

**THE MAITLAND HEAVY INDUSTRIAL
ESTATE**

**ASSESSMENT AND COMPARISON WITH
THE BURRUP PENINSULA INDUSTRIAL
ESTATE**

Prepared for:

Shire of Roebourne



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ABBREVIATIONS

AHD	Australian Height Datum	
ANZECC	Australian and New Zealand Environment and Conservation Council	
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand	
AURA	Australian Rock Art Research Association	
CALM	Conservation and Land Management (Department of)	
CD	Chart Datum	
DAS	Department of Aboriginal Sites (Western Australia)	
DBNG	Dampier to Bunbury Natural Gas (Pipeline)	
DEP	Department of Environmental Protection	
DME	Department of Minerals and Energy	
DPA	Dampier Port Authority	
DRD	Department of Resources Development	
DRI	Direct Reduced Iron	
dwt	Dead Weight Tonnage	
EMI	East Middle Intercourse Island	
EMP	Environmental Management Program, or Environmental Management Plan	
EMS	Environmental Management System	
EPA	Environmental Protection Authority	
GHD	Gutteridge Haskins & Davey	
ha	Hectare	10^4 m^2
IFRAO	International Federation of Rock Art Organisation	
kL	Kilolitre	1 m^3
km	Kilometre	
kV	Kilovolt	10^3 Volts
LAT	Lowest Astronomical Tide	
m	Metre	
m^3	Cubic metre	1 kL
M	Million	10^6
MHIE	Maitland Heavy Industrial Estate	
ML	Megalitre	10^3 m^3
ML/d	Megalitre per day	
MSCL	Mild Steel Cement Lined	
MSDS	Material Safety Data Sheet	
NB	Nominal bore (diameter) of a pipeline	
NOx	Nitrous Oxides	
NWS	North-West Shelf	
NWSGP	North-West Shelf Gas Project	
OMP	Office of Major Projects	
ROM	Run of Mine	
SLAM	Soros-Longworth and McKenzie	
SOx	Sulphur Oxides	
TDS	Total Dissolved Solids	
UKC	Under keel clearance	
WII	West Intercourse Island	
WMI	West Mid Intercourse Island	
WSB	Woodside Supply Base	



Shire of Roebourne

**THE MAITLAND HEAVY INDUSTRIAL ESTATE
ASSESSMENT AND COMPARISON WITH THE BURRUP INDUSTRIAL
ESTATE**

1 INTRODUCTION

1.1 BACKGROUND

The Maitland Heavy Industrial Estate (“MHIE” or the “Maitland Estate”) is a proposed coastal site for heavy industry in the Karratha area. It is situated 24 km west southwest of the town centre. Accessible from the North West Coastal Highway, it has been planned to occupy an area of over 16 000 ha on the western boundary of the Dampier Salt Lease. The estate comprises a mainland portion (4453 ha) and a group of smaller sites on West Intercourse Island (WII), the Burrup Peninsula, West Mid Intercourse Island and Intercourse Island. It also includes some 8000 ha of buffer zone. The area currently proposed by Landcorp is shown on Figure 1.

The Maitland Estate was one of three heavy industry sites in the region investigated by Landcorp and the Department of Resource Development (DRD) in the early 1990’s. Other sites were west of Cape Lambert and Wickham (Dixon Island) and the Burrup Peninsula. Landcorp now advertise two estates for industrial purposes in the Karratha region: the Burrup Peninsula and the Maitland Estate.

The Burrup Peninsula (commonly referred to as “the Burrup”) is a promontory near Karratha characterized by massive ridges of weathered intrusive Archaean rock. Previously known as “Dampier Island”, it is now connected to the mainland by a causeway and currently serves as the location for two of the country’s largest resource projects: Rio Tinto’s Hamersley Iron Port facility and the North West Shelf Project, operated by Woodside Energy Limited. These projects “opened up” the Burrup and resulted in the establishment of two shipping channels, numerous wharves, the creation of the towns of Karratha and Dampier and extensive processing facilities.

The regional population these and other projects in the area have created now totals over 15,000 people, many of whom view the Burrup Peninsula as a major recreation resource. It has some stunning scenery, incorporates the only true beaches in the vicinity and is a favoured location for fishing and camping. Recognition of the aboriginal significance of the Burrup, in particular its rich collection of rock art, has gradually come into public awareness, as has the Peninsula’s botanical importance. This growing appreciation of the values of the Burrup has led to an undercurrent of opposition to new projects planned on its lands.

The imminent construction of one of these projects and the realisation that a large part of the Burrup that is frequented by locals was to be the site for up to six new plants raised public concerns in early 2002. A rally was held on Hearson Cove Beach on 9th June 2002 which was attended by some 500 people. This was an unprecedented event for the region and there has since been a considerable amount of lobbying by stakeholder groups in both Perth and Karratha.



In addition, R. G. Bednarik, Convener of the International Federation of Rock Art Organisations (IFRAO) has recently highlighted the damage being done to engravings on the Peninsula by industrial emissions and has labelled it the largest rock art site of its type in the world (Bednarik 2002).

The theme of this lobbying has not been opposition to the projects themselves, but opposition to their location on the Burrup Peninsula, as opposed to the Maitland Estate. The Shire of Roebourne, local authority to the region, has now been put in a difficult situation: its normal desire for development in the region must be balanced with concern for the major rock-art province on its doorstep and its residents' desire for appropriate recreational and tourism opportunities in the area.

The Shire has therefore commissioned this report to establish the relative merits of the Burrup Peninsula and the Maitland Heavy Industry Estate as a site for future industry in the area. The report has not resulted in any significant new investigative works: it is simply a summary of existing reports and knowledge. Criticism of both Estates is considered. A blueprint for the Maitland Estate is developed and preliminary costings are made to enable a realistic comparison of the alternatives.

1.2 THIS REPORT

This report is a literature survey and costing exercise which has utilized a wide range of previous reports commissioned primarily by DRD now Office of Major Projects (OMP) but also by other government authorities. Its objectives are to:

1. Develop a minimum cost / minimum impact layout for the MHIE.
2. Provide an assessment of the suitability of the proposed MHIE for future development.
3. Compare the suitability of the MHIE with the Burrup Industrial Estate
4. Determine the cost of minimal MHIE establishment.

The assistance of the OMP in particular that of John Prior, is acknowledged. Major studies referred herein are listed in Section 10.

1.3 ESTATE LAYOUT

For this report, only three parts of the MHIE as advertised by Landcorp are considered. These are the mainland site, the north end of West Intercourse Island and the service corridor between the two. None of the extraneous options which comprise the MHIE - including the southern and western parts of West Intercourse Island, the South West Burrup Peninsula, West Mid Intercourse Island and Intercourse Island - are considered. The reason for this is that none are essential to the base-case development of the MHIE, each (in particular, the Southern and Western parts of West Intercourse Islands) has substantial environmental and aboriginal heritage constraints, each has substantial access restrictions and all will be expensive to develop.

A fair comparison of Maitland and Burrup must consider the least environmental impact and least cost options for both. The considered MHIE boundary is shown in Figure 2. The reasoning behind this boundary is given in Section 3 below.



1.4 LIMITATIONS

This report is a cursory review only of an extensive range of literature and other knowledge extant on the Burrup Peninsula and Maitland Heavy Industrial Estate. No claim for completeness is made as the time available to complete this study was limited.

No new work, other than a visual assessment of each area was undertaken. While substantial surveys of a wide range of aspects have been completed over the past decade for both estates, certain aspects, such as geology, hydrogeology, oceanography, seabed, aboriginal sites and other elements are relatively unknown, particularly on West Intercourse Island.

In a comparison of attributes, the regional context is also relevant. Outside the study areas, very little information on a fine scale is available. Thus vegetation, fauna habitat, flora, geology etc beyond the Karratha area require more study to determine the uniqueness of these aspects described on the Burrup and the MHIE.

1.5 AUTHORS

This report has been prepared primarily by Peter Long BE (Hons), BA, BSc (Env Sc), CPEng, FIE (Aust) with significant input from Vicki Long BA, Dip Ed and Julian Kruger, BSc (Hons). The latter two authors have completed the only detailed vegetation survey of the entire West Intercourse Island. Mr Long was involved in several of the early planning studies, including the Burrup Land Use Management Plan (O'Brien 1994), the Pilbara Deep Ports Study (Fraser Consultants 1994) and the Pilbara Heavy Industry Site Evaluation – Karratha Area (Long, P and Fraser Consultants 1993). The report also contains input from various other sources as referenced.



2 HISTORICAL PERSPECTIVE

The Pilbara coast has long been scoured for appropriate port facilities – initially to offload product from the pastoral industry, but in the latter part of the twentieth century, for minerals export. The same criteria for a Port have been important since time immemorial – deep, protected water near flat coastal land. Unfortunately, the Pilbara has no natural harbours, the coastline being for the most part mangrove lined or bordered by extensive mud flats which often extend offshore for some kilometres. During the nineteenth century, the mouths of rivers provided access for some vessels, or for lighters which would transfer cargo to and from ships moored offshore. The Ashburton River (Onslow), Butchers Inlet (Cossack), Johns Creek (Point Samson) Balla Balla (Whim Creek), and Condon Creek (Shellborough) are typical examples. The best of the old Pilbara ports was Mangrove Harbour (Marrapikurrinya) at Port Hedland, which offered a good expanse of water with substantial natural depth, but was limited by the sandbar at its entrance. With no nearshore areas navigable by ocean-going vessels, ports have had to construct long jetties or dredge channels (or both) to obtain adequate water for berthing large ships close to land.

As early as 1908, Depuch Island (Balla Balla) was proposed as a possible port, but surveys by the Western Australian Museum and previous work by F.D. McCarthy (1961) indicated that its extensive aboriginal heritage values precluded its development (Ride *et al* 1964). By the mid twentieth century, the only ports south of Broome were Onslow, Point Samson and Port Hedland. The discovery of iron ore in the Pilbara led the Hamersley and Mt Newman consortiums and others to search again for possible port sites. Details of these investigations have not been reviewed but by the early 1970s, new ports had been created in the Dampier Archipelago and at Cape Lambert and a major dredging programme completed at Port Hedland. By 1972, the Pilbara had 3 major ports. However, it was recognised that this huge mineral province would require more port capacity in future.

In 1973, the Commonwealth and State Governments began an in-depth investigation of the suitable Pilbara Port sites as part of the Pilbara Study. The Pilbara Study (Australia 1974) considered the suitability of Cape Preston, West Intercourse Island, Philip Point to Withnell Bay, Dolphin Island, “Mt Burrup”, Port Walcott, Sherlock River, Dixon Island, Legendre Island and Cape Thouin. It did not consider Ronsard Island and the Peawah River, nor Point Larrey / Breaker Inlet at the mouth of the DeGrey River – marginal sites which had previously been used. The report notably dismissed Philip Point to Withnell Bay as a suitable site for development, yet five years later this area was determined by Woodside to be its port and plantsite for the North West Shelf Project.

The Pilbara Study concluded Dixon Island was the best site for a new port and extensive analysis with input from two major consultants was performed. This research indicated that Dixon Island had a gross development cost of the order of \$ 140 M to \$ 200 M in the dollars of the day (over \$1 billion in 2002). Environmental considerations were discussed in three sentences.

A dissenting view in the report was that of Clough, engaged to consider the Dixon Island development requirements, but whom concluded Legendre Island was superior. The Pilbara Study authors disagreed, stating they believed Dixon a cheaper alternative, and one for which development could be initiated by even a small project.

West Intercourse Island was noted in this study as being “sheltered from all weather except that coming from the west”. It noted “cores taken recently north and south of Intercourse Island indicate that the



material would be dredgable to 15 m below low water, though costly”. Its major negatives noted were the distance to useable industrial land (8 km) and an assumption that port land would need to be reclaimed.

In 1978 Woodside began investigations, the results of which have not been sighted. Two sites on the Burrup Peninsula, Sloping Point at the north-east tip, and Withnell Bay were compared. It is not known if locations remote from the Burrup were considered.

In 1980, the Department of Industrial Development commissioned a report on land and port planning on the Burrup Peninsula. (Clough / Soros-Longsworth & McKenzie (SLAM) 1980). This was not a comparative study and interestingly concluded there was no serious conflict between industrial needs and conservation requirements.

The next broadscale study to make Port recommendations was the Pilbara 21 Study (Government of WA 1992), first commissioned in 1991 with similar objectives to the Pilbara Study of 1974. Unlike the Pilbara Study, Pilbara 21 made no detailed investigations, relying on input from Government Departments, the public and previous work such as the 1974 study. It made a one-sentence comment on each of Cape Preston, WII, Legendre Island, Dixon Island, the Sherlock River, Depuch Island & Regnard Island, and concluded the Burrup, Port Hedland and Dixon Island were the best for heavy industry sites. It also noted, (though with no supporting cost analysis) “it is the strong view of Pilbara 21 that green fields sites would be too expensive to develop”. It then made strong recommendations that the Burrup Peninsula be utilized, the justification being (it seems – it is not actually spelt out) the proximity of existing infrastructure, including the North West Shelf Project. The lack of consideration of geology, storm surge, space, aboriginal and environmental factors was never subsequently questioned, the Burrup Land Use and Management Plan (O’Brien 1994) merely making the best of the problematic area.

The Department of Resource Development clearly saw the limitations of the Burrup in the 1990s and set about searching for alternative heavy industry sites (Long, P & Fraser Consultants 1993; BHP Engineering and AGC Woodward Clyde 1994). The result of these surveys was the Maitland Industrial Estate, which was the subject of an environmental report (AGC Woodward Clyde 1994) and subsequent EPA Bulletin (EPA 1997). The estate eventually obtained full environmental approval and was added to Landcorp’s list of industrial land in Western Australia.



3 DESCRIPTION OF THE CONSIDERED MAITLAND ESTATE

3.1 INTRODUCTION

To provide a reasonable comparison, a minimal Maitland Estate development - i.e. a simpler and smaller development than that advertised as available by Landcorp - had to be devised. The objective was to provide adequate industrial land and facilities for the substantial public investment that would be required, with minimal environmental and aboriginal site impacts. It clearly needed to be the most cost-effective option.

