



CITY OF KARRATHA
Local Planning Scheme No. 8

Amendment No 57

Standard Amendment to amend clause 6.3.1 (b) of the Scheme to provide greater certainty for development to occur within the Maitland Strategic Industry Buffer Area.

Planning and Development Act 2005
RESOLUTION TO PREPARE AMENDMENT
TO LOCAL PLANNING SCHEME

CITY OF KARRATHA LOCAL PLANNING SCHEME NO. 8
[Amendment No 57]

RESOLVED that the Local Government, in pursuance of section 75 of the *Planning and Development Act 2005* (as amended) amend the above Local Planning Scheme by:

1. Deleting clause 6.3.1 (b) of the Scheme which states:

no development is permitted which would attract persons, other than those working in the adjacent strategic industrial area.

2. Inserting the following text into the Scheme after clause 6.3.1 a):

b) with the exception of Maitland Strategic Industrial Area, no development is permitted which would attract persons, other than those working in the adjacent strategic industrial area.

The amendment is STANDARD under the provisions of the Planning and Development (Local Planning Schemes) Regulations 2015 for the following reason(s):

- a) The proposal is a text only amendment to amend and/or delete provisions relating to the existing Maitland Strategic Industry zone.
- b) The proposal will have minimal impact on land in the scheme area that is not subject to the amendment.

Dated this day of 20

.....
(Chief Executive Officer)

1. INTRODUCTION

This report has been prepared by Urbis on behalf of DevelopmentWA and seeks amend clause 6.3.1 b) of the City of Karratha Local Planning Scheme No.8 (LPS 8), to permit development within the Maitland Strategic Industrial Area Special Control Area (Industry Buffer) (**subject land**) which would attract persons, other than those working in the adjacent strategic industrial area.

In 1993, the Western Australian (WA) State Government identified the Maitland Strategic Industrial Area (MSIA) as a suitable location for major industrial development. Located 24 kilometres west of the Karratha townsite and 39 kilometres south of Dampier Port, the MSIA is planned to accommodate gas or petroleum processing, power production and other associated downstream processing industries including urea, ammonia, and ammonium nitrate. The MSIA has a critical role in adding value to export commodities and generating employment opportunities and economic benefits.

An Environmental Assessment Report was prepared by RPS 29 August 2018 to inform the Maitland Strategic Industrial Area Improvement Scheme and included an environmental assessment of the subject site. Appendix C of the EAR includes email advice from the Office of EPA confirming “*that no further ecological assessments are required at this time.*” Accordingly, it is envisaged this Amendment will not require EPA assessment.

A review of LPS 8 has identified general provisions relating to all Special Control Areas (Industry Buffer) within the Scheme Area has the potential to be overly restrictive and potentially curtail investment and development of supporting industries within the MSIA buffer. Specifically, clause 6.3.1 (b) of the Scheme stipulates *no development is permitted within a Special Control Area (Industry Buffer) which would attract persons, other than those working in the adjacent strategic industrial area.* Whilst well intentioned, this provision is considered impractical to administer and creates development investment uncertainty for the MSIA buffer.

This Amendment seeks to amend clause 6.3.1 b) of the City of Karratha Local Planning Scheme No.8 (LPS 8), to permit development within the Maitland Strategic Industrial Area Special Control Area (Industry Buffer) which would attract persons, other than those working in the adjacent strategic industrial area. The Amendment will provide additional guidance to decision makers when considering a future development application for the subject land, and will provide clarity to decision makers to enable approval without demonstrating an actual connection to the MSIA workforce at any one point in time. It is intended this Amendment will provide sufficient certainty to the planning framework to overcome potential issues identified with the existing clause 6.3.1b).

Furthermore, this amendment relates only to the MSIA Special Control Area (Industry Buffer). No changes are proposed to the wider Special Control Area (Industry Buffer) associated with other industrial zones.

This Amendment is considered of a minor nature as the intent remains for the MSIA buffer area to continue to support the strategic direction of the Maitland Strategic Industry zone. Accordingly, this Amendment is deemed to be a standard amendment under Clause 34 of the *Planning and Development (Local Planning Schemes) Regulations 2015*.

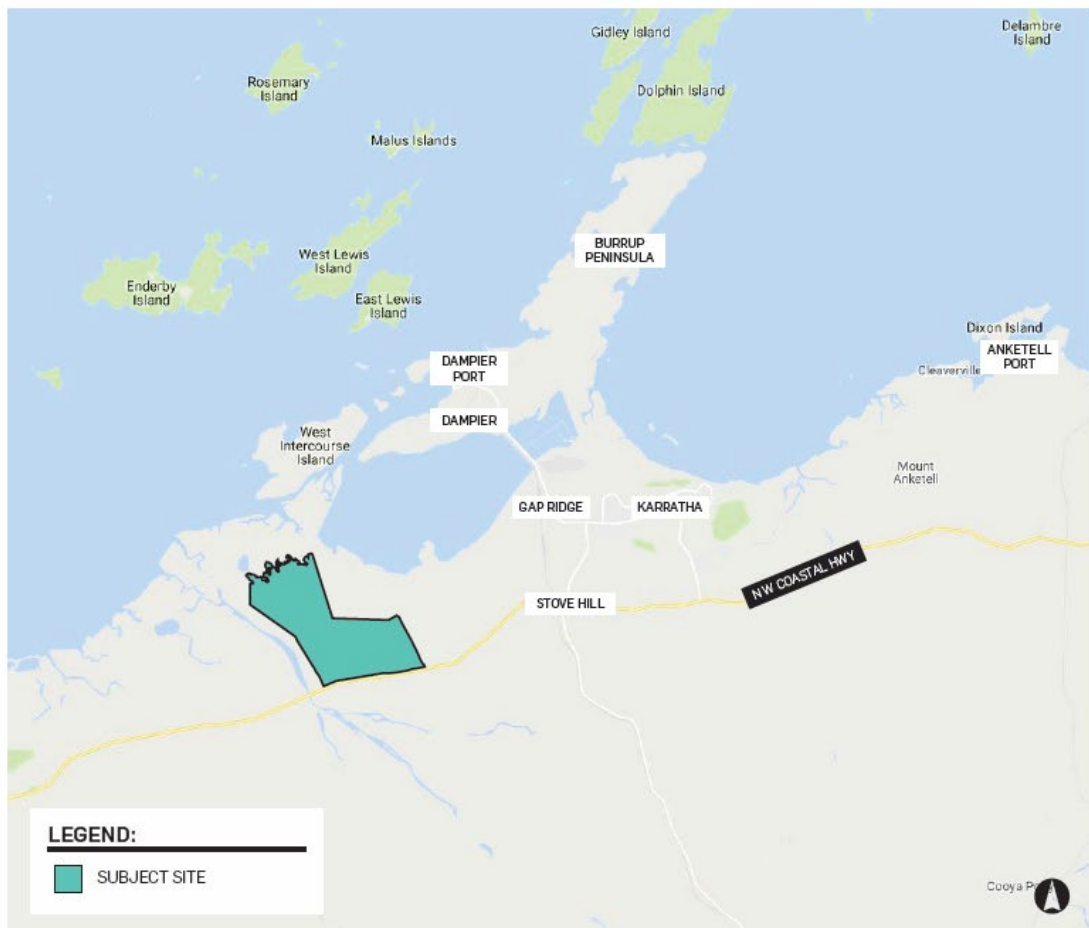
This report demonstrates the appropriateness of the proposed amendment through the following structure:

1. Background and Context
2. Planning Context
3. Environmental Considerations
4. Proposed Scheme Amendment
5. Conclusion

2. BACKGROUND AND CONTEXT

Located 24 kilometres west of the Karratha townsite and 39 kilometres south of Dampier Port, the MSIA is planned to accommodate gas or petroleum processing, power production and other associated downstream processing industries including urea, ammonia, and ammonium nitrate. The MSIA has a critical role in adding value to export commodities and generating employment opportunities and economic benefits.

The MSIA buffer area is undeveloped rural zoned land, with the North West Coastal Highway adjacent the southern boundary of the MSIA.



LOCATION PLAN MAITLAND STRATEGIC INDUSTRIAL AREA

DATE: 04.09.2018
JOB NO: PA1363
DWG NO: LOC
REV: A

Figure 1 – MSIA Location Plan

3. PLANNING CONTEXT

3.1. STATE PLANNING

This section summarises the relevant strategies/policies within the context of MSIA Special Control Area (Industry Buffer).

DOCUMENT	SUMMARY
Pilbara Planning and Infrastructure Framework 2012	The Maitland Strategic Industrial Area is classified as a strategic industrial area at the State level and is anticipated to accommodate heavy industry.
State Planning Policy 2 – Environment and Natural Resources Policy	<p>State Planning Policy No. 2 Environmental and Natural Resources Policy set out the broad environment and resource management policies for ecologically sustainable development.</p> <p>It notes that careful assessment will be required to resolve conflicts between land use and protection of natural resources, giving consideration to potential impacts on the environment, community lifestyle preferences, and economic values.</p>
State Planning Policy 2.7 – Public Drinking Water Source	A key strategic statement in the State Planning Strategy 2050 is to ‘ensure that public drinking water supplies are uncontaminated and public health is protected’. This is recognised in various criteria for plans and key actions in the Strategy to protect existing future public drinking water supplies.
State Planning Policy 3.7 – Planning in Bushfire Prone Areas	<p>The Bushfire policy seeks to utilise land use planning to assist in the preservation of life and reducing the risk of bush fire on property and infrastructure. The policy provides a range of measures such as:</p> <ul style="list-style-type: none"> • Appropriate design and location of development • Management of potential fuel loads • Implementation of Bushfire Management Plans and Bushfire Risk Management Plans <p>Any development which is located within a Bushfire Prone Area is to be accompanied by a Bushfire Attack Level Assessment and if required a Bushfire Management Plan.</p>
State Planning Policy 4.1 – State Industrial Interface	<p>The objectives of this policy are to:</p> <ul style="list-style-type: none"> • Avoid conflict between industry and/or essential infrastructure and sensitive land uses; • Protect industry and/or essential infrastructure from encroachment by those land uses that would be sensitive to impacts and adversely impact the efficient operations;

DOCUMENT	SUMMARY
	<ul style="list-style-type: none"> • Provide for the development of industry and/or the provision of essential infrastructure in a way that maximises amenity, minimises environmental and health impacts and takes account of risk to nearby sensitive land uses; and • Promote compatible uses in areas affected by off-site impacts of industry and/or essential infrastructure. <p>A “compatible land use” is a use that when located in a buffer will tolerate exposure to off-site emissions without impairment to its own operation. Hence the buffer is the area in which sensitive land uses are restricted because of the likely impacts upon it.</p> <p>Local Planning Schemes are the preferred basis for identifying and managing use and development within the buffer.</p> <p>It is noted that the Policy states that proposals which satisfy recommended buffer distances in Environmental Protection Agencies Guidance Statement No. 3 are deemed to comply with the objectives of SPP 4.1.</p>

Table 1 – State Planning Framework

3.2. CITY OF KARRATHA LOCAL PLANNING STRATEGY 2021

The Maitland Strategic Industrial Area is identified as a key industrial location, and an important consideration to the co-ordination of industrial land within the City.

