ruficauda exquisita
Morethia ruficauda ruficauda
Notoscincus ornatus ornatus
Proablepharus reginae
Tiliqua multifasciata

Typhlopidae
Ramphotyphlops ammodytes
Ramphotyphlops braminus
Ramphotyphlops grypus
Ramphotyphlops pilbarensis

Varanidae
Varanus acanthurus
Varanus brevicauda
Varanus eremius
Varanus gouldii

Birds collected between 19.86667°S, 119.2°E and 20.84167°S, 118.1833°E.

Acanthizidae
Gerygone tenebrosa

Ardeidae
Nycticorax caledonicus hilli

Artamidae
Artamus cinereus melanops
Artamus leucorynchus
Campephagidae
Lalage tricolor
Charadriidae
Charadrius mongolus mongolus
Charadrius ruficapillus

Columbidae
Geopelia cuneata
Geopelia striata placida
Phaps histrionica

Corvidae
Corvus orru cecilae

Fregatidae
Fregata andrewsi

Halcyonidae
Todiramphus pyrrhopygia

Hydrobatidae
Oceanites oceanicus

Laridae
Sterna albifrons
Sterna caspia
Sterna hybrida javanica
Sterna leucoptera
Sterna nilotica macrotarsa
Sterna sinensis

Maluridae
Malurus lamberti assimilis
Meliphagidae
Manorina flavigula

Motacillidae
Motacilla flava simillima
Pachycephalidae
Pachycephala lanioides

Passeridae
Passer montanus

Petroicidae
Eopsaltria pulverulenta
Petroica goodenovii

Phasianidae
Coturnix pectoralis

Psittacidae
Melopsittacus undulatus

Ptilonorhynchidae
Ptilonorhynchus maculatus guttatus

Rallidae
Gallirallus philippensis mellori

Recurvirostridae
Recurvirostra novaehollandiae

Scolopacidae
Arenaria interpres interpres
Calidris acuminata
Calidris alba
Calidris ferruginea
Calidris ruficollis
Calidris tenuirostris
Gallinago stenura
Limicola falcinellus sibiricus
Limnodromus semipalmatus
Numenius madagascariensis
Phalaropus lobatus
Tringa brevipes
Tringa cinerea
Tringa stagnatilis

Sylviidae
Cincloramphus mathewsi

Turnicidae
Turnix velox

Tytonidae
Tyto alba delicatula

Mammals collected between 19.86667°S, 119.2°E and 20.84167°S, 118.1833°E.

Dasyuridae
Dasycercus cristicauda
Dasykaluta rosamondae
Dasyurus hallucatus
Ningaui timealeyi
Pseudantechinus roryi
Sminthopsis youngsoni

Delphinidae
Steno bredanensis

Dugongidae
Dugong dugon

Emballonuridae
Taphozous georgianus

Macropodidae
Macropus robustus
Macropus robustus erubescens
Macropus rufus

Molossidae
Chaerephon jobensis

Muridae
Mus musculus
Pseudomys delicatulus
Pseudomys desertor
Pseudomys hermannsburgensis

Pteropodidae
Pteropus scapulatus

Thylacomyidae
Macrotis lagotis

Vespertilionidae
Nyctophilus arnhemensis
Nyctophilus geoffroyi
Vespadelus finlaysoni