The two basic considerations for any industrial estate are readily available flat land, and the cheapest access to deep water. While it is clear that the large mainland area of the current MHIE will be far less expensive to develop than areas in which granophyre and similar rocks outcrop, the distance to a port and the necessity for a causeway is a substantial negative for the MHIE mainland site.

DRD has investigated costs for various port scenarios, however, and this work was used to determine the most appropriate estate layout. The Multi-User Port Development Strategy (GHD 1999) determined costs for the Maitland Estate as developed for a proposed DRI plant (Ausimont) and the Pilbara Petrochemical Project (Dow/Shell). GHD investigated several port options, including access to deep water via West Intercourse Island or West Mid Intercourse Island (WMI). Access to the islands was considered from the mainland MHIE site or the South West Burrup site, with access to the latter via a road over the entrance to Dampier Salt Limited's Pond Zero from the Maitland Service Corridor. No earthwork development costs on the mainland estate were determined by GHD but a 20 ha levelled area on the north end of WII was costed.

For this report, we have simplified the layout, using the cheapest option determined by GHD – a direct causeway link to West Intercourse Island and a wharf off the levelled area. The layout of this revised Maitland Estate layout is shown in Figure 2.

The components of the MHIE, and their areas are given in Table 3.1 following and are briefly discussed below. Further information on the costed MHIE option is given in Appendix 1.

Table 3-1: Maitland Estate Components

Estate Component	Area (ha)	Earthworks Volume (m ³)
Maitland Estate	4450 ha	Minimal earthworks required
WII Access Causeway (top of embankment)	50 ha	863 640 m ³ rock fill from island
Cleared land on WII	58 ha	1 738 000 m ³ rock cut for causeways 975 000 m ³ dredge fill from channel
Wharf Approach Causeway	9 ha	763 000 m ³ rock fill from island
Dredged Area	38 ha	975 000 m ³ cut from seabed

Note: Earthworks volumes and areas are subject to change.



3.2 PORT

Central to the development of any industrial estate is access to a Port. With regard to the Maitland Estate, a wharf could be constructed off WII, West Mid Intercourse Island (WMI) or East Mid Intercourse Island (EMI).

Bathymetry for the area indicates a finger of deep water which extends west-southwest from Mermaid Sound, towards WII. The 5 m contour is closer to West Intercourse Island than either WMI or EMI: it is some 770 m from the north end of WII, 1080 m from WMI and 1540 m from EMI. The 10 m contour is 1810 m distant from WII, but is closer to the other two islands (WMI 1270 m; EMI 1540 m).

The cost differential of dredging a suitable wharf access versus constructing a larger causeway to deeper water was considered by GHD (1999). In addition, two forms of access to a wharf off WMI were considered – one from WII and the other from the Burrup Peninsula. Both were significantly more expensive than a wharf off WII.

Therefore, for this exercise, port access off the north point of WII is chosen as the best option. This will involve an approach causeway 1500 m long – the cheapest option in water depth below 3 m CD (GHD 1999). The causeway has been assumed to have a top width of 10 m and an elevation 12.7 m above chart datum (RL 10 m AHD).

Dredging has been assumed equivalent to GHD's Concept 2: an 11.8 m channel, 150 m wide with a 360 m diameter swing basin. The channel was originally considered to service three, 200 m berths. A reduced length of channel, commensurate with a single, 180 m berth has been assumed.

The wharf has been assumed similar in capacity to that being proposed by Government at the existing Dampier Public Wharf, for future projects. It is 220 m between mooring dolphins. Unlike the 20 m platform being proposed at the Dampier Public Wharf, however, we have assumed a much larger wharf area to provide capacity for bulk solids offloading. It is 3,500 m² in area, with 180 m of berthing face. Full details are given in Appendix 1.

3.3 SERVICE CORRIDOR

The service corridor connects the mainland estate with the Port. GHD (1999) found a route direct to WII was the cheapest alternative. This involved crossing from the mainland at the narrowest point, then making a road along the south east coast of WII to the north end. There are two problems with this approach.

1. There are extensive aboriginal sites along the south-east coast of WII
2. A bend is required in the causeway which requires horizontally curved conveyors or transfer towers.

To avoid these difficulties, a straight service corridor is proposed. This will avoid most of the aboriginal sites and allow straight service runs. It does, however, require a longer causeway over water, which has a cost penalty. For Stage 1, a 20 m top width of causeway at an elevation of RL 5.5 (8.27 above chart datum) has been assumed necessary. This will allow a 10.5 m road (3 x 3.5 m lanes) and space for conveyors, pipe racks and power. This road is 11.9 km long.



3.4 WEST INTERCOURSE ISLAND DEVELOPMENT

The port will need laydown area next to the wharves for storage of product, including bulk dry material, liquids and some gaseous material. The north end of WII is relatively flat and lends itself to this use. An area sufficient to provide fill for the service causeway and jetty causeway has been assumed necessary. This gives an area of 35 ha. Further, the valley on the north west coast at WII (currently a broad foredune, wide swale and rocky hinterland escarpment) can be filled with dredge spoil to provide a further 23 ha of flat land. This gives a total of 58 ha available for development on the current scheme. The laydown area proposed avoids most Aboriginal sites, which tend to be clustered around the coast. Approximately 200 ha of land in total is available on the north end of West Intercourse Island for future development. A buffer zone between the shore and the earthworks will protect many Aboriginal sites. A road 1.1 km long connects the Service Corridor with the wharf approach causeway.

3.5 MAINLAND SITE

No clearing on the mainland has been considered as the area is flat and unencumbered. Road access from WII to the North West Coastal Highway has been assumed. The cost for a bitumen road 6.3 km long has been considered. In addition, the cost of a pipeline to transport low specification gas from the North West Shelf Gas Development (Woodside) Plant has been allowed. There will need to be a flood control bank constructed on the west side of the estate, to prevent flooding from the Maitland River. A broad estimate of this cost has been made assuming a 10 km long bank from adjacent material on site.



4 ENVIRONMENTAL ASPECTS

4.1 INTRODUCTION

This report is not intended to cover environmental aspects of the Burrup or the MHIE in any depth – numerous specialist reports exist which do so. However, a review of the information available is necessary if an informed decision on the merits or otherwise of either site is to be made.

The environmental aspects of the Burrup and WII are similar, but the main land portion of the Maitland estate is quite different and gives the MHIE somewhat greater diversity of landform and vegetation. Fortunately both areas have been the subject of vegetation surveys and while the West Intercourse Island data is not yet in the public domain, some of the results have been made available for this report. These are discussed further below. Both the Burrup and WII have had fauna trapping exercises completed. While Maitland and WII have not been as extensively surveyed as the Burrup, there is enough information available to make an informed decision on the value of both.

The major conservation values (excluding aboriginal heritage aspects, discussed in Section 5) of the Burrup and Maitland are given in Table 4.1.

4.2 GEOLOGY, LANDFORM, HYDROGEOLOGY AND HYDROLOGY

A lack of borehole data and other investigative works means that the physical environment of the MHIE in particular, is not well known. West Intercourse Island is visually similar to the Burrup and its geology and hydrogeology are expected to follow similar patterns on WII to those on the Burrup.

The rockpile formations that characterize the coast in the vicinity of Karratha are unique and quite limited in extent, although they are seen inland at the Pinderi Hills and Munni Munni. Areas of the Burrup have been identified as worth preserving for the nature of their rock structure alone (R. Gordon quoted in Astron Environmental 2002). It is likely that parts of WII may have similar formations.

Landform on WII and the Burrup are similar, with the undulating terrain unit (P. Long in O'Brien 1994) of the Burrup being duplicated on the area of WII proposed for leveling. WII has similar rockpiles and valleys, somewhat less plateaux and terracing and fewer beaches. WII has more extensive tidal flats and associated mangrove communities than the Burrup, but hydrogeology and the physical environment in particular are similar at both sites.

4.3 VEGETATION AND FLORA

Both the Burrup Peninsula and West Intercourse Island lie in the Fortescue Botanical District, one of the several botanical districts defined by Beard (1975) for the Eremaean Botanical Province. The equivalent IBRA (Interim Biogeographic Regionalisation of Australia) region, as described by Thackway and Cresswell (1995), is the "Pilbara Biogeographic Region".

The vegetation of the Burrup Peninsula is rich, varied and diverse. This is resultant of the numerous micro-habitats present in the Burrup's unique landform and geology – both of which are very atypical of the adjacent Pilbara coastline. In addition to this, the vegetation is complex, being comprised of both Kimberley (Northern) and inland (Eremaean) components, and influenced by the humidity and salinity

of the coastal setting of the peninsula. As a result of this, a significant level of difference is found between the vegetation of the Burrup Peninsula and the adjacent mainland, and much of it is limited in its distribution (Trudgen 2002). The number of flora recorded for the Burrup (392) is high and species are diverse. The Burrup appears to be a “meeting point” for floristic elements from the Kimberley, inland and from the south, with many species being at the end of their range. Four Priority species occur on the Burrup, one of these, *Terminalia supranitifolia*, having the very high conservation status of Priority 1. A significant number (39) of Burrup flora are considered to have high conservation value (Trudgen 2002) due to the fact that they are uncommon and very geographically restricted, some being totally restricted to the Burrup.

Table 4-1: Major Conservation Aspects of Burrup and MHIE

Aspect	Burrup Peninsula	Maitland Heavy Industrial Estate
Geology	Unusual geology, including specific rock types and formations.	Detailed geology unknown. WII apparently similar to Burrup.
Landform	Rockpile topography, valleys and ephemeral streams and waterholes	West Intercourse island has virtually identical landform to the Burrup Peninsula, the mainland portion is flat, coastal plain country typical of this stretch of Pilbara coast.
Vegetation and Flora	Vegetation is rich in variation; much of it is limited in distribution and it has a high level of difference to that in the surrounding region. Flora is rich and diverse representing both Eremaean and Kimberley species. Many of the species on the Burrup are restricted in distribution and have high conservation significance.	Vegetation is very similar to that of the Burrup, possibly with a higher representation of the coastal element. It is believed to be as floristically rich as the Burrup, but it does lack the Priority 1 species, <i>Terminalia supranitifolia</i> . However, it houses other woodland species not found on the Burrup. The mainland portion of the MHIE includes tussock and hummock grasslands not represented on the Burrup, but widespread on the Abydos Plain.
Fauna	The Burrup offers potential habitat for at least three rare and endangered species including the Pilbara Olive Python (<i>Liasis olivacea barroni</i>), Western Pebble Mound Mouse (<i>Pseudomys chapmani</i>) and Camaenid Land Snails (<i>Rhagada sp.</i> & <i>Quistrachia legendrei</i>). The Pilbara Olive Python is currently listed as Vulnerable under the <i>EPBC Act 1999</i> .	Although fauna trapping records indicate a depauperate fauna assemblage on WII, no targeted surveys have been conducted on the island to date. Given the general similarity in topography (and therefore habitat) to the Burrup, it is possible that WII also potentially supports the same assemblage of rare and endangered species as listed for the Burrup.
Scenery	High scenic value ~ seaviews, hills and plateaux, valleys, rock pools, beaches,	While not generally as spectacular as the Burrup, WII has similar features, with rock piles, valleys and some superb views. The mainland portion is of average value.
Recreation and Tourism	High recreation and tourism value including beaches, swimming, fishing, walking, camping etc. aboriginal engravings are accessible and of high interest for tourism in particular.	Access difficulties and distance from Karratha, plus the general bio-geography make West Intercourse Island and the adjacent mainland unsuitable for recreation and tourism.

The southern portion of the Burrup, having been impacted significantly by resource and supporting developments, is now weed infested, thus reducing the value of the vegetation found there. In the less impacted northern portion of the Burrup, weeds are more or less confined to the verges of the many tracks that dissect the area.



West Intercourse Island, to the south-west of the Burrup shares a similar setting, landform and underlying geology to the Burrup Peninsula (the latter comprising significantly the Gidley Granophyre, which is restricted in distribution to the Burrup and nearby offshore islands). As the Burrup is now joined to the mainland by a causeway, West Intercourse Island is similarly joined, at low tide, by a sandbar. It is, therefore, not unrealistic to expect the vegetation to be very similar and therefore have the same high conservation status.

Like the Burrup, the vegetation combines both Kimberley and inland elements, but has possibly a stronger coastal component at West Intercourse Island than does the Burrup. The vegetation recorded on similar landforms (beaches, coastal plains, lower and upper hill slopes, rockpiles, drainage gullies) by Long and Kruger (1999) is comparable to that of the Burrup. Floristically, it is believed that West Intercourse Island may be slightly less diverse, a possible result of less protected habitats than are found on the Burrup. One notable omission of flora on West Intercourse Island is the Priority 1 species, *Terminalia supranitifolia*. This species is also lacking from the rockpiles on the adjacent mainland (V Long *pers obs*). However, the paperbark, *Melaleuca lasiantha* and desert poplar, *Codonocarpus cotinifolius* are both present on West Intercourse but not on the Burrup. The former species is found in two narrow drainage gullies on the southern portion of the island whilst the latter is found on the southern portion, proposed for development.

The coastal plains on the southern end of the island are heavily weed infested, but the remainder of the island is relatively weed free.

The mainland portion of the MHIE has been relatively degraded by pastoral activities, significantly grazing and trampling of cattle. The grasslands that occur there consist of Roebourne plains grass (*Eragrostis xerophila*) on the clays and *Triodia epactia* on the stony soils. Samphire communities occur nearer the coast.

4.4 FAUNA

The Burrup Peninsula and WII are both situated within the Arid geographic zone. The Burrup is known to support a diverse terrestrial fauna, representing residual species of both the Bassean and Torresion Zoogeographic zones (Butler 1994). As many as 44 species of mammal, 165 species of bird and 92 species of reptile may inhabit the Burrup Peninsula and the surrounding area. Some of these species are also known to inhabit WII. Zoogeographically, most of the vertebrate species occurring around the Burrup Peninsula and WII are widely distributed throughout the Pilbara and through much of the Eyrian Subregion. However, a number of species represent isolated populations, or are locally or regionally restricted in range.