The Strategy encourages the clustering of nuisance uses within buffer areas and acknowledges *“while a buffer does not necessarily need to exclude all development, it should restrict sensitive land uses and ensure only mutually compatible (generally industrial or infrastructure based) land uses are located within buffer areas.”*

This Amendment conforms with the intent and objectives of industrial buffers identified in the Strategy.

3.3. CITY OF KARRATHA LOCAL PLANNING SCHEME NO. 8

The land applicable to this amendment is zoned ‘*Rural*’ under the City of Karratha Local Planning Scheme No. 8 and subject to a generic Special Control Area (Industry Buffer). The MSIA core area is zoned ‘*Strategic Industry*’ (refer to Figure 3).

Clause 6.1.2 of LPS 8 acknowledges *if a Special Control Area is shown on the Scheme maps, the provisions of the special control area apply in addition to the provisions of the zone and any general provisions of the Scheme.*

Special provisions of the Special Control Area (Industry Buffer) are set out in clause 6.3 and include the following:

6.3.1 Within the Industry Buffers:

- a) *no dwelling is permitted; and*
- b) *no development is permitted which would attract persons, other than those working in the adjacent strategic industrial area.*

6.3.2 When considering applications for development approval within the Industry Buffers the local government shall have regard to:

- a) the existing, proposed or likely risks, hazards and nuisance (odour, noise, and light) associated with the adjoining Strategic Industrial Area;
- b) compatibility of uses; and
- c) the impact of the proposal on the efficient development of the strategic industrial area.

A review of LPS 8 has identified general provisions relating to all Special Control Areas (Industry Buffer) within the Scheme Area may be restrictive and has the potential to curtail investment and development of supporting industries within the MSIA buffer. Specifically, clause 6.3.1 (b) of the Scheme prescribes no development is permitted within a Special Control Area (Industry Buffer) which would attract persons, other than those working in the adjacent strategic industrial area. This provision is considered impractical to administer and creates development investment uncertainty for the MSIA.

This Amendment seeks to amend clause 6.3.1 b) of the City of Karratha Local Planning Scheme No.8 (LPS 8), to permit development within the Maitland Strategic Industrial Area Special Control Area (Industry Buffer) which would attract persons, other than those working in the adjacent strategic industrial area. The Amendment will provide additional guidance to decision makers when considering a future development application for the subject land and will provide clarity to decision makers to enable approval without demonstrating an actual connection to the MSIA workforce at any one point in time.

It is intended this Amendment will provide sufficient certainty to the planning framework to overcome potential issues identified with the existing clause 6.3.1(b).

3.4. MAITLAND STRATEGIC INDUSTRIAL AREA – IMPROVEMENT SCHEME NO. 1

Improvement Plan No. 4 – Maitland Industrial Area was endorsed by the Minister for Planning 24 May 2016, enabling the introduction of an Improvement Scheme under Section 22 of the Planning and Development Act 2005. Once gazetted, provisions of the Improvement Scheme will prevail over the local planning scheme.

Preparation of the Maitland Strategic Industrial Area Improvement Scheme No. 1 has commenced, with progression slowed as issues around coastal impacts associated with forecast rising sea levels are resolved. Whilst the timeframes associated with progressing the scheme are unknown, gazettal of the Maitland Strategic Industrial Area Scheme No. 1 is unlikely to occur prior to gazettal of this Amendment.

Upon gazettal of the Maitland Strategic Industrial Area Scheme No. 1, the provisions of LPS 8 (including this amendment) will no longer apply to the MSIA.

4. ENVIRONMENTAL CONSIDERATIONS

The following environmental sections are informed by an Environmental Assessment Report (EAR) prepared by RPS dated 24 August 2018 for the MSIA. This EAR was prepared to inform the Improvement Scheme report.

Although the EAR was prepared for the MSIA, and not specifically for the land subject to this application, the environmental assessment included the Strategic Industry zone and a 3km buffer area including the subject site.

Appendix C of the EAR includes email advice from the Office of EPA confirming *“no further environmental investigations are required at this time.”*

A copy of the EAR is included at **Appendix A**.

4.1. GEOLOGY AND TOPOGRAPHY

The MSIA is located in the Pilbara Block geological province, which is an Archaean granite-greenstone terrane consisting of metasedimentary and volcanic rocks, intruded by granitoid bodies. The surface geology of the site consists mainly of alluvium 38485 of gravel, sand, silt, and clay and is locally calcreted. The site is underlain by a thin veneer of surficial sediments of Quaternary age, which overly weathered granite. Low-lying areas of alluvial sand and gravel are associated with the river and creek channels with adjacent flood plain areas comprising colluvium and sheetwash deposits of silt, sand and gravel.

4.2. LANDFORM

The MSIA is comprised of relatively flat alluvial plains and has a low relief, ranging in elevation from sea level on the coastal flats in the north to 20 m AHD to the south-west.

4.3. ACID SULPHATE SOILS

Soils within the Pilbara generally have low acid-forming potential. The DWER Acid Sulfate Soil (ASS) risk mapping indicates that the majority of the site is mapped as having a low probability of ASS occurring, while the majority of the south-eastern section of the site, outside of drainage lines is identified as having no known risk/unmapped. The area to the north of the MSIA is mapped as having a high probability of ASS occurring due to being located in the floodplain area.

4.4. FLORA AND FAUNA

The MSIA comprises a large paddock of buffel grass, heavily degraded by cattle grazing and has very little original environmental features that if disturbed would constitute a significant environmental impact. Endemic species remaining are identified as being confined to the creekline tributary which would potentially be retained as a drainage channel. This area also was heavily grazed by cattle and highly degraded.

No threatened species have been identified in the area, although they are two P1, two P2, thirteen P3 and one P4 species potentially occurring within the site. A Protected Matters search did not list any Threatened Ecological Communities, although the DBCA search identified two possible Priority Ecological Communities, of Roebourne Plains, gilgai grasslands (P1). Subsequent discussions have confirmed, however, that this is unlikely.

The dominant vegetation type is “Paddock”, considered as “Degraded” in condition. This vegetation community consisted of aggressive weed species including Buffel Grass (**Cenchrus ciliaris*) and Kapok Bush (**Aerva javanica*) with mixed native grasses and herbs. The creekline is characterised by clay soils with hummock grassland and open shrubland with several smaller areas of *Triodia* species, lacking any mid or upper-storey strata.

Fauna surveys have identified that a number of bird, mammal, reptile and frog species are present on site including the Peregrine Falcon, Grey Falcon, and the Pilbara Olive Python. A number of other species were identified in a desktop review, including the Northern Quoll, the Greater Bilby and

Northern Marsupial Mole. Migratory bird species have been identified along with Priority species potentially occurring on the site including the Ghost Bat, Short Tailed Mouse and Little North-Western Mastiff Bat. A number of these species are identified under the EPBC Act.

4.5. GROUND AND SURFACE WATER

Groundwater elevations range from 1.24 m AHD in March 2016 to a maximum water level of 9.06 m AHD in February 2017 (which was above the bore casing due to flooding). The greatest depth to water was 8.54 m below the top of casing in May 2016. Free groundwater was not observed in geotechnical investigations, excavated to a depth of up to 3.5m.

The site is located in the Pilbara Groundwater Area and the Ashburton Subarea, which consists of the Pilbara Fractured Rock Aquifer. A search of the DWER Water Register indicates that groundwater is available in the area, although bore abstraction yields are expected to be low. An allocation limit for this sub-area has not been identified as this aquifer is classed as a “non-target” aquifer under the Pilbara Groundwater Allocation Plan. As such, groundwater allocations are to be managed on a case-by-case basis.

A DWMS has been prepared by RPS to support the Improvement Scheme and Guide Plan. The purpose of the DWMS is to demonstrate that the area is capable of supporting the industrial development and is able to achieve appropriate urban water management outcomes, particularly as there have been areas identified that will be subject to significant depths of flooding at high velocities.

4.6. ABORIGINAL AND EUROPEAN HERITAGE

A search of the then Department of Aboriginal Affairs (DAA) Aboriginal Heritage Enquiry System identified 15 Registered Aboriginal Heritage Sites within the site boundary.

In 2003, the Western Australian government entered into the Burrup and Maitland Industrial Estates Agreement Implementation Deed. The site is located within the Native Title area of the Ngarluma / Yindjibarndi people which is subject to a 2013 determination of Native Title claim.

Two Aboriginal Heritage investigations have been undertaken within the site and 3 sites were identified. A further 17 sites were identified in proximity to the study area. Additional surveys have been undertaken which have identified other sites and artefact scatters.

No European heritage sites are identified within the MSIA area.

5. PROPOSED SCHEME AMENDMENT

A review of the City of Karratha Local Planning Scheme has identified general provisions relating to all Special Control Area Industry Buffers within the Scheme Area are overly restrictive and will curtail investment and development of supportive industries within the MSIA Special Control Area (Industry Buffer).

This Amendment seeks to amend clause 6.3.1 b) of the City of Karratha Local Planning Scheme No.8 (LPS 8), to permit development within the Maitland Strategic Industrial Area Special Control Area (Industry Buffer) which would attract persons, other than those working in the adjacent strategic industrial area. The Amendment will provide additional guidance to decision makers when considering a future development application for the subject land, and will provide clarity to decision makers to enable approval without demonstrating an actual connection to the MSIA workforce at any one point in time. It is intended this Amendment will provide sufficient certainty to the planning framework to overcome potential issues identified with the existing clause 6.3.1(b).

Pre-lodgement consultation between the proponent, DPLH and City of Karratha considered various options available to achieve the above objective. Through this consultation process it was determined that amending the text of clause 6.3.1 b) to exclude the Maitland Strategic Industrial Area was the preferred pathway.

6. CONCLUSION

This report has been prepared by Urbis on behalf of DevelopmentWA and seeks amend clause 6.3.1 b) of the City of Karratha Local Planning Scheme No.8 (LPS 8), to permit development within the Maitland Strategic Industrial Area Special Control Area (Industry Buffer) (**subject land**) which would attract persons, other than those working in the adjacent strategic industrial area.

A review of LPS 8 has identified general provisions relating to all Special Control Areas (Industry Buffer) within the Scheme Area are overly restrictive and will curtail investment and development of supporting industries within the MSIA buffer. Specifically, clause 6.3.1 (b) of the Scheme stipulates no development is permitted within a Special Control Area (Industry Buffer) which would attract persons, other than those working in the adjacent strategic industrial area. This provision is considered impractical to administer and creates development investment uncertainty for the MSIA.

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An Environmental Assessment Report was prepared by RPS 29 August 2018 to inform the Maitland Strategic Industrial Area Improvement Scheme and included an environmental assessment of the subject site. Appendix C of the EAR includes email advice from the Office of EPA confirming "*that no further ecological assessments are required at this time.*" Accordingly, it is envisaged this Amendment will not require EPA assessment.

This Amendment is considered of a minor nature as the intent remains for the MSIA buffer area to continue to support the strategic direction of the Maitland Strategic Industry zone. Accordingly, this Amendment is deemed to be a standard amendment under Clause 34 of the *Planning and Development (Local Planning Schemes) Regulations 2015*.

It is respectfully requested the City of Karratha support this Amendment.

PLANNING AND DEVELOPMENT ACT 2005
RESOLUTION TO AMEND LOCAL PLANNING SCHEME
City of Karratha Local Planning Scheme No. 8
Amendment No 57

RESOLVED that the Local Government, in pursuance of section 75 of the *Planning and Development Act 2005* (as amended) amend the above Local Planning Scheme by:

1. Deleting clause 6.3.1 b) of the Scheme which states:

no development is permitted which would attract persons, other than those working in the adjacent strategic industrial area.

2. Inserting the following text into the Scheme after clause 6.3.1 a):

b) with the exception of Maitland Strategic Industrial Area, no development is permitted which would attract persons, other than those working in the adjacent strategic industrial area.

COUNCIL ADOPTION

This Standard Amendment was adopted by resolution of the Council of the Shire of Harvey at the Ordinary Meeting of the Council held on the _____ day of _____ 20____.

.....

MAYOR/SHIRE PRESIDENT

.....

CHIEF EXECUTIVE OFFICER

COUNCIL RECOMMENDATION

This Amendment is recommended for support/not to be supported by resolution of the City of Karratha at the Ordinary Meeting of the Council held on the _____ day of _____ 20____ and the Common Seal of the Shire of Harvey was hereunto affixed by the authority of a resolution of the Council in the presence of:

.....

MAYOR/SHIRE PRESIDENT

.....

CHIEF EXECUTIVE OFFICER

WAPC ENDORSEMENT (r.63)

.....

**DELEGATED UNDER S.16 OF
THE P&D ACT 2005**

DATE

APPROVAL GRANTED

.....

MINISTER FOR PLANNING

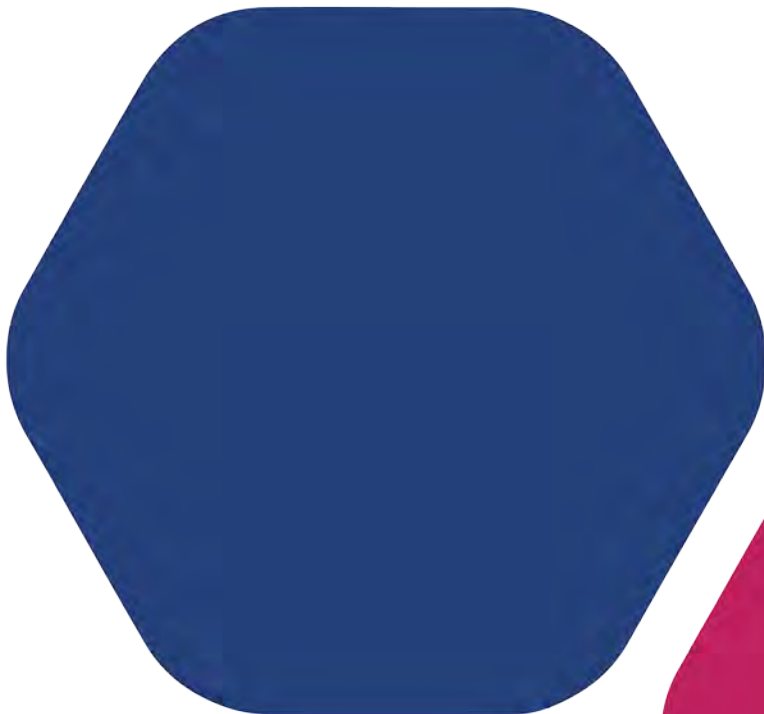
DATE

APPENDIX A **ENVIRONMENTAL ASSESSMENT REPORT**

29 AUGUST 2018

Environmental assessment report

Maitland Strategic Industrial Area improvement scheme



Document status

Version	Purpose of document	Authored by	Reviewed by	Review date
Draft A	Draft for client review	GilGla	JohHal	25.11.17
Rev 0	Final for issue	RebDaw	JohHal	27.08.18

Approval for issue

Name	Signature	Date
John Halleen		29.08.18

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Acronyms and definitions

Table 1 Acronyms and definitions

Acronym	Definitions
AH Act	<i>Aboriginal Heritage Act 1972</i>
ANZECC	Australian and New Zealand Environment Conservation Council
AST	above-ground storage tanks
ARI	Average Recurrence Interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASS	Acid Sulfate Soils
BC Act	<i>Biodiversity Conservation Act 2016</i>
BCH	Benthic Communities and Habitat
BoM	Bureau of Meteorology
Bonn Convention	Convention on the Conservation of Migratory Species of Wild Animals
BUWM	Better Urban Water Management
CAMBA	China–Australia Migratory Bird Agreement
CHRMAP	Coastal Hazard Risk Management Adaptation Plan
CRMP	Coastal Risk Management Plan
DAA	Department of Aboriginal Affairs (now DPLH)
DBCA	Department of Biodiversity, Conservation and Attractions
DBNGP	Dampier to Bunbury Natural Gas Pipeline
DEC	Department of Environment and Conservation (now DWER and DBCA)
DEE	Department of Environment and Energy (Commonwealth)
DER	Department of Environment Regulation (now DWER)
DFES	Department of Fire and Emergency Services
DIA	Department of Indigenous Affairs (now DPLH, preceded DAA)
DoEE	Department of the Environment and Energy (Commonwealth)
DPAW	Department of Parks and Wildlife (now DBCA)
DPLH	Department of Planning, Lands and Heritage
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities
DWER	Department of Water and Environmental Regulation
DWMS	District Water Management Strategy

Acronym	Definitions
EAR	Environmental Assessment Report
EIA	Environmental Impact Assessment
EN	Endangered significance level for fauna protected under the EPBC Act
EP Act	<i>Environment Protection Act 1986</i>
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ha	hectares
JAMBA	Japan–Australia Migratory Bird Agreement
JTSI	Department of Jobs, Tourism, Science and Innovation
KCGS	Karratha Coastal Vulnerability Study
kL/yr	kilolitres per year
km	kilometres
LNG	Liquid Natural Gas
LWMS	Local Water Management Strategy
m	metres
M	Migratory significance level for fauna protected under the EPBC Act
m AHD	Metres in the Australian Height Datum
mbgl	m below ground level
Maitland SIA	Maitland Strategic Industrial Area
MNES	Matters of National Environmental Significance
MRA	MP Rogers & Associates
OEPA	Office of the Environmental Protection Authority
P	Priority flora
PEC	Priority Ecological Community
PD Act	<i>Planning and Development Act 2005</i>
PER	Public Environmental Review
pH _F	Field pH
pH _{FOX}	Field oxidised pH
RIWI Act	<i>Rights in Water and Irrigation Act 1914</i>
ROKAMBA	Republic of Korea–Australia Migratory Bird Agreement
RORB	Runoff and stream-flow routing model
RPS	RPS Australia West Pty Ltd
SEPFO	Statement of Environmental Principles, Factors and Objectives

Acronym	Definitions
SPP	State Planning Policy
TDS	Total Dissolved Solids
TEC	Threatened Ecological Communities
TPS	Town Planning Scheme
TSP	Total Suspended Particulates
V	“Vulnerable” significance level for fauna protected under the EPBC Act
WAPC	Western Australian Planning Commission
WC Act	<i>Wildlife Conservation Act 1950</i>
WMP	Water Management Plan

1 Summary

1.1 Maitland Strategic Industrial Area (SIA) context

In 1993, the Western Australian (WA) State Government identified the Maitland Strategic Industrial Area (SIA) as a suitable location for major industrial development and subsequently established the Maitland SIA.

Located 24 kilometres (km) west of the Karratha townsite and 39 km south of Dampier Port (Figure A), the Maitland SIA is planned to potentially accommodate gas or petroleum processing, power production and other associated downstream processing industries including urea, ammonia and ammonium nitrate.

The Maitland SIA comprises approximately 4,500 hectares (ha) of Crown land and freehold land owned by the Western Australian Land Authority (LandCorp). The area consists of land designated for strategic industry and industry protection. The Dampier-Bunbury Natural Gas Pipeline (DBNGP) traverses the estate, and the North-West Coastal Highway runs along the southern boundary (Figure B).

The Maitland SIA has a critical role to play in adding value to export commodities and generating employment opportunities and economic benefits. It is of strategic economic significance to the State, and the WA State Government has identified the need to provide a statutory planning framework that reflects the significance of the Maitland SIA to the State's economy, and, as far as practicable, provide improved project ready capacity.

Improvement Plan No. 44 – Maitland Strategic Industrial Area was prepared pursuant to the Planning and Development Act 2005 (P&D Act) and gazetted in June 2016. This provided the head of power for the preparation of the Maitland SIA Improvement Scheme. Once gazetted, the City of Karratha's local planning scheme will cease to have effect over the Planning Scheme Area.

The purpose of the Improvement Scheme Report is to provide the context, rationale and explanatory commentary outlining the origins of the planning framework; the key considerations in establishing the Improvement Scheme framework including the Maitland SIA Guide Plan; the rationale for decisions made; and the direction taken during the preparation of the Improvement Scheme.

This Environmental Assessment Report (EAR) has been prepared to inform the Scheme Report and forms an appendix to this report.

1.2 Maitland SIA site details

The Maitland SIA comprises 4,500 ha of land which has long been identified for heavy industrial developments, specifically for industries unable to locate on the Burrup Peninsula.

A summary of the Maitland SIA key development components and zoning are summarised in Table 2 and shown in Figure B.

Table 2 Maitland SIA improvement plan and scheme area key components

Maitland SIA	Description
Land use zoning	City of Karratha Town Planning Scheme No. 8 zoning: <ul style="list-style-type: none"> • "Strategic Industry" permitting the development of heavy / strategic industries • A 2 km "Special Control Area" surrounds the proposed Maitland SIA core area, acting as a buffer to ensure incompatible land uses do not hinder the development of heavy industries in the estate.
Proposed zoning	Scheme Industrial Areas: <ul style="list-style-type: none"> • Strategic Industrial Zone – 4,500 ha • Industry Protection Zone (3 km buffer) – 13,000 ha

The location of the Maitland SIA is provided in Figure B.

1.3 Statutory planning framework

The proposed sequencing of the planning approach for the Maitland SIA Improvement Scheme is as follows:

1. Improvement Plan No. 44 across the Maitland SIA was approved by the Minister for Planning and the Western Australian Planning Commission (WAPC) in June 2016. This Improvement Plan provides the statutory head of power for the Maitland Improvement Scheme to be prepared.
2. Preparation of the Maitland Improvement Scheme across the Improvement Plan Area triggers an assessment of the Scheme by the Environmental Protection Authority (EPA) in accordance with Section 48(a) of the *Environmental Protection Act 1986* (EP Act).