The species richness of the Burrup Peninsula is comparatively high considering its relatively small area compared with the Pilbara as a whole. This high diversity can be partly explained by the multitude of different macro-habitats found along the peninsula and, more importantly, the microhabitats each broad habitat contains. The area also offers potential habitat for at least three rare and endangered species:

- Western Pebble Mound Mouse *Pseudomys chapmani*
- Pilbara Olive Python *Liasis olivacea barroni*
- Camaenid Land Snails *Rhagada sp.* and *Quistrachia legendrei*



Details and the current status of each of these species are given below.

The Western Pebble Mound Mouse has only been identified from distinct mounds formed at the mouth of their nesting burrows. Although there are many mounds throughout the Burrup Peninsula, to date no live *P. chapmani* have been captured. The Western Pebble Mound Mouse is currently listed as a Priority 4 species under the CALM Priority Fauna List.

The Pilbara Olive Python *Liasis olivacea barroni* is a very large (<6.5m) nocturnal python, which is restricted to the Pilbara region. It is known to inhabit the Burrup Peninsula. Recent surveys conducted by the Karratha based Nickol Bay Naturalists Club indicate that in some areas of favourable habitat in the region, such as the Pistol Ranges on the Burrup, the density of Pilbara Olive Pythons may be as high as 30 individuals/ha (S. Van Leeuwin *pers. comm.*). This species is currently listed on CALM's Declared Threatened Fauna List and highlighted as Vulnerable under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC).

The two Camaenid land snails, *Rhagada sp.* and *Quistrachia legendrei* are very small snails that are known only to inhabit the granophyre outcrops and ridges of Dampier and the Burrup Peninsula. Both species depend on the crevices and holes created by rockpiles in order to survive high temperatures (Slack-Smith 1999, 2000). Due to a lack of intensive surveys of land snails, there is still considerable uncertainty regarding the extent and distribution of these snails on the Burrup Peninsula, and indeed whether or not they exist on WII.

Although fauna trapping records indicate a depauperate fauna assemblage on WII, no targeted surveys have been conducted on the island to date. Given the general similarity in topography (and therefore habitat) to the Burrup, however, it is possible that WII also potentially supports the same assemblage of rare and endangered species as listed for the Burrup. The relatively contained nature of WII, however, (access to and from the mainland, across the tidal flats and through the mangrove forests, is possible only on the largest spring tides), along with the presence of feral animals (D. Rochford *pers. comm.*) and the absence of a dedicated baiting programme, such as is currently conducted on the Burrup, may have resulted in the decimation of the resident macro-fauna population on the island.

4.5 HUMAN HEALTH

Considerable concern has been expressed by residents in Karratha and Dampier with regard to the effect of emissions from existing and proposed industry on their communities. Less discussed, but also relevant, is the effect of explosion or terrorist attack on industrial facilities.

The effects of emissions is broadly assessed in Table 4.2 following. This table is based on the occurrence of certain wind directions, extracted from the DRD report completed by AGC-Woodward Clyde (1994). To allow for the distance of the emissions, a simplistic inverse linear relationship is assumed. Thus an Occurrence Magnitude Factor (or OMF) has been derived, which is equal to the wind percentage occurrence in a given direction, divided by the average distance from the emission source. Further details are given in notes to the table. Note that wind speed has not been accounted for in this factor.

**Table 4-2: Comparison of Industrial Emission Effects on Karratha and Dampier**

	OCCURRENCE AND MAGNITUDE OF WIND BLOWN EMISSIONS							
	BURRUP PENINSULA				MAITLAND INDUSTRIAL ESTATE			
	Dampier		Karratha		Dampier		Karratha	
Distance (km) ¹	8.5		14.0		20.0		25.5	
Wind Direction ²	%	OMF ³	%	OMF ³	%	OMF ³	%	OMF ³
N	(9%	1.05) ⁵	9%	0.66	-	-	-	-
NE	16%	1.88	-	-	-	-	-	-
E	(10%	2.12) ⁵	-	-	-	-	-	-
SE	-	-	-	-	-	-	-	-
S	-	-	-	-	(4%	(0.20) ⁵	-	-
SW	-	-	-	-	5%	0.25	(5%	0.20) ⁵
W	-	-	-	-	-	-	(19%	(0.75) ⁵
NW	-	-	16%	1.14	-	-	-	-
TOTAL – Indicated Direction	16%	1.88	25%	1.78	5%	0.25	0%	0
TOTAL – Within 45° arc of Indicated Direction	43%	5.05	25%	1.78	9%	0.45	24%	0.95

1. Distance is taken from a central point on the King Bay - Hearson Cove Estate on the Burrup, or the geographic centre of the mainland portion of the MHIE, to the shopping centres of either Karratha or Dampier. The length of Karratha (approximately 8 km) means that some areas will be significantly closer or further away.
2. This table is based on the wind rose published in AGC-Woodward Clyde (1994). Percentages noted are the percentage occurrence of wind in that sector. No account for local topographic effects has been made.
3. Occurrence Magnitude Factor or OMF (% occurrences / km distance) is a contrived number designed to account for the incidence and likely magnitude of emissions impacting a town. It is derived from the percentage occurrence of wind in a given direction divided by distance from the emission in km.
4. Wind-blown emissions are considered to impact the towns if a corridor the width of the industrial zone on the relevant estate, aligned on the compass directions noted, crosses part of the built-up area.
5. If variation from the considered alignment occurs such that intermediate wind directions are included, the bracketed impacts occur. A 22.5° sector either side of each considered direction has been assumed in these cases.
6. Expansion of Karratha south of the Karratha Hills will place areas of the town in direct alignment with westerly winds from Maitland. This area will have an OMF of 0.74.

The Maitland Estate was partly chosen because of all the options considered, it resulted in the most favourable wind-blown emission fallout on the nearby towns. As expected, the occurrence and magnitude of wind-blown emissions from Maitland is much less than those from the Burrup. For the given wind orientations, no direct alignment with Karratha occurs. To be conservative, we have also calculated the results for winds in a 45° sector centred on each quoted wind direction – i.e. a 22½ wind swing on either side of these alignments. On such an assumption, some wind driven contaminants do reach the town. The incidence of such occurrences from the MHIE is similar, on this assumption, to current wind incidence from Burrup industrial areas, but the magnitude is much less (0.95 cf. 1.78).

It is clear that with regard to the effect of atmospheric emissions on local populations, placing industry on the MHIE is far superior than on the Burrup. The effect of explosion or terrorist activity is similarly far superior, as Maitland is 25 km from Karratha and 20 km from Dampier, compared with the Burrup's 14 km and 8.5 km respectively. (In fact, some industrial facilities on the Burrup are immediately adjacent the town of Dampier).



4.6 SCENERY, RECREATION AND TOURISM

Although both sites contain attractive rock-sided valleys, ephemeral streams and pools, and locally lush vegetation, the Burrup features, in general, a more varied terrain in comparison to WII. Given this fact, and combined with its location, orientation and neighboring islands, the Burrup makes for scenery that is visually stunning. The tall, red rockpiles of the Burrup are surprising when first seen, but they create unique scenery and are particularly attractive in combination with the alluvial lower slopes, mangrove-lined embayments and sea-views. The Burrup also has a number of beaches and coves, some of which have already been destroyed or heavily impacted by industry.

In contrast, the northern portion of WII has a few coves and only one significant beach. Nevertheless, the boundary-like structure of rock formations along the northern and southern coastlines of WII, along with a high north-south joining ridge in the mid portion of the island, come together to form a natural amphitheatre of immense proportions. This amphitheatre encompasses a large broad drainage basin, situated within the central western portion of the island, which contains a series of well vegetated and steep sided rocky drainage gullies. This topography, in conjunction with views of the ocean and extensive mangrove forests and tidal creeks along the southern and western coasts, lends to scenery of dramatic natural beauty.

West Intercourse Island is difficult to visit, both because the adjacent coastline has wide mangrove growth edging extensive mudflats, but also due to the shallow, sub-tidal platform that surrounds most of the island. This makes mainland access impossible and sea access difficult. Much of the coast is mangrove-lined, making for further difficulty. The industrial facilities of Dampier Salt and Hamersley Iron are also visible from the eastern coast of WII, which destroys the sensation of “getting away”. The lack of beaches and difficult hinterland complete the list of disincentives for recreational or tourist interest in the island.

In summary, the Burrup has much more to offer the recreationist and tourist: it is easily accessible, has more varied scenery, allows people to get away from industry and is therefore much frequented. Although Phillip beach is now lost (Woodside’s Supply Base is in this area), the extensive Conzinc Bay beaches and those on the eastern coast are still pristine. For this reason, threats to these remaining resources are resisted by the local population.

4.7 IMPACTS OF FUTURE DEVELOPMENTS

4.7.1 Burrup Peninsula

Industrial land on the Burrup Peninsula includes most reasonably flat terrain south of Withnell Bay. Projects proposed for the Burrup will destroy the scenic value of the King Bay – Hearson Cove valley, and noise and visual pollution will render the area’s most popular beach greatly compromised. Proposed industries in this area have been given land which varies from steep rockpile, through undulating terrain to mudflat landforms. The excessively hard rock has meant proponents have opted for the soft mudflat areas, even though these are subject to king tides and cyclone surge. Landform on the lower slopes and mudflats will be destroyed, as will its covering vegetation and fauna habitat. Cowrie Cove will be partially, possibly fully cut-off from recreational use, and the currently pristine embayment and its small boat-ramp will be in sight of one of the facilities.



Further north, Withnell Bay will not be directly affected by developments on the Withnell East industrial area, but the east-west trending valley will be eventually covered by industry. Access to the boat ramp in the Bay will be maintained: this is not an area used for beach activities, so this change will not be as obvious to recreationists as the Hearson Cove and Cowrie Cove impacts.

The necessity to bring low-specification gas, plus product, water and other fluids south from the Withnell East part of the Burrup, means further impacts to the valley along which the North West Shelf Gas Project access road, the DBNG and Epic pipelines currently run, will be further impacted. Development on the west coast of the Burrup, between the Woodside Supply Base and the NWS Gas Plant means this area will eventually be levelled. The area contains extensive rock piles, valleys, some pristine beach area and the highest concentration of the Priority *Terminalia supranitifolia* species on the Burrup.

Effectively, based on current plans, nearly all the Burrup Peninsula south of Withnell Bay will be levelled for industry, with the Pistol Ranges and the plateau north-west of Cowrie Cove the major undisturbed areas.

This very significant landform alteration and concentration of heavy industry will render the southern two-thirds of the Burrup unsuitable for most recreational and tourist activity. It will result in the destruction of seven major habitats, (samphire flats, coastal flats, plateaus, lower hill slopes, upper hill slopes, rockpile ridges and gullies) each with very distinct and unique vegetation types. The cumulative loss of the vegetation from each of these habitats, is critical, especially as some of these habitats, are not duplicated elsewhere on the Burrup. Heavily impacted will be the vegetation that occurs on the more level plateau areas, the lower hill slopes and the samphire flats due to the fact that they are more acceptable to developers. The plateaux and particularly the samphire flats (ie. King Bay – Hearson Cove tidal inlet) are not found in the area that has been set aside for industry. The samphire flat vegetation has been shown to be unique to the Burrup (Astron 2001). The introduction of new weeds and the further spread of existing weeds into areas that are presently not infested will lead to further loss of native vegetation. All these impacts to vegetation result in a corresponding fauna habitat loss. This affect is exacerbated by the fact that industry is placed on soil areas: the preserved part of the Burrup is mainly rockpile topography.

4.7.2 Maitland Estate – Mainland and West Intercourse Island

If the MHIE was developed to its fullest extent, the entire north-east end of WII would be levelled and all vegetation and landform destroyed. Impact on the mainland portion would be mainly visual (i.e due to the placement of industrial facilities), as the area is so flat that little landform modification is required. As the coastal terrain unit extends for over 100 km, the 4000 ha lost to industry will have a negligible effect on regional flora and fauna loss.

Given strict adherence to the design outlined in this report, the impact on West Intercourse Island will be significant, but as it is localized and concentrated in one part, the effect is far less than the spread of small sites that occurs on the Burrup Peninsula. In the plan developed for this study, no rockpile destruction or removal of beaches as has already extensively occurred on the Burrup, will occur. However, development beyond these limits cannot be guaranteed: it is advisable that the area zoned for industry be reduced on WII to the boundaries developed in this study.



According to the design outlined in this report, the impact on vegetation will be significantly less than on the Burrup. Three habitats would be impacted including low, undulating hillslopes and plateaux, rock outcrops, minor drainage gullies. The low undulating hillslopes and plateau habitat, which is favoured for development, is not found elsewhere on the island. In order to minimize the impact on the vegetation specific to this habitat, development would need to be contained, and some of the habitat retained. This area is also where a small stand of desert poplar, *Codonocarpus cotinifolius* occurs. This is not found elsewhere on West Intercourse Island, nor is it found on the Burrup Peninsula. The scrub that is found along the dissecting shallow drainage gullies is specific to this low undulating habitat and occurs over much of the northern portion of the island. If the design is adhered to, some of this vegetation type will not be impacted. The low rockpiles that occur in the area house rockpile vegetation that is found elsewhere. Some impact may occur to the coastal plain behind the long sandy beach to the west unless development goes beyond the current design. The probability of the introduction and spread of weeds into this area is a related impact.

The causeway between the mainland and West Intercourse Island will cause extensive destruction of mangal and seabed communities, even though it has been kept as close as practicable to the Dampier Salt Pond Zero levee. Mangrove loss is expected to be approximately 11 ha which is less than 1% of the area of mangrove between Dampier Salt and the western side of WII.

The wharf causeway and WII access causeways will cause benthic fauna and flora loss, though the area is largely moving sand and relatively depauperate. Pipes or bridges will need to be incorporated to maintain current and tidal flows.

**Table 4-3: Summary of Environmental Impacts: Burrup and MHIE**

Aspect	Burrup Peninsula	Maitland Heavy Industrial Estate
Landform and Geology	Major destruction of landform on the west coast and within King Bay – Hearson Cove axis. Including existing industrial leases and infrastructure, some 43% of the central and southern Burrup (from Mt. Wongama south) will be destroyed or severely affected. This equates to approx. 27% for the entire Burrup area.	Proportional disturbance to mainland terrain unit is small. Disturbance to WII would maximize at approx. 20% of the total WII area. All rock pile landform is preserved.
Vegetation and Flora	Major destruction to vegetation within 7 habitats will occur, particularly on plateaux and on the tidal flats. These habitats are not duplicated elsewhere on the Burrup, and the samphire flats have been shown to house samphire associations unique to the inlet. Flora of high conservation status including the Priority 1 species will be destroyed. The cumulative loss of vegetation, and flora both with high conservation value, including the Priority 1 species, will be significant. The introduction and further invasion of weeds will occur.	Major destruction on north-east end of island to all vegetation will occur. This will include the vegetation specific to the low, undulating hillslopes, and that found in dissecting drainage gullies, not found elsewhere on the island. Strict adherence to the development design will minimize impact and should preserve the nearby coastal plain vegetation. Species of high conservation value will be removed but no Priority 1 species will be included. The introduction and spread of existing weeds is likely to occur.
Fauna	Substantial impact to fauna habitat on west coast and King Bay – Hearson Cove axis. Potential impact on habitat species including rare and/or endangered species such as the <i>EPBC Act 1999</i> listed Pilbara Olive Python.	Substantial impact to fauna habitat on the north end of WII. Although trapping records indicate that the island is relatively depauperate in macrofauna, there will be impact on habitat species. This potentially includes rare and/or endangered species such as those listed for the Burrup.
Scenery, Recreation and Tourist	Major disturbance of recreational and tourist values will occur.	No impact on recreation and tourist values. Major impact on scenic values.

5 ABORIGINAL HERITAGE

5.1 OVERVIEW OF HERITAGE SURVEYS IN THE AREA

West Pilbara Coast

The Aboriginal heritage value of islands and coastal sites in the Karratha region has long been recognized by the archaeological community (McCarthy 1961; Crawford 1964; Ride & Neumann 1964). In fact, archaeological surveys of Depuch Island (Balla Balla) showed it was unacceptable for development on the grounds of its exceptional aboriginal heritage as early as 1964 (Ride *et al* 1964). As a result of these surveys, attention was diverted to the Dampier Archipelago. However, early reports on the Aboriginal heritage value of the Burrup Peninsula (Wright 1968; Dix 1970; Virili 1974; Bednarik 1977) were essentially ignored by government and developers.

The Burrup Peninsula

Subsequent to the work of Bednarik (1967 – 1970) who recorded almost 600 rock art sites, F.L. Virili (a Project Engineer for Dampier Salt) and French archaeologist and European cave art specialist Michel Lorblanchet did extensive surveys on the Burrup in the 1970s on what was then known as Dampier Island¹ (Vinnicombe 2002). At the completion of a number of similar surveys throughout Australia, Lorblanchet notably advocated the creation of a Museum / Research Centre at both Kakadu and Dampier as both represented “the most impressive clusters of sites I (have) ever seen” (Lorblanchet 1984).

During 1977 and 1978 Hamersley Iron and Dampier Salt employed archaeologists to carry out surveys of land leases where development was planned (Brown 1979; Bindon 1978). In 1980, Woodside Offshore Petroleum contracted the Western Australian Museum to undertake the Dampier Archaeological Project as part of the investigative procedures related to its development on the Burrup (DAS 1984). This 16 month project with 14 resident crew members collected a huge amount of data which took several years to process.

Between 1991 and 1993 CALM initiated a systematic study of Aboriginal Heritage values of the Burrup Peninsula, which involved a series of transects running east-west across the Burrup. The Aboriginal community was involved throughout (Veth *et al* 1994). In addition to these major studies, a variety of smaller surveys and research papers on the Burrup have been completed. These include various papers by Department of Aboriginal Sites (DAS), Green (1982), O'Connor and Quartermaine (1988), Vinnicombe (1987, 1988 and 1997b), Veth *et al* (1993) and Bradshaw (1994). (This list is indicative only).

Numerous surveys of proposed industrial sites on the Burrup have been completed since this time, in particular in the Hearson Cove / King Bay area. Proponents include Mermaid Marine, BHP Petroleum, Water Corporation of Western Australia, Plenty River / Dampier Nitrogen, Burrup Fertilizers, Syntroleum Corporation, Methanex, GTL and Japan DME.

¹ Dampier Island was officially renamed Burrup Peninsula in 1979 because of confusion with the Dampierland Peninsula, north of Broome (Vinnicombe, 2002).



Maitland Estate and West Intercourse Island

A series of surveys have been completed at the proposed location of the Maitland Industrial Estate. These commenced in 1994 and included work on both the mainland and West Intercourse Island. One of the earlier surveys highlighted some mound middens of astonishing size on WII and an historic pearling camp (Murphy *et al* 1994). The final survey reports (Vinnicombe 1997a) indicate that the WII in particular coincides with remarkably rich Aboriginal cultural heritage. Full surveys of the Estate have not been completed, but the site density on the WII access route were even higher than the Burrup (R. Stevens *pers. comm* 2002).

5.2 PLANNING AND DEVELOPMENT ON THE BURRUP

The archaeological community has long demanded that the rich Aboriginal heritage of the area be appropriately managed (Bednarik 1997, Virili 1977 (as quoted in Vinnicombe 2002), Wright in DAS 1980a, Seaman 1984, Lorblanchet 1984, Schwede and Veth in O'Brien 1994). Apart from the Government's early acceptance of the unsuitability of Depuch Island, however, Aboriginal heritage has not been seen as an impediment to project development on the Burrup. None of the planning studies have included an Aboriginal heritage field survey component and archaeological investigations usually go hand-in-hand with the design and approval process for major projects rather than before it. Vinnicombe (2002) noted that Woodside located its gas plant at Withnell Bay after preliminary helicopter and ground searches only. "Thereafter, irrespective of the findings of the full survey that followed, there was no flexibility that allowed for further negotiation regarding the siting of principal areas". In addition "No consultation took place with Aboriginal people who had traditional associations with the area" until later, when development plans were finalized.

Vinnicombe (2002) also laments that the Clough / SLAM (1980) report "astoundingly concluded that there was no conflict between industrial needs and conservation requirements" and states that proposals by the Department of Aboriginal Sites (Wright in DAS 1980) to urgently complete site reconnaissance, provide site protection and planning were ignored by Government. "In 1981, the State Cabinet adopted the Clough / SLAM report as a guide for development on the Burrup Peninsula, and no concession was made regarding Aboriginal Heritage issues".

Interestingly, Vinnicombe (2002) notes that as late as 1991, in the *Pilbara Region Economic Development Overview* prepared for Pilbara 21, "no mention whatever is made of Aboriginal heritage, not even in the section on the tourism industry." This omission was later repaired and although Vinnicombe notes the report credibility is seriously compromised by certain statements, the Pilbara 21 Final Strategy Report (1992) does outline a policy to ensure recognition of the importance of preserving aboriginal culture in the region.

The Burrup Land Use Management Plan (O'Brien 1994) was the first true planning document for the Peninsula. It proposed a further 19.6 km² or 22.2% of the Burrup for industry. No consideration of the relative importance of Aboriginal heritage sites across the Peninsula was made, apart from recognition of protected areas nominated to the National Estate. Generally, O'Brien reserved the west coast of the Burrup (as it was closest to the port), plus available flat land east of this for industry (p.61).



It is notable that the richness of the Burrup Peninsula has only become known since industry provided the finance to fund, directly or indirectly, these archaeological surveys. However, the general disregard for Aboriginal heritage in the industrial planning process, has left some bitterness which has a continuing effect on the project approvals process. The IFRAO website now contains a link to a protest letter (to be sent to the WA State Government), prominent on its opening page. Professors of Archaeology have written in complaint and even Prince Charles has been involved. Negotiation of a project through this lobbying is the last thing a proponent needs, but detailed consideration of the effect of a project on Aboriginal sites is now part of the Burrup approval process. This is a burden on developers.

5.3 CURRENT PLANNING ISSUES

One of the most important aspects of the decision over which Estate is most appropriate for further development, is its impact on Aboriginal heritage sites, in particular rock engravings. Both WII and the Burrup Peninsula have a remarkable concentration of Aboriginal heritage sites and neither has been surveyed to its fullest extent. To preserve the world class rock art of the area, it is essential that appropriate site reconnaissance, protection and management of Aboriginal heritage sites, as outlined by Wright (DAS 1980a) be instigated in future.

The revised MHIE layout developed for this study has relocated the WII access causeway to avoid most of the dense aggregation of sites on the south-east coast of West Intercourse Island. The Stage I, or minimal development option costed in this report, also avoids many sites on the north-east end of WII. However, many known sites (approximately 31) will be impacted even with its minimal development, and if the entire north-east end of WII is eventually developed, 118 known sites will be physically disturbed². It is likely that this will be less than the number of sites destroyed by full industrial development of the Burrup Peninsula.

Apart from direct physical impacts, however, the effect of plant emissions on aboriginal sites is thought to be extensive. Bednarik (2002) estimates a substantial loss of engraving definition has already occurred and that the end result will be total loss of engravings on the Burrup Peninsula by the end of the present century. The effect on engravings further afield – e.g. on the islands of the Dampier Archipelago – has not been quantified in this way.

One of the reasons for the choice of the Maitland site, was its location with respect to dominant winds in the area. The Karratha Annual Wind Rose (Figure 3) shows that Aboriginal sites on the Burrup, south of the NWSGP will have emissions blown over them most of the time. In addition, the sheer proximity of the Burrup Industrial Estate to petroglyphs will undoubtedly result in a higher concentration of emissions. Industry on the mainland portion of the MHIE, however, will have most emissions blown away from Aboriginal sites on WII and coastal areas. Even when winds blow towards engravings, the distance over which emissions travel would allow for dissipation and atmospheric entrapment, resulting in less impact.

² Office of Major Projects, unpublished data (2002). The given numbers represent only those sites that are currently known and recorded. In this regard they should not be perceived as comprehensive and the possibility of further sites being discovered/recorded should not be disregarded.



Informed discussions with some Aboriginal people and various specialists involved in the field (archaeologists, anthropologists) have indicated that the MHIE is the preferred site for future development. This is after consideration of the probable impact on sites on the mainland and the north end of WII and existing impacts on the Burrup sites. One of the reasons appears to be the forecast extensive removal of rock art along the west coast of the Burrup. However, it is apparent that further discussions and more field surveys are necessary to fully resolve this issue.



6 MAITLAND DEVELOPMENT COST

The Maitland development cost has been derived from the application of unit rates to quantities calculated for the minimal option described in Section 3 above. These unit rates are largely based on the work of the Multi-User Port Development Strategy (GHD 1999), but also more recent considerations as noted below. To obtain earthwork quantities of causeways, required island cut and dredging, the computer program 4D Model was used.

Digital terrain models of the north end of WII were available, and natural surface contours of the mainland portion of the estate have been determined in the past. Ground and seabed levels in between were interpolated, with the aid of soundings taken from a marine vessel traverse of the proposed service corridor alignment. The proposed 20 m wide service corridor and 10 m wide wharf access causeway were used to determine cut quantities and the north end of WII contoured appropriately to source this volume. Dredge spoil was assumed placed on WII to create more useable space.

Earthwork rates were obtained from BGC Contracting, Karratha who reviewed the preliminary drawings. These were increased somewhat to provide a contingency. Dredging rates used by GHD were compared with those determined by Mermaid Marine during their recent Supply Base expansion. As these were less than GHD's, the latter were used. Other unit rates were obtained from the GHD report or other reputable sources. A summary of unit rates utilized is given in Table 6.1

Table 6-1: Unit Rates Utilized for Construction Cost Estimate

ITEM	UNIT RATE
Dredging	
Mobilize / Demobilize	\$ 1,500,000
Dredge Disposal of Type I Material to WII	\$ 7/m ³
Dredge Disposal of Type II & Type III Material to WII	\$ 18/m ³
Earthworks	
Drill, blast, haul and place ROM material	\$ 15/m ³
Source, grade and place armour – to 0.5 tonne	\$ 30/m ³
Source, grade and place armour – to 3.0 tonne	\$ 45/m ³
Source, carry, place and compact surface material	\$ 100/m ³
Wharf Structures	
Supply, install and paint roadway trestle	\$ 23,000/m
Supply, install and paint concrete and steel-piled wharf structure	\$ 3,500/m ²
Supply and install piled, concrete mooring dolphin	\$ 3,500,000
Pipelines	
Supply, install and coat above-ground water pipeline, 1000 mm dia.	\$ 1,110/m
Supply, install and coat above-ground water pipeline, 900 mm dia.	\$ 965/m
Supply, install and coat below-ground gas pipeline, 16" dia.	\$ 1000/m
Roads	
Source fill, install base course, roll and compact 10 m road base	\$ 400/m
Supply and install 2-coat seal	\$ 70/m



The costs adequate to establish the MHIE – i.e. dredging, wharf and civil works, are given in Table 6.2. below. For a total cost of approximately \$ 100 million, the estate complete with port could be prepared ready for its first client. Note that power and water are not included in this cost.

Table 6-2: Maitland Estate Civil Work Cost Estimate

Item	Quantity	Rate \$	Cost \$'000	Sub-Total \$'000
Dredging				
Type I Material	375 000 m ³	7.00	2 625	
Type II Material	600 000 m ³	18.00	10 800	
Mob / Demob			1 500	14 925
Berths				
Roadway Trestle	300 m	23 000	6 900	
Wharf Head	3 000 m ²	3 500	10 500	
Dolphins & Walkways			6 400	23 800
Causeways				
High Level – Core	513 000 m ³	15.00	7 695	
- Armour	250 000 m ³	45.00	11 250	
Low Level – Core	597 000 m ³	15.00	8 955	
- Armour	266 000 m ³	30.00	7 980	35 880
Earthworks				
WII Finish to Grade	350 000 m ²	10.00	3 500	
Maitland River Flood Bank	10 000 m	100.00	1 000	4 500
Access Road				
Form Sub-grade	20 800 m	400.00	8 320	
Two-coat seal	20 800 m	70.00	1 456	9 776
TOTAL				88 881
Design Documentation and Further Investigative Works @ 20%				17 776
OVERALL TOTAL				106 657

To provide a fair comparison with Burrup, the cost to transport low specification gas from the NWSGP to a central point on the MHIE must be obtained. The average pipeline length for this on the Burrup is 5 km – there is a penalty of a further 28 km to pipe gas to Maitland. A 16” supply pipeline has been assumed for costing. Of course, if a gas project should establish on Maitland, this cost will not occur.