1.4 Purpose of report

The purpose of this report is to:

- Define the key environmental characteristics and issues of the Maitland SIA Improvement Scheme area based on desktop assessments, existing site surveys, formal reports and EPA advice.
- Identify the relevant policy and guideline documents that have been considered and which are relevant to the site.
- Define the EPA's objectives relevant to environmental characteristics identified, potential impacts and mitigation measures proposed through the Improvement Scheme and Guide Plan for assessment by the EPA under section 48 of the EP Act.
- Ensure future industrial developments in the Maitland SIA are managed by proposed statutory mechanisms (the Improvement Scheme and/or Guide Plan) which will be administered by the WAPC as the Responsible Authority (in consultation with the EPA and other relevant authorities).
- Describe the planning and environmental approvals framework and future governance for the Maitland SIA.

1.5 Key investigations

A summary of the key historical investigations and reports undertaken for the Maitland SIA is provided in Table 3.

Table 3 Historical investigations and reports undertaken for the Maitland SIA

Report	Summary
AGC Woodward-Clyde Pty Ltd. 1994. Maitland Heavy Industry Estate Public Environmental Review. Prepared for LandCorp and Department of Resources Development.	This report is a technical review of the proposed estate development, incorporating input from the public consultation process. The report outlines both key issues and potential impacts.
Prangley, C.J. 1994, Results of Drilling Investigations at the Proposed Heavy Industry Site Karratha, Western Australia, Geological Survey, Perth	This report presents the results of a drilling program carried out in August 1994 within the study area to determine the underlying geology and the potential for groundwater contamination to occur as a result of industrial activities at the site.
Mattiske Consulting Pty Ltd. 1994. <i>Karratha Heavy Industry Site Study – Flora, Vegetation and Vertebrate Fauna</i> . Prepared for AGC Woodward-Clyde Pty Ltd	This survey was undertaken in 1994. The methods used are consistent with what is currently referred to as Level 1 assessment under EPA Guidance Statement 51 (EPA 2004)

Report

Summary

EPA. 1997. Maitland Heavy Industrial Estate, Karratha (Bulletin 855).	Recommends protection of the estate from stormwater from the Maitland River and prevention of industrial run-off water entering the Maitland River.
Vinnicombe PJ 1997. Maitland Heavy Industry Estate - Aboriginal Heritage Survey. Prepared for the Department of Resources Development / LandCorp	This report is a detailed Aboriginal Heritage Survey of the Burrup Peninsula and associated islands of the Dampier Archipelago. Maitland is considered in this report.
Astron. 2002. The Maitland Heavy Industrial Estate – Assessment and Comparison with the Burrup Peninsula Industrial Estate. Prepared for the Shire of Roebourne	This report is a literature survey and costing exercise for the study area. The report briefly summarises the environmental aspects within the study area and compares the area with the Burrup Industrial Estate
Appleyard, S.J. 1993, Hydrogeological Assessment of a Proposed Heavy Industry Site Near Karratha, WA, Geological Survey, Perth	This report summarises and analyses the hydrogeological setting within the proposed study area. Information on ground water quality, depth to water table, groundwater salinity, climate, groundwater use within the area is presented.
Department of Water. 2009a. Surface water Proclamation Areas. <i>Rights in Water and Irrigation Act 1914</i> (RIWI Act). Department of Water. Government of WA.	This map indicates Surface Water Proclamation Areas within WA.
Max Van Weert. 2009. Pilbara Integrated Water Supply, Pre- Feasibility Study. Prepared for Department of Water.	<p>This document is a prefeasibility study that identifies water supply integration opportunities in the Pilbara Region of Western Australia.</p> <p>This report identified a range of options for water in the Pilbara: use of water extracted by mine dewatering operations supplemental groundwater for water supply schemes development of aquifers near the coast construction of transfer pipelines from source to demand locations desalination options.</p>
BG&E. 2013. Maitland Industrial Estate – Storm Surge and Flood Study. Prepared for LandCorp.	Report in preparation with a 2D 100-year ARI terrestrial flood and 20-year ARI Storm Surge model showing the site to be underwater in the worst-case scenario.
AECOM. 2013. Maitland Industrial Estate Environmental Due Diligence – Maitland Industrial Estate. Prepared for LandCorp.	The purpose of the environment due diligence is to describe the existing environment, describe the approvals process, make recommendations on the likely approvals required for the project and recommend further environmental studies for the development of the Maitland Industrial Estate, Karratha if and where necessary for approval. It is included in this report as Appendix A.
Department of Biodiversity, Conservation and Attractions. 2017. <i>Naturemap – Mapping Western Australia's Biodiversity Search</i> . Search created on August 2017	This is a search using DBCA's Naturemap service, providing records of not just Threatened and Rare Flora but all species recorded in the Maitland SIA
EPBC Act Protected Matters Search Report. Report created: 18/02/2017	This is a search of Protected Matters under the EPBC Act, within the study area of Maitland.

Report

Summary

RPS. 2018. District Water Management Strategy Maitland Strategic Industrial Area. Prepared for LandCorp.

This District Water Management Strategy (DWMS) has been developed in the context of the Improvement Scheme process to not only addresses the objectives of Better Urban Water Management and demonstrate that the area is capable of supporting future development with respect to water related constraints, but also to inform the water management detail required by each proponent at subdivision stage. The report identifies the planning and environment context of the subject site, and outlines the key water servicing, drainage and environmental management considerations to be progressed in support of subsequent design development and planning approval phases.

MP Rogers & Associates (MRA). 2017. Coastal Hazard Study. Prepared for LandCorp.

This report has been prepared to inform the engineering and future planning for development within the Maitland Industrial Estate.

MRA. 2018. Maitland Strategic Industrial Area CHRMAP. Report prepared for LandCorp.

The CHRMAP has been developed to inform the Scheme Report (and will be appended to the Scheme Report). The main objective of the CHRMAP is to define areas of the coastline which could be vulnerable to coastal hazards and to outline the preferred approach for the assessment and management of these hazards where required. It also acts as a guideline for future CHRMAPs when individual lots are developed. This management plan is informed by the results of the Coastal Hazard Study (MRA 2017). It is appended to this report as Appendix B.

GHD. 2017. Ground and Surface Water Monitoring. Prepared for LandCorp.

This report has been prepared to inform the engineering and planning works for development within the Maitland Industrial Estate. This report can be found appended to the DWMS for the site (RPS 2018).

1.6 Identified key environmental factors for the improvement scheme

In 1994, LandCorp and the then Department of Resource Development prepared a concept plan and undertook a Public Environmental Review (PER) for the Maitland SIA (known as the “heavy industrial estate”). A vegetation and flora survey undertaken by Mattiske in 1994 (this survey not completed in accordance with the relevant EPA guidance) and a fauna survey (which consisted of broad field observations) were the key investigations undertaken for the PER assessment.

The EPA provided the Minister for the Environment with advice on the Maitland SIA proposal under Section 16 of the EP Act (Bulletin 855). The EPA identified the following key environmental factors associated with the Maitland SIA during their assessment:

- Mangroves
- Marine Fauna
- Threatened and Priority Fauna
- Rare and Priority Flora and Vegetation Communities
- Air Quality
- Greenhouse Gases
- Dust and Particulate Emissions
- Noise and Vibration
- Surface Water, Marine Water and Sediment Quality

- Turbidity
- Liquid and Solid Wastes
- Public Health and Safety
- Cultural Surroundings.

Environmental factors are those parts of the environment that may be impacted by an aspect of a proposal. The EPA has 14 environmental factors, organised into five themes: Sea, Land, Water, Air and People. The environmental factors relevant to Maitland SIA are provided in Table 4 together with the EPA's objective for each factor.

Table 4 Identification of key environmental factors

Factor	Objective	Relevance to Maitland SIA
Sea		
Benthic Communities and Habitat	To protect benthic communities and habitat so that biological diversity and ecological integrity are maintained.	Managing construction activities and controlling storm and groundwater water post development to avoid potential impacts to benthic habitats.
Coastal Processes	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.	Development within Maitland SIA will need to be consistent with the requirements of State Planning Policy No.2.6: State Coastal Planning Policy (SPP2.6). The CHRMAP (MRA 2018; Appendix B) defines the areas of the coastline which could be vulnerable to coastal hazards and outlines the preferred approach for the assessment and management of these hazards where required. It will serve as a guide for the preparation of CHRMAPs for future industrial developments.
Marine Environmental Quality	To maintain the quality of water, sediment and biota so that environmental values are protected.	Managing construction activities, controlling storm and groundwater water and waste management post development to avoid potential impacts to marine environmental quality.
Marine Fauna	To protect marine fauna so that biological diversity and ecological integrity are maintained.	Managing of construction and operations noise
Land		
Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained	Construction of each individual industrial development and associated infrastructure (roads, power, water) will result in localised vegetation clearing.
Landforms	To maintain the variety and integrity of distinctive physical landforms so that environmental values are protected	Distinctive landforms are not present. Construction will likely result in cut and fill for each industrial development and associated infrastructure.
Terrestrial Environmental Quality	To maintain the quality of land and soils so that environmental values are protected.	Management of potential Acid Sulfate Soils during construction works
Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	Construction of each individual industrial development and associated infrastructure (roads, power, water) will result in localised clearing of fauna habitat.

Factor	Objective	Relevance to Maitland SIA
Water		
Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.	<p>Manage storm and groundwater water post development to avoid potential impacts to Maitland River, tidal creeks, benthic habitats and the adjacent marine environment.</p> <p>The DWMS addresses the objectives of Better Urban Water Management (BUWM), but also informs the water management detail required by each proponent at subdivision stage, as part of the lot-scale water management plan (WMP) to avoid impacts to water dependent ecosystem and the adjacent marine environment.</p>
Inland Waters Environmental Quality	To maintain the quality of groundwater and surface water so that environmental values are protected	<p>Manage storm and groundwater water post development to avoid potential impacts to Maitland River, tidal creeks, benthic habitats and the adjacent marine environment.</p> <p>A DWMS has been developed in the context of the Improvement Scheme process to:</p> <ul style="list-style-type: none"> addresses the objectives of BUWM and demonstrate that the area is capable of supporting future development with respect to water related constraints inform the water management detail required by each proponent at subdivision stage. The DWMS identifies the planning and environment context of the subject site, and outlines the key water servicing, drainage and environmental management considerations to be progressed in support of subsequent design development and planning approval phases.
Air		
Air Quality	To maintain air quality and minimise emissions so that environmental values are protected.	Dust management requirements during construction works. Post construction emissions from heavy industries will be controlled in accordance with licence approvals under Part V of the EP Act.
People		
Social Surroundings	To protect social surroundings from significant harm.	Each industrial development proposal will need to assess and accommodate its own buffer within its leasehold in accordance with the EPA's recommended separation distances. For heavy industrial development proposals (e.g. ammonia processing plant) within the Strategic Industry Zone a specific environmental assessment for example of air quality, noise and human health risk will need to be undertaken in consultation with the EPA as part of a separate referral and assessment under Section 38 of the EP Act.
Human Health	To protect human health from significant harm.	Air quality and noise management requirements during construction works. Post construction air and noise emissions from heavy industries will be controlled in accordance with licence approvals under Part V of the EP Act.

1.7 Engagement with Department of Water and Environmental Regulation (DWER)

In March 2017 preliminary advice was sought from the then Office of the Environmental Protection Authority (OEPA) (now the Department of Water and Environmental Regulation [DWER]) prior to the initiation of the Maitland SIA Improvement Scheme and before the formal referral of the Improvement Scheme to the EPA.