Water is necessary for most projects and the Government is currently in the design stage of a Desalinated Water System for the Burrup. The extra distance to water at Maitland – an average of 5 km extra over the Burrup, is also a substantial cost. Water suction and discharge lines have been assumed to access water midway along the WII access causeway.



The cost of power to the estate has not been considered as most industries generate their own electricity. High voltage transmission lines do run close to the MHIE, however. Investigation into the cost of accessing this power has not been instigated.

The cost of supplying scheme water has been derived assuming a pipeline running along the North West Coastal Highway from the current Water Corporation feed pipeline which crosses the highway near the Hamersley Iron railway. Pipeline pressure at this point is considerable and a pump station probably would not be required. Such a service is not meant for industrial use, but rather for construction, offices and relatively light demand.

These costs are outlined in Table 6.3 below.

Table 6-3: Maitland Estate Infrastructure Penalty Cost

Item	Quantity	Rate \$	Cost \$'000
Water Pipelines			
Suction Pipeline – 1000 ϕ	5 000 m	1 110	5 550
Discharge Pipeline – 900 ϕ	5 000 m	965	4 825
Low Specification Gas Pipeline			
16" Gas Pipeline	28 000 m	1 000	28 000
Scheme Water			
12" Pipeline	15 000 m	250	3 750
TOTAL			42 125

A penalty over the Burrup of some \$ 28 million is relevant if gas needs to be piped from Woodside. A further cost of \$ 10 million will accrue for high volume, high quality desalinated water and waste discharge. The total penalty of \$ 42 million excludes access to Western Power.

Should another gas project be established on Maitland, a gross penalty of less than \$ 15 million, excluding power, will occur.



7 COMPARISON : MAITLAND v BURRUP

Comparison of Maitland and Burrup is a complicated exercise, there being a wide range of variables. To assist in this, a table of advantages and disadvantages has been constructed. This table follows in the next two double pages but some points are summarized below.

The advantages of the Burrup centre around its closeness to an existing port and the accompanying infrastructure. Environmentally, the Burrup is already compromised, existing projects having destroyed many engravings, large areas of vegetation and some beaches. However, should all the proposed industrial areas on the Burrup be developed, a major effect on Aboriginal heritage, vegetation, scenery, recreation and tourist values will occur. Large areas of rockpile are planned to be levelled with the concomitant impact on all other uses: effectively, a large proportion of the southern Burrup could be destroyed.

The difficulties with the Burrup are more extensive than commonly realised. After nearly a decade of planning, Government still has not been able to resolve the problems with fitting pipelines for product and services within the narrow rocky valleys. The rocky terrain, the lack of flat land, the limits of space and cramped port conditions are major disincentives. The public wharf has barely more than 6 m water depth on approach and there is inadequate space for services and jetties. It is very expensive for a proponent to establish on the Burrup and the importance of its rock art and both Native Title and Heritage issues has made it an expensive alternative. It is also a significant risk, environmental impacts and Aboriginal heritage are issues which frighten financiers.

The advantages of Maitland are that it has effectively unlimited flat land with few environmental issues. It has an excellent port which is readily expandable. The estate itself can expand west as needed and the flat terrain allows for simple cost-effective design. Synergy between projects is facilitated. It is an appropriate distance from population centres, in that it is easily accessible for working residents yet does not compromise scenic, recreation or tourist values.

Its disadvantages relate to its distance from the sea and its initial development cost. In addition, West Intercourse Island is essentially pristine, and while the north-east end has less environmental value, its disturbance is an issue. Many aboriginal sites will need to be removed, even on the relatively depauperate flat area planned for infrastructure.

An extensive list of bullet points is given below.



Table 7-1: Advantages and Disadvantages of the Burrup Industrial Estate

A: Advantages of the Burrup
<ul style="list-style-type: none">• Bitumen road access within a few kilometres of each site.• Existing power and water adequate for construction purposes.• Relatively close to an existing Port (average distance 5.8 km).• Existing wharf with 209 m of wharf face dredged to 10 m (Access channel = 6 m) is available.• Minimal government infrastructure investment required.• The NWS (Woodside) Gas Plant is already within the estate providing both high and low specification gas.• Many aboriginal sites have already been impacted: much of the proposed Burrup Estate is relatively free of engravings.
B: Disadvantages of the Burrup Industrial
<ul style="list-style-type: none">• Relatively limited amounts of flat land available.• Industrial sites are hilly and require substantial earthworks.• Ground is mostly very hard rock which is extremely expensive to excavate.• A significant portion of land is mudflat, which is below the king tide and cyclone surge levels, requiring extensive fill and across which access is difficult.• Sites are confined between large, rocky hills, making plant expansion difficult.• Service corridors are relatively long and sinuous, requiring numerous pipe bends and transfer towers.• There is inadequate room for full service corridors.• The limited space causes congestion of services at several areas, in particular the wharf and Burrup Road.• There is very limited laydown space available at the Port and even with extensive rock blasting, current facilities and rock hills limit laydown area.• Un-dredged water depths at the port are limited to around 6 m.• Difficult terrain and other developments along the coast at the Port limit the wharf berth space available and results in severe congestion.• Industrial power and water are limited in quantity and need to be produced on site.
Aboriginal
<ul style="list-style-type: none">• The Burrup is a world-class rock art province: disturbance to rock art in the past has been substantial and efforts to protect engravings (both those removed already and those remaining) have been almost non-existent.• There is evidence that current emissions are harming engravings irretrievably. Further emissions from proposed plants will accelerate this process, perhaps ruining the engravings.• Native Title negotiations on the Burrup have proven extremely difficult, both because of the desire to extract some reward from the massive proposed investment, but also because of the density and importance of the aboriginal sites.



Flora and Vegetation

- The Burrup has a rich flora and extremely varied vegetation, not replicated elsewhere in the Pilbara. It has been recently classified as being largely unique and worthy “of world heritage status”. (Trudgen 2002)
- The Burrup has a significantly high number of species with high conservation value, some of which may be restricted to the Burrup. There are four Priority species on the Burrup, one of which has the high conservation status of Priority 1.
- Past and current impact on the southern Burrup vegetation has been and continues to be substantial, both as a result of roads, infrastructure and plant footprint related to the Woodside and Hamersley developments, but also as a result of service industries on Port Authority lands. The cumulative impact has not been considered.
- Apart from substantial direct impact, weed introduction, invasion and spread has been severe, both on land disturbed for industry and along tracks frequented by recreational vehicles and tourists.

Fauna

- The species richness of the Burrup is comparatively high considering its relatively small area compared with the Pilbara as a whole. The area also offers a potential habitat for at least three rare and endangered species, one of which (Pilbara Olive Python) is currently listed as Vulnerable under the *EPBC Act 1999*.

Social, Recreational & Tourism

- Being a physically attractive and unique area, the Burrup Peninsula is the main recreational area for Karratha and Dampier: it provides a relatively pristine environment used intensively for beach activities, camping, fishing, walking, diving and rock climbing. Tour operators take parties to view engravings, to fish and sightsee. Industry is not compatible with these areas.
- Emissions from proposed industry will impact Karratha and Dampier, drastically increasing NO_x and SO_x and other contaminant levels. This will have human health and legal implications.
- Proposed industry will visually impact on Karratha’s only beach changing it from a rural to an industrial setting and thereby decreasing its value significantly.
- The volumes of industry proposed on the Burrup will turn it from an open area with some industry, to an industrial estate, with the consequent effect on the recreational and tourist value.
- The concentration of industry on the favoured recreational and tourist area will serve to substantially reduce the attractiveness of Karratha as a place to live; necessitating higher salary packages and other initiatives to get people to work in the area. This also has a negative effect on rents.
- The full tourist potential of the Burrup Peninsula is yet to be realised.



Table 7-2: Advantages and Disadvantages of Maitland Industrial Estate

A: Advantages of Maitland Industrial
<ul style="list-style-type: none">• The estate is large and has virtually unlimited expansion capacity.• The entire area is flat.• Land does not contain rock and can be readily excavated.• The area is not subject to cyclone storm surge.• The Dampier to Perth Natural Gas Pipeline runs through the estate.• High voltage power lines pass across the western boundary of the estate.• The area can be properly planned with wide, straight service corridors.• The potential for symbiotic growth of industries is uninhibited because of the space available for a wide range of industrial types.• Access to the Port can be obtained with a single straight conveyor or pipe run.• Laydown space at the Port is unrestricted.• Water depth at the Port is 8 m undredged and 11.8 m dredged.• Major aboriginal site areas will be avoided by the proposed layout
Vegetation
<ul style="list-style-type: none">• Due to the reduced number of habitats beneath the proposed development area, the vegetation is less varied and diverse than the proposed development areas on the Burrup.• The vegetation is very similar to that of the Burrup, and further studies will probably indicate that much of the vegetation and flora restricted to the Burrup occurs here also.• There are 3 Priority species on the island, but this does not include the Priority 1 <i>Terminalia supranitifolia</i>.• Weed management should be more attainable due to the lack of existing weeds in the area, or reduced sizes of populations with reduced seed bank in the soil. The creation of vehicle tracks and other disturbances can be controlled from the outset.• The vegetation on the mainland is widespread and well represented beyond the project area.
Fauna
<ul style="list-style-type: none">• Initial non-targeted surveys indicate that the fauna on West Intercourse Island is relatively depauperate.
Recreational & Tourism
<ul style="list-style-type: none">• The proposed Maitland Estate is a flat, treeless plain with little relief. The north end of the West Intercourse Island comprises undulating countryside, typical of the Dampier part of the Burrup. None of these are considered attractive and have not generated any tourist / recreational interest in the past.



B: Disadvantages of Maitland

Industrial

- Maitland is relatively distant from its proposed Port, a central point on the estate being approximately 16 km from the possible jetty location.
- Access to the proposed port will require construction of a 12 km causeway across coastal mudflats and shallow marine channels.
- The Port requires construction of a jetty access bridge or causeway 1.5 km long across a shallow sub-tidal platform until deep water is obtained.
- The Port requires levelling of laydown area at the North end of West Intercourse Island.
- There are no direct services such as power or water currently available. All infrastructure must be constructed.

Aboriginal

- The Port site for MHIE, West Intercourse Island, has many aboriginal sites that have had no European impact. They are pristine and correspondingly valuable.

Vegetation

- The island is in essentially a pristine state, therefore the vegetation has not yet been significantly impacted. Development will result in largely undisturbed vegetation being impacted by human activity.
- Development of the causeway infrastructure will result in disturbance to areas of mangrove forest along the western boundary of Pond Zero.
- Further studies may find that the vegetation on the island includes some, and maybe many of the vegetation types that are currently considered to have significant conservation status on the Burrup.
- It is known that many of the flora on the island are the same as those on the Burrup that have been recently attributed with high conservation value.
- Although much of the vegetation mapping of the island has been done (Astron 1999), detailed flora studies are yet to be undertaken. This may result in currently unknown species of high conservation value being found.
- The island has introduced weeds in some areas, predominantly on the south end – any construction will cause weed spread.



8 DISCUSSION

From the issues discussed above, it seems the following broad conclusions can be drawn.

- Development of the port, including a berth suitable for Panamax vessels, a wharf of some 3,500 m², dredging, over 70 ha of laydown space and an access road off the North-west Coastal Highway can be achieved for a cost of around \$ 100 million.
- The MHIE will have minimal impact on scenic values, recreation and tourist facilities in the area, unlike development on the Burrup Peninsula.
- Industry at Maitland will cause substantially fewer emissions to affect the towns of Karratha and Dampier and engravings in the area than will industry on the Burrup Peninsula.
- There are no issues with tidal surge at Maitland, the ground being high and the coastal topography acting to reduce surge heights. This is unlike Burrup, where industry is planned on a coastal zone subject to 2 m to 3 m surge above the current natural surface.
- Soil conditions on Maitland will result in far lower construction costs. On West Intercourse Island, hard rock, similar to the Burrup is expected.
- Full development of the MHIE as envisaged in this report, will probably result in the destruction of fewer aboriginal engravings than full development of the Burrup will cause. However, incremental work on the Burrup is likely to cause less destruction to aboriginal heritage sites than minimal development of the MHIE.
- While it is difficult at this stage to compare vegetation, it appears that full development of the MHIE as envisaged in this report, will result in less destruction to vegetation than full development of the Burrup.
- Fauna on WII being depauperate, the considered development is not expected to cause significant dislocation or mortality to fauna. On the other hand, fauna on the Burrup will be significantly affected by further development.
- If a significant gas development is placed on Maitland, it will be economically, as well as environmentally attractive to downstream industry. Piping of low specification gas from the NWSGP will result in an approximate \$ 30 M cost penalty, however.
- Suction and discharge lines for desalinated water production will be substantially more expensive (over \$ 10 million and possibly much more than this) on the MHIE.
- Industries for which close proximity to a port is essential will be disadvantaged by the MHIE, unless placed on WII itself. While there is substantial space available on WII, the effect of emissions on engravings will significantly increase if industry is placed on the island.



The MHIE offers excellent scope for industry integration and as a site favoured by green and aboriginal groups, should speed the approvals process. The disadvantage of its distance from the sea, is a substantial one, however.

The importance of proximity to water is exemplified in the cost penalty accepted by the NWS partners when the site of the NWSGP was determined. A dedicated shipping channel, vast amounts of dredging and extensive removal of hard granophyre were accepted as a necessary expense for a short transport distance between plant and ship.