The then OEPA advised the following:

- The Department has reviewed the documents and considers the information provided as sufficient for the EPA to make a determination under S48A of the EP Act when the Improvement Scheme is referred.
- The Department recommends the Improvement Scheme Text, Guide Plan and Scheme Report adequately addresses potential impacts to identified environmental factors and considers the unknown nature and size of future industries that may be located at the site.

The OEPA advice is provided in Appendix C.

1.8 Environmental management framework

The environmental factors identified in Table 4 (such as coastal processes, hydrological process and terrestrial environmental quality) are capable of being resolved (i.e. avoided or managed to meet the EPA's objectives) through site-specific investigations detailed engineering design and management/mitigation measures. A DWMS has been prepared for the Maitland SIA Improvement Scheme to guide future industrial developments hydrological management requirements at the subdivision and development stages. The CHRMAP has been prepared to guide the preparation of CHRMAPs for future industrial developments" coastal hazard risk management and adaptation requirements at the subdivision and development stages. Potential impact to the key factors of flora and vegetation and terrestrial fauna may require resolution through detailed investigations and liaison with the state regulatory authorities, based on design, mitigation and management measures, which will be proposed as part of future development (but are not currently known).

At a future time when the nature and land requirements for industrial development(s) are more comprehensively known (i.e. detailed planning design/subdivision stage) the developments will be subject to the following environmental Scheme Provisions (Table 5).

Table 5 Maitland SIA development requirements – improvement scheme and guide plan

Zone	Improvement scheme (Part 4 of text)	Guide plan (appended to scheme)
Strategic Industry	If applicable, scheme text is to set out environmental conditions applicable to the scheme as a result of an assessment carried out under the <i>Environmental Protection Act 1986</i> Part IV Division 3. If no environmental conditions apply, the scheme text will state, "There are no environmental conditions imposed under the <i>Environmental Protection Act 1986</i> that apply to this Scheme".	Development shall be in accordance with the following management plans (as relevant): <ul style="list-style-type: none"> • Construction Environmental Management Plan • Marine Turtle Baseline Lighting Survey and Design Guidelines (if required) • Terrestrial Flora and Vegetation Management Plan • Terrestrial Fauna Management Plan (in particular northern quoll) • Terrestrial Weed Management Plan • Water Management Plan • Acid Sulfate Soil and Dewatering Management Plan • Bushfire Management Plan • Noise and Air Quality Management Plan* • Coastal Hazard Risk Management Adaptation Plan

*Due regard shall be given to:

(a) Any applicable operating licence granted under Part 5 of the EP Act.

(b) Any previous advice provided by the Environmental Protection Authority as a result of Sections 38 and 48 Referrals.

1.9 Additional proponent environmental considerations

1.9.1 Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act)

This assessment identified as an outcome of future (to be defined industrial development) there is a potential to impact on specific Matters of National Environmental Significance (MNES) (e.g. northern quoll). Defining the potential impacts is subject to future project planning and site-specific design detail and investigations. Based on the outcomes of this assessment a referral and possible Ministerial approval under the Commonwealth EPBC Act may be required by future proponents.

1.9.2 Proponent Industrial Buffers

Within the Maitland SIA, in particular the Strategic Industry Zone, (which is proposed to accommodate mineral and hydrocarbon processing activities) each industrial development proposal will need to assess and accommodate its own buffer within its leasehold in accordance with the EPA's recommended separation distances. For heavy industrial development proposals (e.g. ammonia processing plant) within the Strategic Industry Zone a specific environmental assessment for example of air quality, noise and human health risk will need to be undertaken in consultation with the EPA as part of a separate referral and assessment under Section 38 of the EP Act. This assessment would also delineate separation distances between industrial developments within the Maitland SIA.

Industrial premises (for example chemical manufacturing, electric power generation bulk storage of chemicals, processing/beneficiation of metallic or non-metallic ore) identified as have the potential to pollute or otherwise impact on the quality of our air, land or water are known as "prescribed premises" and trigger regulation under the EP Act. The DWER is responsible for regulating these industrial emissions and discharges to the environment through a works approval and licensing.

As each industrial development will require a buffer from neighbouring industries spatially, the likely key outcome for the Maitland SIA particularly in the Strategic Industry Zone areas is there will be "pods" of industrial development(s), connected by roads and common infrastructure within the Maitland SIA landscape.

Following the State / Commonwealth Environmental Impact Assessment (EIA) process undertaken for the Maitland SIA Improvement Scheme individual heavy industrial proposals will in addition to addressing the environmental Scheme Provisions will be required to gain environmental approvals under the following State Acts, prior to it proceeding:

- Part V of the EP Act
- RIWI Act.

1.10 Summary

An assessment of the environmental factors relevant to this Proposal, in accordance with the approach in the EPA's Statement of Environmental Principles, Factors and Objectives (SEPFO) (2016) and the EPA's Environmental Factor Guidelines and Environmental Factor Technical Guidance. The outcome of this assessment is presented in Table 6.

This Environmental Assessment Report (EAR) has used regional data sets to undertake EIA for each of the preliminary key environmental factors relating to the Maitland SIA Improvement Scheme. Where impacts have been assessed as significant the application of a management hierarchy which will be included in the Maitland SIA Improvement Scheme Text and Guide Plan for implementation will result in a reduction of potential impacts and the EPAs objectives being met.

Table 6 provides a summary of the environmental factors and objectives, the potential impacts, and proposed management measures.

Table 6 Summary table of the relevant environmental factors and management response

Environmental Factor	Environmental Objective	Applicable Legislation and/or Guidelines	Potential Impacts	Proposed Management Response
Sea				
Benthic Communities and Habitat	<i>To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained</i>	Environmental Factor Guideline – Benthic Communities and Habitat (EPA, 2016). Technical Guidance – Protection of Benthic Communities and Habitat (EPA, 2016).	<p>The Maitland SIAs coastal frontage consists of the following intact marine habitat areas:</p> <ul style="list-style-type: none"> • Mangrove communities • Intertidal and mudflats • Sand beaches <p>The potential impacts include:</p> <ul style="list-style-type: none"> • Unmanaged surface and groundwater drainage into the coastal environment from the industrial development causing scouring and impacting on the creek and coastal sediment. • Toxicity in the sediments or accumulation of metals and other chemicals as a result of construction and operational activities may be deposited in intertidal coastal areas during storm events. 	<p>There will no direct impact to the coastline, creeks or mangroves. The Maitland SIA is adjacent to intertidal flats. The intertidal flats are setback 1.4 km to 2 km from the mangrove creeks and coastline.</p> <p>A DWMS has been prepared as part of the Improvement Scheme process. The purpose of the DWMS is to demonstrate that the area is capable of supporting the industrial development and is able to achieve appropriate urban water management outcomes, particularly as there have been areas identified that will be subject to significant depths of flooding at high velocities. Potential environmental impacts to benthic communities and habitat will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans as part of future subdivision design and approval:</p> <ul style="list-style-type: none"> • Water Management Plan <p>The objective of the Water Management Plan is to minimise potential impacts on natural ecosystems relying on pre-development hydrological regimes and prevent unacceptable flooding.</p> <p>Applications for planning approval within the Strategic Industry Zone are required to be supported by a Water Management Plan as required by the Guide Plan.</p>
Coastal Processes	<i>To maintain the geophysical processes that shape coastal morphology so that the environmental values</i>	EPA 2016, Environmental Factor Guideline – Coastal Processes, EPA, Western Australia. Development within Maitland SIA will need to be consistent	<p>The potential impacts include:</p> <ul style="list-style-type: none"> • activities that remove natural communities and habitats that protect the coastline and increase exposure to the action of coastal processes. 	<p>There will no direct impact to the coastline, creeks or mangroves. The Maitland SIA is adjacent to intertidal flats. The intertidal flats are setback 1.4 km to 2 km from the mangrove creeks and coastline.</p> <p>A DWMS has been prepared as part of the Improvement Scheme process. The purpose of the DWMS is to</p>

Environmental Factor	Environmental Objective	Applicable Legislation and/or Guidelines	Potential Impacts	Proposed Management Response
	<i>of the coast are protected.</i>	with the requirements of State Planning Policy No.2.6: State Coastal Planning Policy (SPP2.6)		<p>demonstrate that the area is capable of supporting the industrial development and is able to achieve appropriate urban water management outcomes, particularly as there have been areas identified that will be subject to significant depths of flooding at high velocities.</p> <p>A CHRMAP has been prepared (MRA 2018; Appendix B) as part of the Improvement Scheme process. The main objective of the CHRMAP is to define areas of the coastline which could be vulnerable to coastal hazards and to outline the preferred approach for the assessment and management of these hazards where required.</p> <p>Potential environmental impacts to coastal processes will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans as part of future subdivision design and approval:</p> <ul style="list-style-type: none"> • Water Management Plan <p>The objective of the Water Management Plan is to minimise potential impacts on natural ecosystems relying on pre-development hydrological regimes and prevent unacceptable flooding.</p> <ul style="list-style-type: none"> • Coastal Hazard Risk Management Adaptation Plan (CHRMAP) <p>The objective of future proponent's site specific Coast Hazard Risk Management Adaptation Plans is to detail how proposed development of individual lots addresses the risk level and management strategies outlined in the MSIA CHRMAP.</p> <p>Applications for development approval within the Strategic Industry zone are required to be supported by a Water Management Plan and if within the Special Control Area over the northern portion of the Strategic Industry zone, a Coastal Hazard Risk Management Adaptation Plan.</p>

Environmental Factor	Environmental Objective	Applicable Legislation and/or Guidelines	Potential Impacts	Proposed Management Response
Marine Environmental Quality	<i>To maintain the quality of water, sediment and biota so that environmental values are protected</i>	Environmental Factor Guideline – Marine Environmental Quality (EPA, 2016). Technical Guidance – Protecting the quality of Western Australia's marine environment (EPA, 2016).	The potential impacts include: <ul style="list-style-type: none"> • surface water runoff from the industrial areas and entering the marine environment directly via drains or indirectly via groundwater carrying contaminants such as heavy metals, nutrients, oils and pesticides, and pathogens. • Unplanned releases of chemicals or hydrocarbons associated with heavy industrial activities such as oil and gas production, transfer and storage of bulk commodities. Generally, these have a low probability of occurring but, if they do, the consequences for marine environmental quality can be severe. 	<p>There will no direct impact to the coastline, creeks or mangroves. The Maitland SIA is adjacent to intertidal flats. The intertidal flats are setback 1.4 km to 2 km from the mangrove creeks and coastline.</p> <p>A DWMS has been prepared as part of the Improvement Scheme process. The purpose of the DWMS is to demonstrate that the area is capable of supporting the industrial development and is able to achieve appropriate urban water management outcomes, particularly as there have been areas identified that will be subject to significant depths of flooding at high velocities.</p> <p>Potential environmental impacts to marine environmental quality will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans as part of future subdivision design and approval:</p> <ul style="list-style-type: none"> • Water Management Plan <p>The objective of the Water Management Plan is to minimise potential impacts on natural ecosystems relying on pre-development hydrological regimes and prevent unacceptable flooding.</p> <p>Applications for planning approval within the Strategic Industry Zone are required to be supported by a Water Management Plan as required by the Guide Plan.</p>
Marine Fauna	<i>To protect marine fauna so that biological diversity and ecological integrity are maintained</i>	Environmental Factor Guideline – Marine Fauna (EPA, 2016d)	<p>Potential impacts include:</p> <p>Construction activities may cause temporary displacement of marine fauna through noise impacts</p> <p>Potential indirect impact to marine fauna habitat, including foraging habitats for shorebirds from light and noise.</p> <p>Future industrial development within the Maitland SIA has the potential to contribute to cumulative light impacts</p>	<p>There will no direct impact to the coastline, creeks or mangroves. The Maitland SIA is adjacent to intertidal flats. The intertidal flats are setback 1.4 km to 2 km from the mangrove creeks and coastline.</p> <p>Potential construction noise and stormwater impacts to marine fauna will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans as part of future subdivision design and approval:</p>

Environmental Factor	Environmental Objective	Applicable Legislation and/or Guidelines	Potential Impacts	Proposed Management Response
			(skyglow), to the existing night light environment	<ul style="list-style-type: none"> • Construction Environmental Management Plan • Water Management Plan. <p>The Scheme Text, will require these management plans to be prepared (as relevant) as part of future subdivision and approval. The specific requirements of the management plans will be included in the Guide Plan.</p> <p>Post construction, noise emissions are primarily regulated under Part V of the EP Act. Emissions will be managed in accordance with operating Licence issued under Part V of the EP Act.</p> <p>Within the local regional Flatback and Hawkesbill Turtle rookeries are located on Wickham Boat Beach, Cleaverville, Cape Preston and Gnoorea. The beaches that attract nesting turtles usually possess suitable feeding grounds in near shore areas and reasonable access to the ocean during lower tides. Potential environmental impacts to marine turtles will be addressed by requiring any future planning applications within the Strategic Industry Zone undertake Baseline lighting studies. The purpose of this study will be to inform the expected cumulative lighting impacts from the proposed industrial development upon marine turtles.</p> <p>The Guide Plan, as relevant, will require future proposed industrial developments within the Strategic Industry Zone to undertake a Marine Turtle Baseline Lighting Study in support of any applications for planning approval.</p> <p>The specific requirements of the Marine Turtle Baseline Lighting Study will be included within the Guide Plan. Should the Marine Turtle Baseline Lighting Study predict potential significant impacts from lighting on marine turtles from development, then the preparation and implementation of Design Guidelines for reducing light emissions will be required.</p>

Environmental Factor	Environmental Objective	Applicable Legislation and/or Guidelines	Potential Impacts	Proposed Management Response
Land				
Vegetation and Flora	<i>To protect flora and vegetation so that biological diversity and ecological integrity is maintained.</i>	SEPFO (EPA, 2016). Environmental Factor Guideline – Flora and Vegetation (EPA, 2016). Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016). <i>Wildlife Conservation Act 1950</i> (WC Act) <i>Environmental Protection Act 1986</i> <i>Environmental Protection (Clearing of Native Vegetation) Regulations 2004</i>	The majority of the Maitland SIA was reported by AECOM (2013) (Appendix A Error! Reference source not found.) to be in a “degraded” condition as a result of historical clearing and cattle grazing. The areas of intact native vegetation were along the existing creeklines. The potential impacts on terrestrial flora and vegetation from the development of the project study area include: <ul style="list-style-type: none"> clearing of terrestrial vegetation impacts on Priority flora species introduction and distribution of weed species unnecessary clearing hydrological changes. 	Potential environmental impacts to flora and vegetation will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans as part of future subdivision design and approval: <ul style="list-style-type: none"> Construction Environmental Management Plan Terrestrial Flora and Vegetation Management Terrestrial Weed Management Plan Water Management Plan. The Guide Plan will require these management plans to be prepared (as relevant) as part of future subdivision and approval. The specific requirements of the management plans will be included in the Guide Plan.
Landforms	<i>To maintain the variety and integrity of physical landforms so that environmental values are protected.</i>	SEPFO (EPA 2016). Environmental Factor Guideline: Terrestrial Environmental Quality (EPA 2016).	Development of industrial Lots and associated infrastructure such as roads is expected to result in permanent changes to local landforms. These local landforms are not of elevated conservation significance or other special interest and are not unique to the coastal Pilbara region. There are no permanent industrial development activities within existing creeks and rivers.	Potential environmental impacts to landforms will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans as part of future subdivision design and approval: <ul style="list-style-type: none"> Construction Environmental Management Plan Terrestrial Flora and Vegetation Management Terrestrial Weed Management Plan Water Management Plan.
Terrestrial Fauna	<i>To protect terrestrial fauna so that biological diversity and ecological integrity is maintained.</i>	<i>Wildlife Conservation Act 1950</i> <i>Environmental Protection Act 1986</i>	Species identified that may be potentially impacted by the proposal include: <ul style="list-style-type: none"> northern quoll (<i>Dasyurus hallucatus</i>) 	Potential environmental impacts to fauna will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation

Environmental Factor	Environmental Objective	Applicable Legislation and/or Guidelines	Potential Impacts	Proposed Management Response
		<p><i>Environment Protection and Biodiversity Conservation Act 1999</i></p> <p>Environmental Protection (Clearing of Native Vegetation) Regulations 2004</p> <p>EPA 2016m, Environmental Factor Guideline: Terrestrial Fauna, EPA, Western Australia.</p>	<ul style="list-style-type: none"> northern short-tailed mouse (<i>Leggadina lakedownensis</i>) pebble-mound mouse (<i>Pseudomys chapmani</i>) lined soil-crevice skink (<i>Notoscincus butleri</i>) Pilbara olive python (<i>Liasis olivaceus barroni</i>) <p>Potential impacts to fauna on the site are summarised below:</p> <ul style="list-style-type: none"> animal deaths during the clearing process and the destruction of burrows and retreat sites habitat fragmentation an increased abundance of introduced species (cats and wild dogs) road fauna deaths, in particular this is likely to impact kangaroos, nocturnal birds and ground dwelling large carnivorous predators 	<p>and implementation of the following environmental management plans:</p> <ul style="list-style-type: none"> Construction Environmental Management Plan Terrestrial Fauna Management Plan Terrestrial Weed Management Plan. <p>The Scheme Text, will require these management plans to be prepared (as relevant) as part of future subdivision and approval. The specific requirements of the management plans will be included in the Guide Plan.</p>
Terrestrial Environmental Quality	<i>To maintain the quality of land and soils so that environment values are protected.</i>	<p><i>Environmental Protection Act 1986</i></p> <p><i>Contaminated Site Act 2003</i></p> <p>Assessment Levels for Soil, Sediment and Water (DWER 2010)</p> <p>Acid Sulfate Soils Guideline Series. Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DWER 2011)</p> <p>Identification and Investigation of Acid Sulfate</p>	<p>Most of the industrial areas in the Maitland SIA have no known ASS mapped across them, however the drainage lines have been mapped as having a moderate to low risk of ASS and a portion of land to south-east has an ASS risk mapping of high to moderate.</p>	<p>If ASS is identified as occurring and is proposed to be disturbed by construction works, a detailed Acid Sulfate Soil and Dewatering Management Plan is required to be prepared as part of future development.</p> <p>The objectives of the Acid Sulfate Soil and Dewatering Management Plan will be to adequately identify “actual” and “potential” acid sulfate soils and determine appropriate management strategies and construction practices to be followed to ensure effective handling, treatment and disposal of acid sulfate soils and produced water.</p> <p>The Scheme Text will require an Acid Sulfate Soil and Dewatering Management Plan to be prepared (as relevant) as part of future subdivision and approval. The specific</p>

Environmental Factor	Environmental Objective	Applicable Legislation and/or Guidelines	Potential Impacts	Proposed Management Response
		Soils and Acidic Landscapes (DWER 2013).		requirements of the management plan will be included in the Guide Plan.
Water				
Hydrological Processes and Inland Waters Environmental Quality	<p><i>To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.</i></p> <p><i>To maintain the quality of groundwater and surface water so that environmental values are protected.</i></p>	<p>Environmental Factors Guidelines – Hydrological Processes (EPA, 2016).</p> <p>Environmental Factors Guidelines – Inland Waters Environmental Quality (EPA, 2016).</p> <p>SEPFO (EPA, 2016).</p> <p>State Planning Policy 2.9 – Water Resources (WAPC 2006a)</p> <p>Better Urban Water Management (WAPC 2008).</p>	<p>Potential impacts to hydrology on the site includes:</p> <ul style="list-style-type: none"> • groundwater level changes that occur as a result of a change in land use • removal of vegetation and installation of impervious surfaces that lead to an increase in run-off during rainfall events • development may result in an increase in the potential for industrial generated pollutants, such as nutrients, hydrocarbons, litter and sediment, being transported, through surface water run-off, into the local storm water drainage system • development may result in changes to surface water flows. <p>In terms of potential impacts to proposed development on the site due to on-site hydrological conditions, the subject land may be impacted by flooding during high rainfall or less frequent extreme events, such as tropical cyclones (during site surveys, parts of the site were flooded due to high rainfall).</p>	<p>A DWMS has been prepared as part of the Improvement Scheme process.</p> <p>The purpose of the DWMS is to demonstrate that the area is capable of supporting the industrial development and is able to achieve appropriate urban water management outcomes, particularly as there have been areas identified that will be subject to significant depths of flooding at high velocities.</p> <p>In addition to identifying and addressing these constraints, the preparation of the DWMS will identify and discuss other significant environmental factors pertaining to the development of the site.</p> <p>The Scheme Text, will require a Water Management Plan to be prepared as part of future subdivision and approval. The specific requirements of the management plan will be included in Guide Plan and detailed in the DWMS.</p>
Air				

Environmental Factor	Environmental Objective	Applicable Legislation and/or Guidelines	Potential Impacts	Proposed Management Response
Air Quality	<i>To maintain air quality and minimise emissions so that environmental values are protected.</i>	EPA 2016, Environmental Factor Guideline: Air Quality, EPA, Western Australia.	<p>Clearing and construction works are expected to result in the generation of dust and greenhouse gas emissions. During the operational phase activities that have the potential to impact air quality include, but are not necessarily limited to:</p> <ul style="list-style-type: none"> • waste to energy plants where the emissions from the combustion of waste is discharged to the air • the capture, processing and refining of oil and gas • the burning of fossil fuels for the production of energy • heavy industries that emit atmospheric waste such as metal smelting and refineries • bulk handling and transport (both road and rail) of materials, including the loading and unloading of bulk materials • stockpiling of bulk material • the crushing and screening of materials • chemical manufacturing and processing. 	<p>Potential environmental impacts to air quality will be addressed both at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans:</p> <ul style="list-style-type: none"> • Construction Environmental Management Plan <p>The Scheme Text, will require this management plan to be prepared (as relevant) as part of future subdivision and approval. The specific requirements of the management plan will be included in the Guide Plan.</p> <p>Post construction, emissions are primarily regulated under Part V of the EP Act. Emissions will be managed in accordance with operating Licence issued under Part V of the EP Act.</p>
People				
Social Surroundings	<i>To ensure that social surroundings are not materially affected.</i>	EPA 2016, Environmental Factor Guideline: Social Surroundings, EPA, Western Australia.	The Maitland SIA is remote from the Karratha communities or other sensitive receptors. Clearing and construction works may result in disturbance to some sites of archaeological significance however, any disturbance will be in	The Improvement Scheme and/or Guide Plan will set out the Aboriginal heritage and native title compliance requirements in accordance with the <i>Aboriginal Heritage Act 1972</i> (WA).