The study of this question further is beyond the scope of this report, but unlike Burrup, there is substantial room at the Maitland Port for stockpiling product prior to shipment. Access corridors are straight and can be appropriately planned as the estate grows. This contrasts with the Burrup, where extensive rock piles and limited space make product export routes and service corridors extensive and difficult. If all planned industry proceeds on the Burrup, services will become a major routing and maintenance problem.

The Maitland Estate has many advantages over the Burrup, but it is costly to establish and it is relatively distant from the sea. This has been the reason for its never having proceeded.



9 CONCLUSION

If this study were instigated 30 years earlier, we believe the argument for Maitland would be much stronger: the Burrup was pristine north of Parker Point in those days. Phillip Beach was the preferred recreation area and the valleys and engravings between Withnell Bay and King Bay were untouched.

The importance of Aboriginal heritage, in particular rock art, and the necessity to preserve unique and beautiful scenery has been recognised late in the twentieth century. The conundrum of what dollar value to place on such issues – and in the final analysis, this is the question – remains, however, a difficult one.

All things considered, the authors of this report conclude that the \$ 100 million establishment cost of a port and industrial estate at Maitland / West Intercourse Island is a good investment by Government. The refusal to commit this money during the 1990s may have already lost projects to Western Australia as the construction cost and financial risk of being in the middle of a world class rock art site are substantial. The Burrup is an exceedingly difficult and expensive area to work and the flat, easily excavated land at Maitland, free of most environmental concerns, would be generally preferred. West Intercourse Island has similar attributes and difficulties as the Burrup and any development there needs to be limited in scope. Strict Aboriginal heritage and environmental management plans would be necessary from the start.

It is apparent that the Maitland Heavy Industrial Estate:

- can be established at a reasonable cost
- provides an excellent basis for synergistic development of downstream processing industries
- has less impact on community expectations of safety, freedom from emissions and recreational freedom
- would have negligible impact on tourist and scenic values.

Further surveys and discussions with Aboriginal groups are needed to determine whether its development is less destructive of Aboriginal heritage values than further work on the Burrup Peninsula

While it has difficulties of cost and remoteness, the Maitland Heavy Industrial Estate has substantial industrial, environmental and Aboriginal heritage advantages over the Burrup. Its establishment should be seriously considered by Government, further investigations commissioned as necessary, and its development promoted ahead of any further industrial projects on the Burrup Peninsula.



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APPENDICES



APPENDIX 1: MAITLAND PORT DESIGN CONSIDERATIONS



Appendix 1: MAITLAND PORT DESIGN CONSIDERATIONS

A1.1 INTRODUCTION

This appendix provides data and the reasoning behind the design details adopted for the MHIE port off West Intercourse Island. Most of it has been extracted verbatim from GHD (1999) who considered these aspects for the combined AUSI Iron DRI Plant and the DOW/Shell Pilbara Petrochemical Project. Full acknowledgment is given to GHD, but some minor alterations have been made.

The location of the port offshore has been selected with the objective of providing safe and efficient navigation. The dependent infrastructure, dredging and approach causeway/trestle have been optimised as much as possible with the information available at this stage.

The approach from the land to the berths is proposed to be by a combination of causeway and trestle. When the cost of a causeway exceeds the cost of a trestle structure, then a trestle is adopted. In this report it is assumed that trestle structures are more economical in water depths greater than 3 m below LAT. In shallow water areas the costs of crossings are similar to a depth of 3.0 metres, irrespective of whether a causeway or trestle option is adopted.

A further constraint on the construction of causeways is the need to preserve as much as practical tidal flows around the islands to minimise impacts on the coastal environment in general and mangrove stands in particular. Additionally any changes in tidal flows and elevation should be avoided in the vicinity of the Dampier Salt intake pump station to prevent interference to its operations. Causeways will need to be constructed with bridge sections or pipes to allow flow through of tidal flows through.

Access to and from the berths will be along a dredged navigation channel linking to the existing channels in Mermaid Sound.

A1.2 NAVIGATION

A1.2.1 Navigation Within Port of Dampier

The principle approach channel from the sea to the potential port site is via the dredged and marked channel through Mermaid Sound at a declared depth of 15.3 m chart datum. According to the Port of Dampier a maximum vessel draft of 18.5 m can transit the channel by working the tides.

The Mermaid Sound channel primarily serves vessels departing the iron ore export terminals at East Intercourse Island and Parker Point. These vessels range in size from 60,000 dwt to over 200,000 dwt. The larger vessels, which are in the majority, are constrained to leave fully or part laden at or near high water. Incoming vessels in ballast are not generally restricted by tide. Laden vessels sailing from these berths with minimum under keel clearance (UKC) would have priority both on channel usage and port services e.g. tugs and pilots. Channel transit time from the East Intercourse Island iron ore terminal is approximately 1.5 hours. Over 500 vessels per annum currently use the channel (excluding Dampier Salt vessels).



Vessels using the Dampier Salt Wharf at Mistaken Island are often not draft limited but leave the berth via the 15.3 m channel or, if tide and draft permit, on a route parallel to the channel. Some 100 vessels use the salt berth each year.

Vessels serving the LNG/LPG berths to the north approach these facilities via a separate dedicated channel.

Report No.T4207 "*Port of Dampier Strategy and Capacity Study*" (Sept 1997) by Halpern Glick Maunsell (HGM) details proposed developments in the Port of Dampier, including those South of King Bay together with the requirements of a range of potential industries including those likely for Maitland. The principle conclusions of the HGM report that are relevant to the port needs of Maitland are those of the availability of the channel and of port services.

In respect of channel availability and usage, the report makes the assumption that vessels servicing Maitland will not be larger than Panamax and that laden vessels will use the existing dredged channel to 15.3 m LAT with priority given to laden ore export vessels and with a 40 minute headway on departure. Provision of such headway allowance either by time or distance, is common practice to provide safe navigation along channels.

Arriving ballasted vessels would use the channel (but outside the departure tidal window for deep drafted vessels) and a route parallel and to the west of the dredged channel. Departing laden vessels could also use the parallel route subject to draft and tide. The report also recommended that in future the parallel route should be cleared to 11.5 m LAT to provide a new channel and allow improved access for inbound vessels.

In respect of services, particularly towage, it would appear that there may be a need to augment the existing tug fleet to minimise waiting times.

The impact of any additional shipping traffic on the port services needs to be reviewed in the light of existing traffic levels and expansion of facilities on East Intercourse Island and Parker Point.

A1.2.2 Navigation at Maitland Berths

The largest vessels likely to use the MHIE berths are Panamax vessels. Fully laden Panamax vessels have been assumed to have a loaded draft of 13.5 m and a minimum UKC on sailing of 1.5 m. Therefore a water depth of 15.0 m or greater is required for safe navigation. For a dredged channel of 11.8 m below chart datum this would require fully loaded Panamax vessels to await water levels of mean high water neaps or above before departing the berth. Tides at Dampier are semi-diurnal meaning two high tides and two low tides occur daily. Thus there would normally be two windows of opportunity for vessel departure each day.

An analysis of historical water levels would be required to determine the average amount of time tide levels exceed mean high water neaps. This could be carried out based on tidal information recorded at the Port of Dampier to give an indication of available time for departure of Panamax vessels.



It is therefore proposed that the vessels would leave fully loaded on mean high water neap tide or above with a minimum UKC of 1.5m, through a dredged and marked channel of 11.8 m least navigation depth to join the 15.3 m dredged and marked channels through Mermaid Sound. Panamax vessels in ballast will be able to access the berths at any tide, swing in the turning basin (360 m dia) and berth starboard side to allow rapid departure. A dredged pocket of depth 15.0 m LAT would be provided at the berth to allow vessels to stay alongside at all tides.

Navigation procedures for Handimax vessels with a generic draft of 12.1 m, would be similar to those of Panamax ships, except that laden vessels could depart at mean low water neap tide or above and the dredged berth pocket need only have a depth of 13.6 m LAT.

It is assumed that arrival and departure procedures for all vessels would be tug assisted.

It should be noted that there are no available tidal current measurements either of magnitude or direction applicable to the proposed Port areas. It is understood however that magnitudes are probably low and will not constrain operations. Alignment of berths have been selected to conform with the probable tidal flow directions through the natural channels.

While the berths will primarily cater for export vessels, laden or part laden vessels will, on occasion, berth at the facilities. The largest laden or part laden vessels likely to use these berths would be a 25,000 dwt vessel a part laden 65,000 dwt slab carrying vessel returning to the Port after a cyclone event. Such vessels could, by arriving at mean high water neap tides and above, access the berths and turn in the swing basin to berth starboard side to.

A1.2.3 Congestion

Access to and from the port facilities will be via Mermaid Sound. This will increase the potential for congestion in the main channel and departure times for the Maitland ships may be affected by the channel priorities of the departing laden ore vessels from East Intercourse Island and Parker Point. As a result clearing of a parallel channel may be required to minimise potential delays.

The HGM report indicates there should be sufficient capacity in the existing channel provided the high spots along the western side of the channel are cleared to 11.5 m LAT. This would enable separation of inbound, non channel traffic from outbound departures.

In the event that sufficient capacity is not available for the Post Panamax vessels departing the Maitland berth, the parallel channel on the west side of the existing channel could be cleared and deepened. The required depth of such a channel would be 11.8 m LAT to allow departure of ships on mean high water neap tide or above, with a 1.5 m UKC. The channel width would be approximately 150 m to provide for one-way movement. It is estimated that approximately 550,000 m³ of material would need to be dredged at a cost of the order of \$9 million to clear such a channel. With the clearing of a second channel, operating practices, particularly the suggested 40 minute headway allowance on vessel departures, would need to be reviewed to maximise the benefits of the parallel channel. The need for clearing of a parallel channel requires detailed assessment of future shipping movements, vessel types



and scheduling requirements for all berths south of Dampier, including the Hamersley Iron wharfs and Dampier Salt berths. This assessment should be undertaken prior to detailed design stage.

A1.3 OCEANOGRAPHY & METEOROLOGY

A1.3.1 General

The port area, although open to substantial south west to westerly weather and seas, is well sheltered by the coastal islands. Winds are typically monsoonal with velocities rarely in excess of 12 m/sec, except during cyclonic events. It is not anticipated that ambient wind conditions will have a significant influence on port operations.

Cyclonic events will however have a significant impact, closing down all port activities and concomitant with very strong winds causing substantial surges raising the astronomical tides by up to 2.0 m or more.

Cyclone frequency is reported by HGM as 1.6 years and high wind frequencies as 22 events/year.

Ocean swell generated by remote storms will penetrate into the proposed berthing areas but will be substantially attenuated by the islands by the time it reaches the port sites.

A1.3.2 Local Wave Climate

The local wave climate is largely governed by the south west weather and swell penetration which produces fully arisen seas in Mermaid Strait.

An analysis of incident ambient and swell wave conditions in the area has shown that waves of about 1.0 m will only be exceeded for about 3% of the time which will have little impact on navigation or operations. A summary of the analysis is included in GHD (1999).

A1.3.3 Tides

Tides within the Port of Dampier are semi-diurnal with a marked daily inequality between successive tides. Tidal streams within the port are generally weak with a maximum velocity of about 1.0 knot at spring tides.

The datum for the port is lowest astronomical tide (LAT) which is 2.7 m below Australian Height Datum (AHD).

Tidal planes with reference to chart datum are:

Highest Astronomical Tide (HAT)	+5.2 m
Mean High Water Springs (MHWS)	+4.5 m
Mean High Water Neaps (NHWN)	+3.2 m
Mean Sea Level (MSL)	+2.7 m
Mean Low Water Neaps (MLWN)	+2.2 m
Mean Low Water Springs (MLWS)	+0.9 m
Lowest Astronomical Tide (LAT)	+0.1 m



A1.3.4 Cyclonic Winds

Design conditions for structures and plant within the region are well known and defined, as are tie down requirements for plant. Karratha is located in an area of tropical cyclones and basic design wind speeds will be in the order of 85 m/s ultimate (69 m/s permissible stress) for design purposes.

A1.3.5 Waves and Surge

There appear to be no relevant and accessible wave records for the area.

In order to assess deck and land formation elevations for berths, trestles, causeways, corridors and landside storage areas, the cyclonic wave for this purpose (and for design) is assumed to be the maximum sustainable wave in the depth of water at the location under consideration. The depth of water being taken as the 1 in 100 year still water level either as provided by the Karratha Storm Surge Inundation Study (Bureau of Meteorology Special Services Unit, Nov 1996) or estimated where necessary.

An elevation of 10 m AHD was selected for the exposed wharf causeway (12.7 m above chart datum) and 5.5 m AHD (8.2 m above chart datum) was selected for the protected mainland access causeway.

It should be noted that the LNG terminal to the north was designed for wave heights of 8.6 m.

The 1 in 1000 year still water level should also be evaluated at a later stage to assess the risks of inundation.

A1.3.6 Downtime

On the basis of analyses carried out, it is not anticipated that downtime due to weather will be more than 2 percent to 5 percent, excluding cyclonic events. The estimates of 2% to 5% of weather related downtime are based on "normal" weather conditions and do not include direct cyclonic events.

During the cyclone period (from November to April) northerly swells generated by distant low pressure systems can necessitate the closing of some wharves. Similarly wind speeds can exceed 20 knots for sustained periods, often 3 to 4 days at a time.

This is generally confirmed from other operations in the immediate area. Dampier Port Authority report downtime due to weather as 11 days per year.

It should be noted that the port sites considered for Maitland are generally more protected from the north than for example the Hamersley iron ore port but more exposed from the west.

A1.4 CAUSEWAY ACCESS CORRIDOR TO PORT

A1.4.1 Low Level Causeway Between Maitland and WII

The port laydown area on WII will be linked to the MHIE by the mainland service access corridor. This corridor will generally follow the western levee of the Dampier Salt Pond Zero. The length of the access corridor from Maitland (at the 1: 100 year storm surge limit) to the shoreline is approximately



9.7 km. A large portion of this section of the corridor is in the tidal zone and mangroves and soft soils exist nearer the coastline.