Environmental Factor	Environmental Objective	Applicable Legislation and/or Guidelines	Potential Impacts	Proposed Management Response
		<i>Aboriginal Heritage Act 1972</i> (AH Act) <i>Heritage of Western Australia Act 1990</i> <i>Native Title Act 1993</i> Aboriginal Heritage Due Diligence Guidelines (DIA 2013)	accordance with approval under section 18 of the <i>Aboriginal Heritage Act 1972</i>	
Human Health	<i>To ensure that human health is not materially affected.</i>	Environmental Factors Guidelines – Human Health (EPA, 2016).	Construction activities may result in noise levels occasionally exceeding assessment criteria however, noise levels are not expected to result in any significant impacts to human health at the nearest noise sensitive receptor.	<p>Potential environmental impacts from noise levels will be addressed both at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans:</p> <ul style="list-style-type: none"> • Construction Environmental Management Plan <p>The Scheme Text, will require this management plan to be prepared (as relevant) as part of future subdivision and approval. The specific requirements of the management plan will be included in the Guide Plan.</p> <p>Post construction, noise impacts are primarily regulated under Part V of the EP Act. Noise will be managed in accordance with operating Licence issued under Part V of the EP Act.</p>

2 Introduction

2.1 Location

The Maitland SIA is located within the City of Karratha, approximately 1,500 km north of Perth, 24 kilometre (km) west of the Karratha Townsite and 39 km south of Dampier Port (Figure A).

The North-West Coastal Highway runs along the southern boundary of the Estate and the DBNGP traverses the southern edge of the site (Figure B). The Maitland River forms the western boundary of the Estate while Dampier Salt is located along the eastern boundary. It sits within Karratha Station Pastoral lease.

2.2 Key characteristics of the Maitland SIA

In 1993, the Western Australian (WA) State Government identified the Maitland SIA as a suitable location for major industrial development and subsequently established the MSIA.

The Maitland SIA is planned to potentially accommodate gas or petroleum processing, power production and other associated downstream processing industries including urea, ammonia and ammonium nitrate.

The Maitland SIA comprises approximately 4,500 ha of Crown land and freehold land owned by the Western Australian Land Authority (LandCorp). The area consists of land designated for strategic industry and industry protection.

The Maitland SIA has a critical role to play in adding value to export commodities and generating employment opportunities and economic benefits. It is of strategic economic significance to the State, and the WA State Government has identified the need to provide a statutory planning framework that reflects the significance of the Maitland SIA to the State's economy, and, as far as practicable, provide improved project ready capacity.

Improvement Plan No. 44 – Maitland Strategic Industrial Area was prepared pursuant to the P&D Act and gazetted in June 2016. This provided the head of power for the preparation of the Maitland SIA Improvement Scheme. Once gazetted, the City of Karratha's local planning scheme will cease to have effect over the Planning Scheme Area.

The purpose of the Improvement Scheme Report is to provide the context, rationale and explanatory commentary outlining the origins of the planning framework; the key considerations in establishing the Improvement Scheme framework including the Maitland SIA Guide Plan; the rationale for decisions made; and the direction taken during the preparation of the Improvement Scheme.

This EAR has been prepared to inform the Scheme Report and forms an appendix to the Scheme Report.

Maitland SIA comprises approximately 4,500 ha and is part of the State's network of SIA's in key locations positioned to promote and facilitate the processing of the State's natural resources.

The site has been identified as a long-term industrial development site capable of accommodating industries unable to be located on the Burrup Peninsula. Examples of suitable industries include gas or petroleum processing, power production and other downstream processing industries (Urea, Ammonia, Ammonium Nitrate, etc.).

A 3 km Industry Protection Zone (13,000 ha) surrounds the Estate ensuring incompatible land uses do not hinder the development potential of the Estate.

The Maitland SIA key site characteristics are summarised in Table 7.

Table 7 Key site and proposal characteristics of the Maitland SIA

Aspect	Description
Project location	Maitland SIA is approximately 24 km from Karratha
Current responsible authority	City of Karratha
Proposed responsible authority	Western Australian Planning Commission
Current zoning (under local planning scheme)	The SIA is zoned as "Strategic Industry" A 2 km buffer around the Maitland SIA is currently zoned as a "Special Control Area"
Proposed zoning (Scheme Industrial Areas)	<ul style="list-style-type: none"> • Strategic Industrial Zone – 4,500 ha • Industry Protection Zone (3 km buffer) – 13,000 ha
Current land use	Crown land used in areas a pastoral station (Karratha Station). There is currently already a small LNG plant on the site (Strategic Industry).
Surrounding land uses	South: North-West Coastal Highway West: Maitland River East: Dampier Salt North: King Bay is 27 km north-east

The characteristics and specific requirements of the Maitland SIA create the need for an appropriate statutory planning framework to manage the allocation and future development of land within the Improvement Plan boundary.

The Improvement Scheme zones land within the scheme area of the purposes defined in the scheme and therefore controls and guide land use and development. Importantly, the Improvement Scheme makes provision for the administration and enforcement of the scheme, e.g. specific Scheme Provisions.

The Improvement Scheme will be the principal statutory tool for implementing the strategic planning objectives for the project and the Improvement Scheme Report provides an outline of the planning arrangements as they apply to the area, the strategic intentions for the industrial areas and an overview of the statutory provisions of the Improvement Scheme (RPS 2015).

The Guide Plan is included in the Improvement Scheme for the purposes of:

1. Providing spatial arrangement of planned industrial activities.
2. Identifying criteria and considerations to be addressed by proponents in preparing applications for subdivision and planning approval.
3. Providing guidance for the assessment and determination of applications for subdivision and planning approval by the Western Australian Planning Commission (WAPC).

The Guide Plan is intended to be interpreted and applied with flexibility, responding to specific requirements of proponents as needs of particular industries become apparent.

2.3 Purpose of report

The purpose of this report is to:

- Define the key environmental characteristics and issues of the Maitland SIA Improvement Scheme area based on desktop assessments, existing site surveys, formal reports and Environmental Protection Authority (EPA) advice.
- Identify the relevant policy and guideline documents that have been considered and which are relevant to the site.

- Define the EPA's objectives relevant to environmental characteristics identified, potential impacts and mitigation measures proposed through the Improvement Scheme and Guide Plan for assessment by the EPA under section 48 of the EP Act.
- Ensure future industrial developments in the Maitland SIA are managed by proposed statutory mechanisms (the Improvement Scheme and/or Guide Plan) which will be administered by the WAPC as the Responsible Authority (in consultation with the EPA and other relevant authorities).
- Describe the planning and environmental approvals framework and future governance for the Maitland SIA.

2.4 Scope of report

This preliminary environmental assessment of the Maitland SIA addresses the following themes of sea, land, water and people in accordance with the EPA's SEPFO, December 2016, as outlined below:

- sea
 - benthic communities and habitat
 - coastal processes
 - marine environmental quality
 - marine fauna
- land
 - flora and vegetation
 - terrestrial fauna
 - landforms
 - terrestrial environmental quality
- water
 - hydrological processes and inland waters environmental quality
- Air
 - air quality
- People
 - social surroundings
 - human health.

3 Land use and planning context

3.1 Project background

The Maitland SIA is located within the Karratha Station Pastoral Lease. Karratha Pastoral Lease was purchased by Hamersley Iron in 1966, to facilitate access to the Port of Dampier. Historically, the station was originally established as a sheep station and has subsequently been used for cattle grazing.

The DBNGP also traverses the site and a small LNG plant operated by Energy Development Limited is already located within the site boundary. The Maitland SIA is shown in Figure B.

Site specific identification, planning and baseline technical studies were carried out in the 1990s. An outcome of these studies resulted in the Maitland SIA being incorporated in the then Shire of Roebourne's Town Planning Scheme (TPS) No. 8 (2000) and zoned for "Strategic Industry".

AECOM undertook a site assessment of the Maitland SIA in 2013 (Appendix A). As part of this assessment there reviewed information on the activities historically occurring within the site. The key outcomes from this historical review include:

- The Maitland SIA site is used for the grazing of cattle and is under a pastoral lease.
- There has been no other infrastructure on the site, apart from the original concrete water tanks.
- Water for the tanks is sourced from onsite bores and used to water the cattle.
- No fuel storage has occurred at the site, except for the mini LNG plant located in the south-eastern corner of the site.

3.1.1 Site and proposal characteristics

The Maitland SIA is largely undeveloped and has historically and is currently used for the grazing of cattle. There is a small LNG gas plant located in the south-eastern portion of the SIA which is operational. This LNG plant was constructed between 2004 and 2008.

The site comprises 4,500 ha of land and is one in a network of Strategic Industrial Areas to promote and facilitate the processing of the State's natural resources. The Maitland SIA key site characteristics are summarised in Table 7.

The Maitland SIA includes a 3 km Industry Protection Zone buffer around the site, to prevent any conflicting land uses in the immediate vicinity. Any development within the Industry Protection Zone will be inline within the permissible land uses set out in the Improvement Scheme and the development requirements detailed in the Guide Plan.

3.2 Regional environmental assessment context

Numerous environmental studies and investigations have been completed within the Maitland SIA, however the majority of these investigations were undertaken during in the early 1990's as part of the Maitland Heavy Industry Estate Public Environmental Review (AGC Woodward-Clyde Pty Ltd 1994). These investigations are generally out of date and not consistent with current EPA guidelines.

The Maitland Heavy Industry Estate Public Environmental Review was reviewed by the EPA and formed the basis of the EPA Bulletin 855 Section 16(e) advice to the Minister for the Environment. Key studies used in the Maitland Heavy Industry Estate Public Environmental Review include:

- Mattiske & Associates 1994. Pilbara Heavy Industry Sites Study - Flora, Vegetation and Fauna Preliminary Appraisal.
- Mattiske Consulting Pty Ltd 1994. Karratha Heavy Industry Site, Study - Flora, Vegetation and Vertebrate Fauna.

The EPA in Bulletin 855 (1997) identified the following key environmental factors applicable to the Maitland SIA development:

- mangroves
- marine fauna
- threatened and priority fauna
- terrestrial vegetation and flora
- terrestrial fauna
- air quality
- greenhouse gases
- dust and particulate
- noise and vibration
- surface water, marine water and sediment quality
- turbidity
- liquid and solid wastes
- public health and safety
- cultural surroundings.