Ground levels along the proposed corridor vary between RL 7 m AHD in the vicinity of the Estate to RL 2 m AHD at the coast, near the causeway at Pond Zero. From previous flood and surge studies associated with the Maitland Industrial Estate, it has been determined that the minimum level along the corridor, to avoid inundation, is RL 5.5 m AHD. Therefore the construction of an embankment for the corridor along most of its length will be necessary.

For the first stage of the design a 20 m top-width of causeway has been allowed. This gives room for a 10.5 m wide bitumen road (3 x 3.5 m lanes) plus adequate space for conveyors and pipes.

A typical section of embankment along the access corridor is shown on Figure 6.

The maximum grade on roads for road train trucks should ideally be kept to 3% with an absolute maximum of 5%.

A1.4.2 High Level Causeway to Wharf Head

Access to the wharf head in deep water, can be either by a steel trestle or a rock-fill causeway.

A1.5 DREDGING

According to available information, obtained from seabed grab sampling and sub-bottom profiling in the area, the seabed between West Intercourse Island and South West Burrup generally comprises clayey, gravelly sands.

Sub-seabed sediments are indicated to comprise a thin layer of silts or very soft clays overlying unconsolidated gravelly sand of various thicknesses which in turn overlies well cemented calcarenite and/or rock.

Offshore, north of West Intercourse Island, seabed sediments consist of fine to medium sand. Offshore sub-bottom sediments were interpreted to consist of 3 m to 4 m of sand and weak calcarenite overlying an interbedded sequence of cemented calcarenite and unconsolidated sediments.

Seabed sediments in this report are referred to as Type 1 to Type 4 materials, with Type 1 material being predominantly fine to medium sands; Type 2 material predominantly coarse sand and/or gravel; Type 3 materials predominantly coarse gravelly sand with patches of hard substrate; and Type 4 materials outcrops of cemented reef with patches of uncemented sands.

Increases in turbidity occur naturally during flooding and cyclonic activity and marine biota in the area of the Port are relatively tolerant to such impacts.



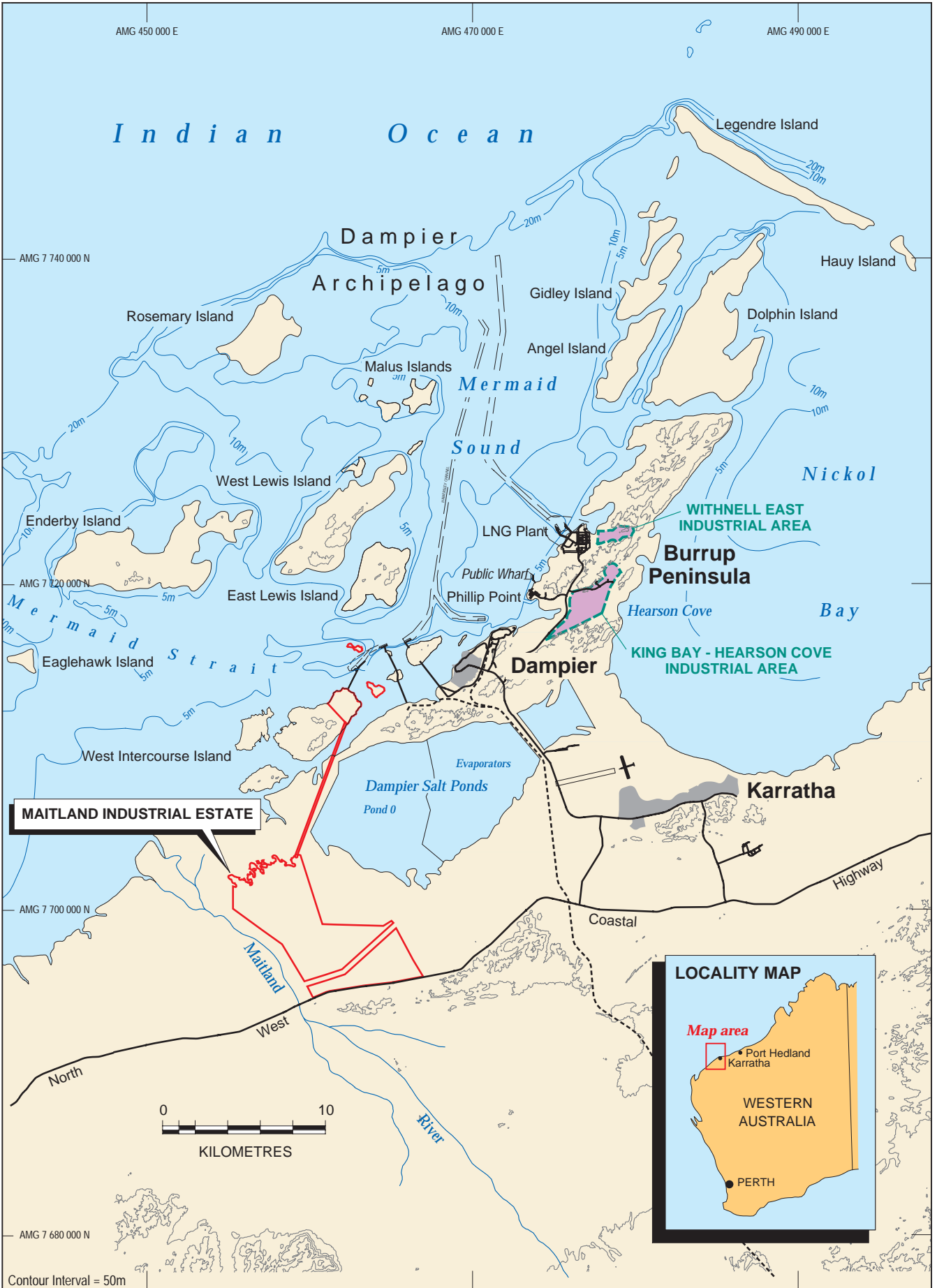
The EPA reports that sediment plumes associated with dredging for the Woodside LPG project had a relatively minor effect on coral beds and were limited to locations less than 1.5 km from the dredging site. It was further reported that turbidity returned to normal levels within three weeks of dredging.

Spoil will be used for landfill on West Intercourse Island.



FIGURES

Fri 02 Aug



Astron environmental

Auth: PJJ Date: 07/02

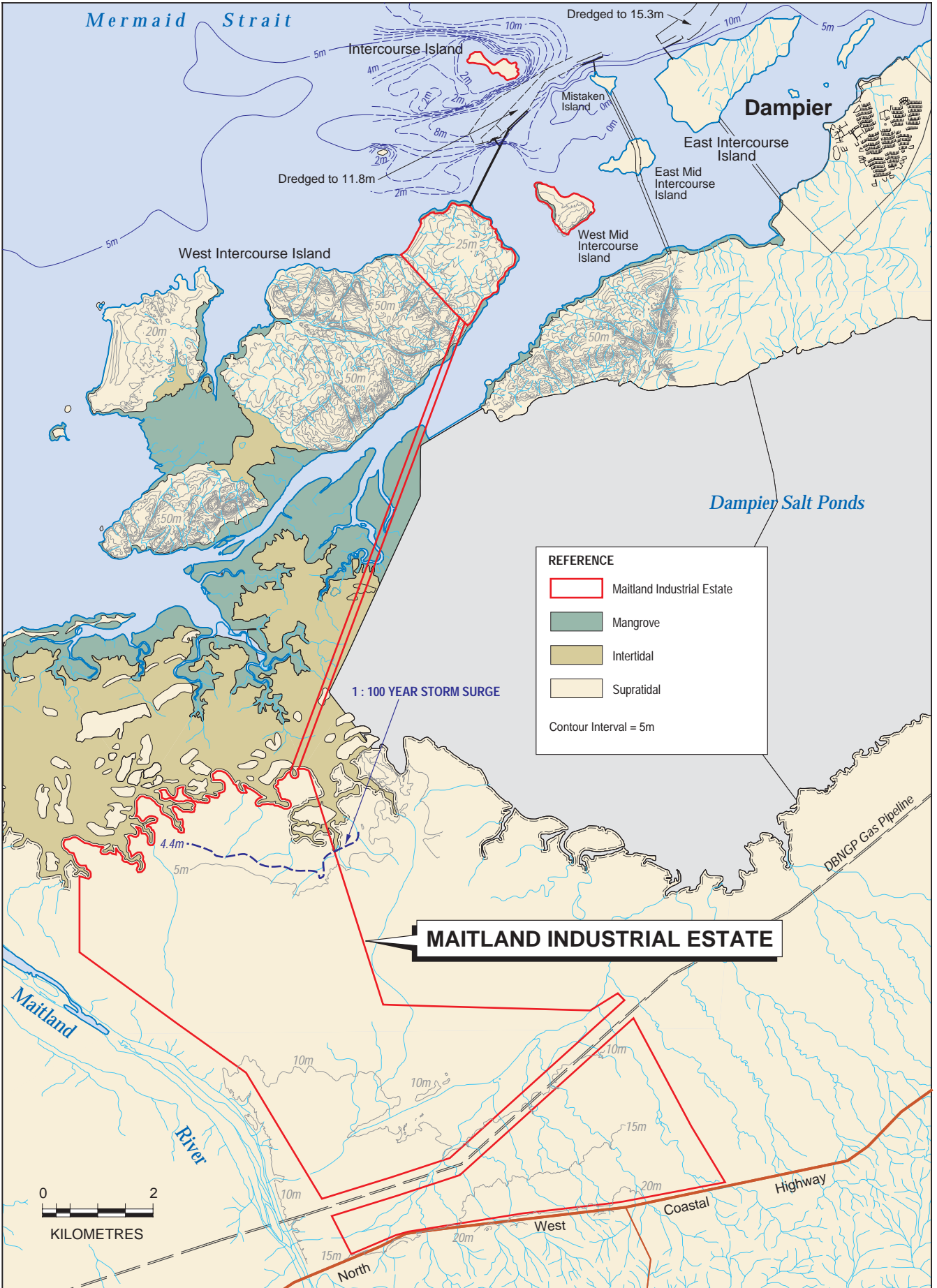
Shire of Roebourne
 MAITLAND INDUSTRIAL ESTATE

REGIONAL PLAN

Figure
1

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Fri 02 Aug



Shire of Roebourne
MAITLAND INDUSTRIAL ESTATE

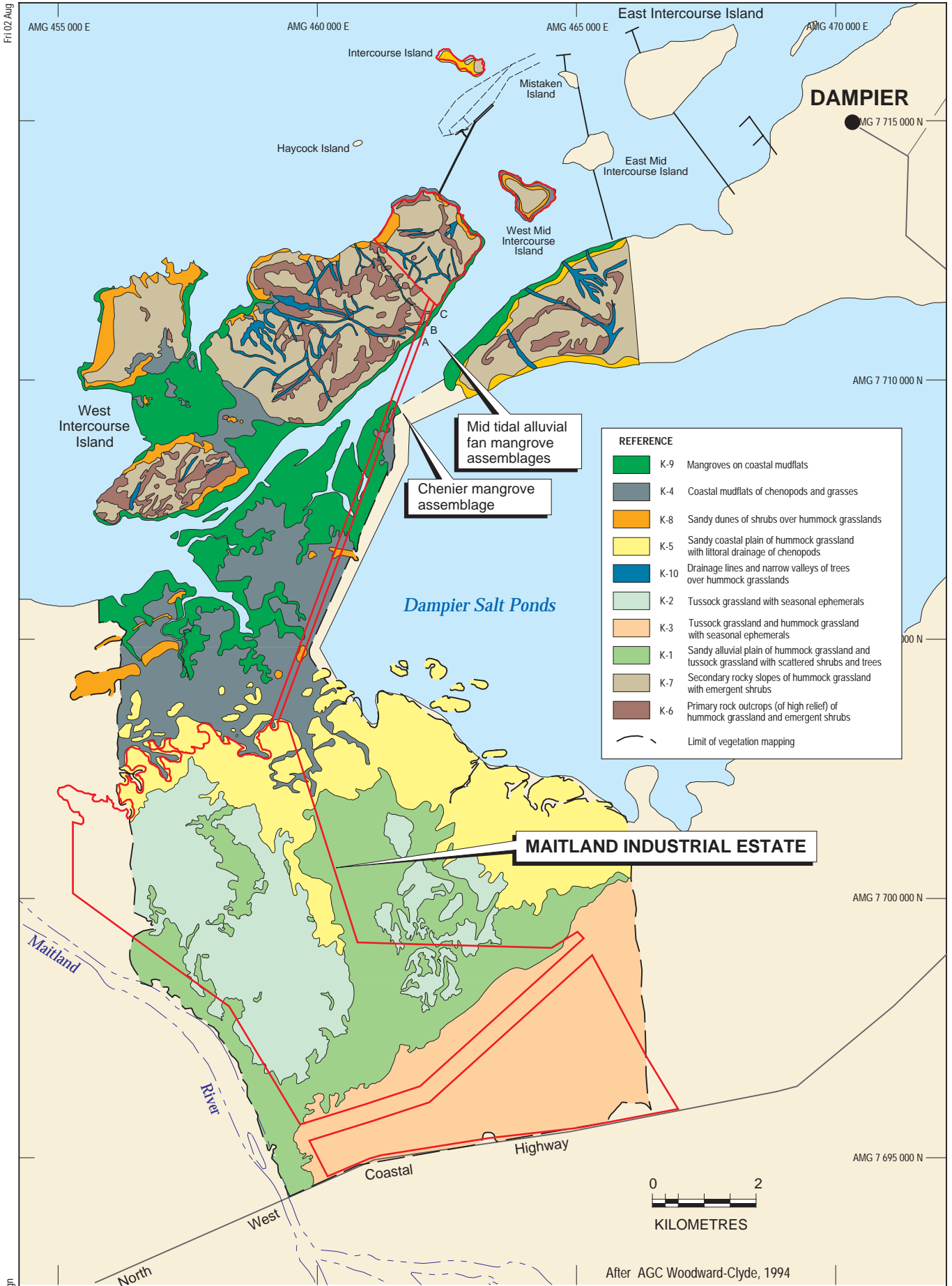
PROPOSED MAITLAND INDUSTRIAL ESTATE BOUNDARIES

Figure

2

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After AGC Woodward-Clyde, 1994



Shire of Roebourne
MAITLAND INDUSTRIAL ESTATE

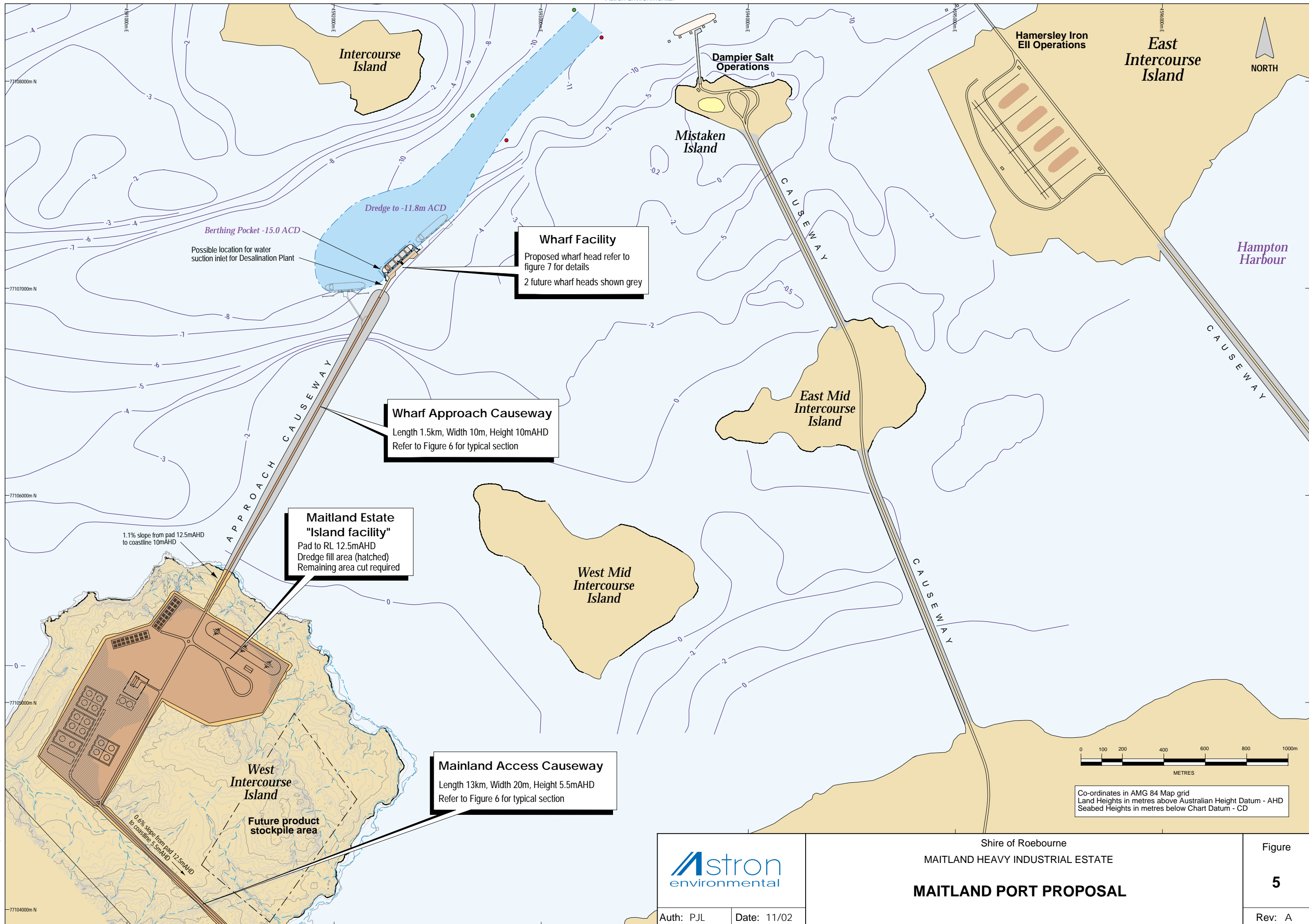
Figure

VEGETATION

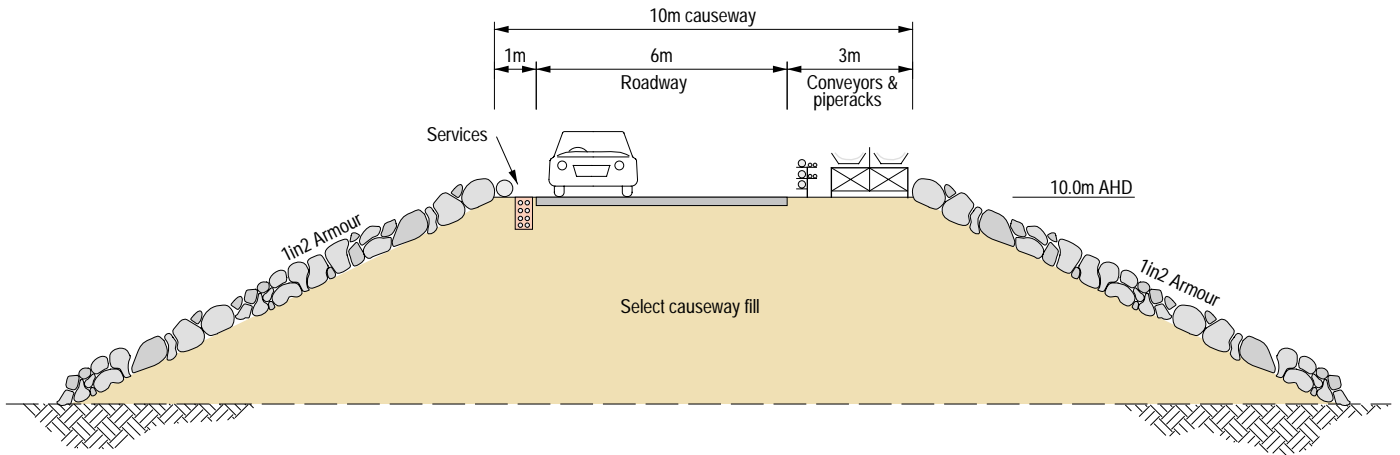
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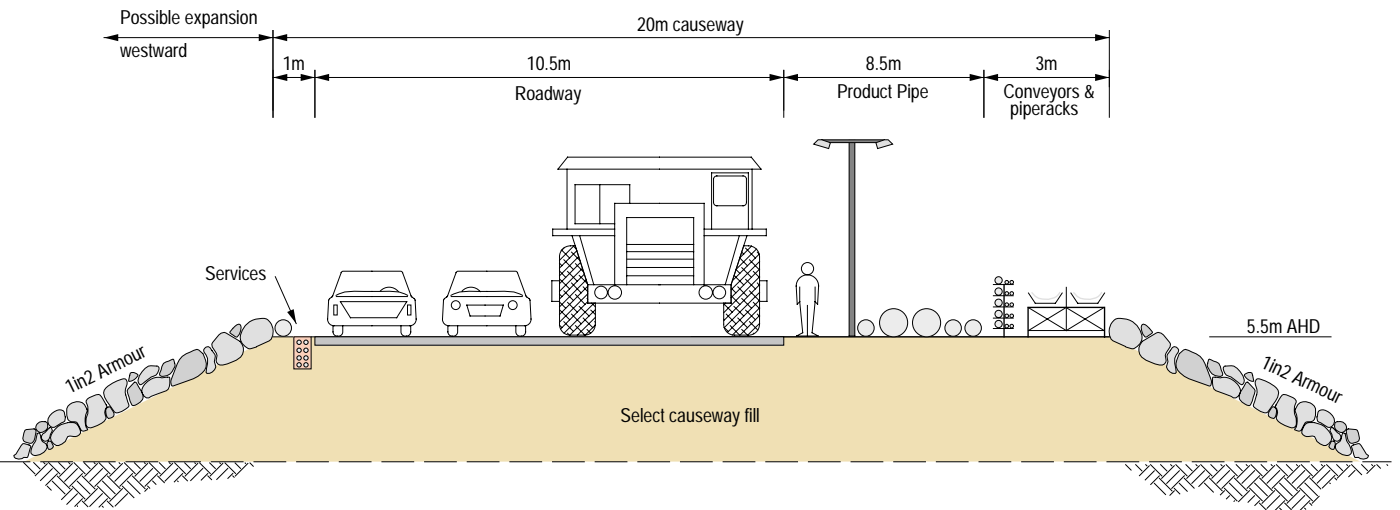


	Shire of Roebourne MAITLAND HEAVY INDUSTRIAL ESTATE		Figure
	MAITLAND PORT PROPOSAL		5
Auth: PJJ	Date: 11/02	Rev: A	



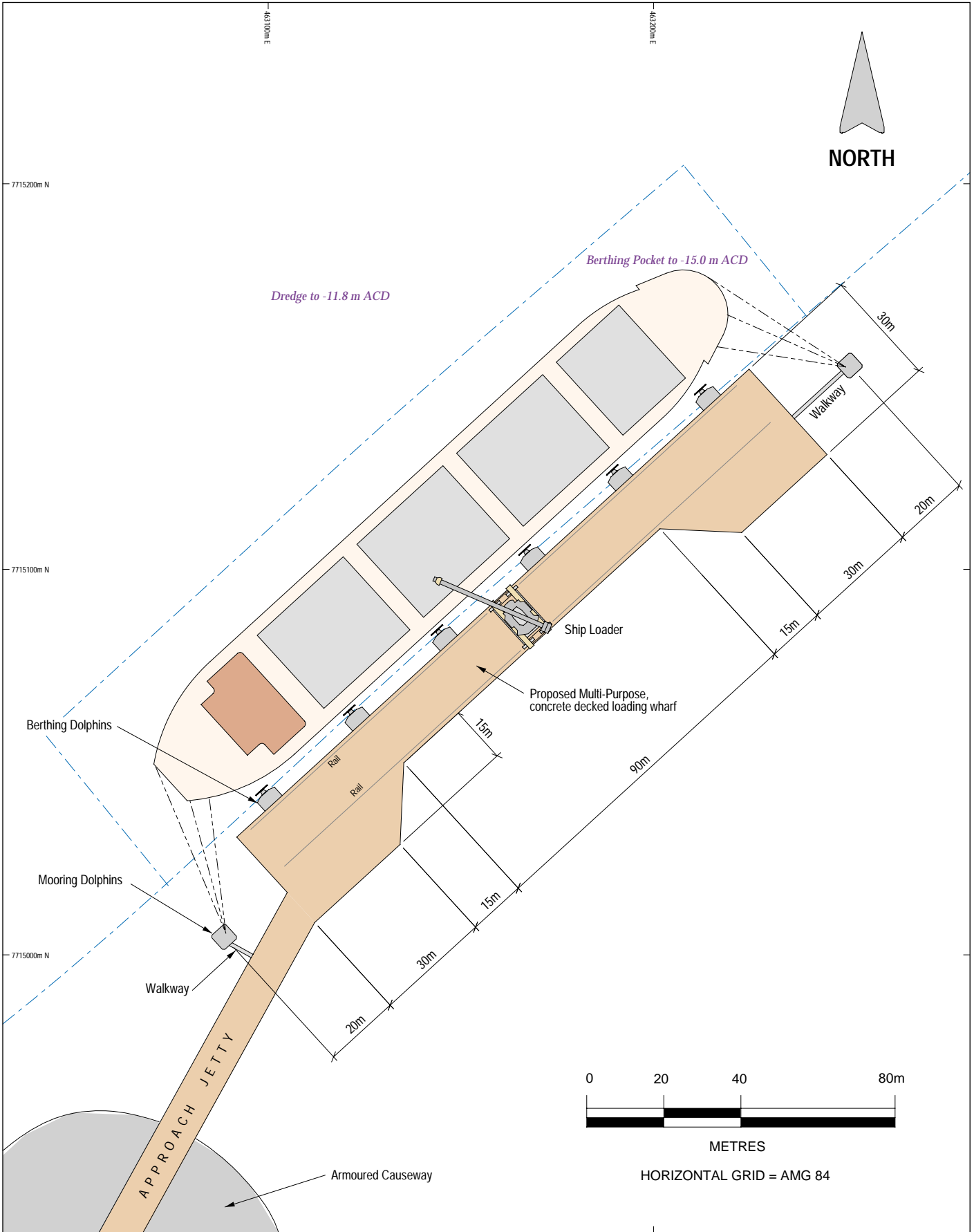
HIGH LEVEL CAUSEWAY - ISLAND TO WHARF

diagrammatic



LOW LEVEL CAUSEWAY - MAINLAND TO ISLAND

diagrammatic



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Auth: PJJ

Date: 11/02

Shire of Roebourne
MAITLAND INDUSTRIAL ESTATE

MAITLAND WHARF PROPOSAL

Figure

7

REV 'A'



COLOUR PLATES



Maitland Development Area



Plate 1: View north from centre of southern part of estate.



Plate 2: View south-west from centre of southern part of estate.



Plate 3: View north from central part of estate.



Plate 4: View west from central part of estate.



Plate 5: View north from gully zone near northern edge of estate.



Plate 6: View north from northern edge of estate.



Plate 7: View north across supra-tidal mudflats to West Intercourse Island.



Plate 8: The causeway to West Intercourse Island will need to allow drainage through for gullies such as this.



West Intercourse Island Causeway



Plate 9: View south to shore crossing.



Plate 10: Mangroves at shore crossing are dense and in good condition.



Plate 11: Alignment of the proposed causeway. View north from shore crossing area.



Plate 12: Access to West Intercourse Island.



West Intercourse Island



Plate 13: View south from West Intercourse Island Causeway access point.



Plate 14: Aboriginal sites on the western shore of West Intercourse Island.



Plate 15: Topography inland from the access point.



Plate 16: The north end of West Intercourse Island.



Plate 17: View north-east back to Hamersley Iron.



Plate 18: A large swale on the western side of the north end.



Plate 19: View east from foredune of beach on north-west tip of island.



Plate 20: View north along alignment of proposed high-level causeway to wharf head.



Plate 21: The proposed wharf causeway access point on the north end of West Intercourse Island.