The EPA made four recommendations for management of the Maitland SIA and identified further studies. If these measures were implemented, and subject to study results the implementation of the industrial estate is capable of being managed so not to compromise the EPA's objectives. This Section 16(e) advice is strategic advice only and does not place any environmental obligations or conditions on the Maitland SIA.

3.2.1 AECOM environmental due diligence – Maitland Industrial Estate

In 2013 AECOM undertook a Level 1 flora and fauna survey and preliminary site investigation to bring the baseline data for the Maitland SIA to present requirements to evaluate the need for further investigations to support the preparation of approval documentation to permit development to occur on the site.

The AECOM report reviews the existing data and investigations from the 1990s and considers whether developing the land at the Maitland SIA has the potential to have a significant impact on the environmental values of the area. The AECOM report also discusses the future referral of the Maitland SIA to the EPA under Part IV of the EP Act or to the Department of Environment and Energy (DEE) under the EPBC Act.

A summary of the environmental assessment undertaken across the Maitland SIA area are summarised in Table 8.

Table 8 Summary of assessments within the Maitland SIA

Report	Summary
AGC Woodward-Clyde Pty Ltd. 1994. Maitland Heavy Industry Estate Public Environmental Review. Prepared for LandCorp and Department of Resources Development.	This report is a technical review of the proposed estate development, incorporating input from the public consultation process. The report outlines both key issues and potential impacts.
Prangley, C.J. 1994, Results of Drilling Investigations at the Proposed Heavy Industry Site Karratha, Western Australia, Geological Survey, Perth	This report presents the results of a drilling program carried out in August 1994 within the study area to determine the underlying geology and the potential for groundwater contamination to occur as a result of industrial activities at the site.

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Mattiske Consulting Pty Ltd. 1994. <i>Karratha Heavy Industry Site Study – Flora, Vegetation and Vertebrate Fauna</i> . Prepared for AGC Woodward-Clyde Pty Ltd	This survey was undertaken in 1994. The methods used are consistent with what is currently referred to as Level 1 assessment under EPA Guidance Statement 51 (EPA 2004)
EPA. 1997. Maitland Heavy Industrial Estate, Karratha (Bulletin 855).	Recommends protection of the estate from stormwater from the Maitland River and prevention of industrial run-off water entering the Maitland River.
Vinnicombe PJ 1997. Maitland Heavy Industry Estate - Aboriginal Heritage Survey. Prepared for the Department of Resources Development/LandCorp	This report is a detailed Aboriginal Heritage Survey of the Burrup Peninsula and associated islands of the Dampier Archipelago. Maitland is considered in this report.
Astron. 2002. The Maitland Heavy Industrial Estate – Assessment and Comparison with the Burrup Peninsula Industrial Estate. Prepared for the Shire of Roebourne	This report is a literature survey and costing exercise for the study area. The report briefly summarises the environmental aspects within the study area and compares the area with the Burrup Industrial Estate
Appleyard, S.J. 1993, Hydrogeological Assessment of a Proposed Heavy Industry Site Near Karratha, WA, Geological Survey, Perth	This report summarises and analyses the hydrogeological setting within the proposed study area. Information on ground water quality, depth to water table, groundwater salinity, climate, groundwater use within the area is presented.
Department of Water. 2009a. Surface water Proclamation Areas. RIWI Act. Department of Water. Government of WA.	This map indicates Surface Water Proclamation Areas within WA.
Max Van Weert 2009. Pilbara Integrated Water Supply, Pre- Feasibility Study. Prepared for Department of Water.	<p>This document is a prefeasibility study that identifies water supply integration opportunities in the Pilbara Region of Western Australia.</p> <p>This report identified a range of options for water in the Pilbara: use of water extracted by mine dewatering operations supplemental groundwater for water supply schemes development of aquifers near the coast construction of transfer pipelines from source to demand locations desalination options.</p>
BG&E 2013 Maitland Industrial Estate – Storm Surge and Flood Study. Prepared for LandCorp.	Report in preparation with a 2D 100-year ARI terrestrial flood and 20 year ARI Storm Surge model showing the site to be underwater in the worst case scenario. This report can be found appended to the DWMS for the site (RPS 2018).
AECOM 2013 Maitland Industrial Estate Environmental Due Diligence – Maitland Industrial Estate. Prepared for LandCorp.	The purpose of the environment due diligence is to describe the existing environment, describe the approvals process, make recommendations on the likely approvals required for the project and recommend further environmental studies for the development of the Maitland Industrial Estate, Karratha if and where necessary for approval. It is included in this report as Appendix A.
Department of Biodiversity, Conservation and Attractions. 2017. <i>Naturemap – Mapping Western Australia's Biodiversity Search</i> . Search created on August 2017	This is a search using DBCA's Naturemap service, providing records of not just Threatened and Rare Flora but all species recorded in the Maitland SIA.
EPBC Act Protected Matters Search Report. Report created: 18/02/2017	This is a search of Protected Matters under the EPBC Act, within the study area of Maitland.
RPS 2018. District Water Management Strategy Maitland Strategic Industrial Area. Prepared for LandCorp.	This District Water Management Strategy (DWMS) has been developed in the context of the Improvement Scheme process to not only addresses the objectives of Better Urban Water Management and demonstrate that the area is capable of

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	supporting future development with respect to water related constraints, but also to inform the water management detail required by each proponent at subdivision stage. The report identifies the planning and environment context of the subject site, and outlines the key water servicing, drainage and environmental management considerations to be progressed in support of subsequent design development and planning approval phases.
MP Rogers & Associates (MRA). 2017. Coastal Hazard Study. Prepared for LandCorp.	This report was prepared to inform the engineering and planning works for development within the Maitland Industrial Estate. This report can be found appended to the DWMS for the site (RPS 2018) and the CHRMAP (MRA 2018; Appendix B).
MRA. 2018. Maitland Strategic Industrial Area CHRMAP. Report prepared for LandCorp.	This CHRMAP has been developed to inform the Scheme Report (and will be appended to the Scheme Report). Developed in this report is a risk-based adaptation framework targeted towards for a subset of potential industrial land uses. This is informed by the results of the Coastal Hazard Study (MRA 2017). It will also act as a guideline for future CHMPs when individual lots are developed. It is included in this report as Appendix B.
GHD. 2017. Ground and Surface Water Monitoring. Prepared for LandCorp.	This report was prepared to inform the engineering and planning works for development within the Maitland Industrial Estate. This report can be found appended to the DWMS for the site (RPS 2018).

3.3 Consultation with DWER

Representations from LandCorp and the Department of Jobs, Tourism, Science and Innovation (JTISI) met with the then Office of the EPA (OEPA), (now DWER) in February 2017. At our meeting the ecological investigations undertaken to date for the project area was discussed, and if they are satisfactory in terms of providing the EPA with sufficient information to set a level of assessment for the project, given that an Improvement Scheme will be introduced. More specifically, whether targeted or full Level 2 flora, vegetation and fauna studies are required at this time.

After the meeting, the OEPA was provided with a letter report which overviewed the Maitland SIA project, together with summary of ecological investigations undertaken to date.

In March 2017, the OEPA advised:

- They had reviewed the letter report and considered the information provided as sufficient for the EPA to make a determination under S48A of the EP Act when the Improvement Scheme is referred. No further technical site investigations were considered to be required.

It recommended that the Improvement Scheme Text, Guide Plan and Scheme Report adequately address potential impacts to identified environmental factors and take into account the unknown nature and size of future industries that may be located within the Maitland SIA.

4 Legislative framework

4.1 State legislation

4.1.1 *Environmental Protection Act 1986 (EP Act)*

The EP Act is the key legislative tool for environmental protection in Western Australia. The EPA undertakes the EIA of some proposals and schemes referred to it under Part IV of the EP Act. EIA is a systematic and orderly evaluation of a proposal and its impact on the environment. The assessment includes considering ways in which the proposal, if implemented, could avoid or reduce any impact on the environment.

The EP Act is administered by the EPA and the Minister for the Environment.

The Maitland Improvement Scheme will be referred and assessed by the EPA in accordance with Section 48 of the EP Act and the Planning and Development Act 2005 (PD Act).

Proponents of industrial developments will require a separate referral assessment by the EPA under Section 38 of the EP Act. These industrial developments may require specific assessment of environmental factors such as air quality, human health, noise and separation distances.

Industrial premises have the potential to pollute or otherwise impact on the quality of our air, land or water. The DWER is responsible for regulating industrial emissions and discharges to the environment through a works approval and licensing process.

The DWER has responsibility under Part V of the EP Act for the licensing and registration of prescribed premises, the issuing of works approvals and administration of a range of regulations. The DWER also monitors and audits compliance with works approvals, licence conditions and regulations.

4.1.2 *Relevant legislation and regulations*

The proposed Maitland SIA will be required to comply with the requirements of other relevant state legislation and regulations. Table 9 provides a summary of the key State legislation and regulations relevant to the future industrial development.

Table 9 Key state legislation

Key Legislation	Responsible government agency	Aspect
<i>Aboriginal Heritage Act 1972</i>	Department of Planning, Lands and Heritage	Archaeological and ethnographic heritage
<i>Aboriginal Heritage Regulations 1974</i>	Department of Planning, Lands and Heritage	Archaeological and ethnographic heritage
<i>Agricultural and Related Resources Protection Act 1976</i>	Department of Primary Industries and Regional Development	Weeds and feral animals
<i>Biodiversity Conservation Act 2016</i> <i>Wildlife Conservation Act 1950</i>	Department of Biodiversity, Conservation and Attractions	Wildlife conservation and protection
<i>Bush Fires Act 1954</i>	Department of Fires and Emergency Services	Bush fire control
<i>Conservation and Land Management Act 1984</i>	<ul style="list-style-type: none"> Department of Biodiversity, Conservation and Attractions Department of Primary Industries and Regional Development 	Flora and fauna / habitat / weeds / pests / diseases

Key Legislation	Responsible government agency	Aspect
Conservation and Land Management Regulations 2002	<ul style="list-style-type: none"> Department of Biodiversity, Conservation and Attractions Department of Primary Industries and Regional Development 	Flora and fauna / habitat / weeds / pests / diseases
<i>Contaminated Sites Act 2003</i>	Department of Water and Environmental Regulation	Management of contaminated soils and water
<i>Environmental Protection Act 1986</i> - Air Quality	<ul style="list-style-type: none"> Environmental Protection Authority Department of Water and Environmental Regulation 	Under Part V of the EP Act air pollution or emission requires to be: <ul style="list-style-type: none"> permitted under a “works approval” or “licence” as a result of an emergency or other exempt activity; or permitted under an approval granted by the Minister for the Environment.
<i>Environmental Protection Act 1986</i>	<ul style="list-style-type: none"> Environmental Protection Authority Department of Water and Environmental Regulation 	<ul style="list-style-type: none"> Part IV – Environmental Impact Assessment Part V – Works Approvals and Licences
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	Department of Water and Environmental Regulation	Clearing of native vegetation
<i>Planning and Development Act 2005</i>	Department of Planning, Lands and Heritage	Structure planning and subdivision approval
<i>Rights in Water and Irrigation Act 1914</i>	Department of Water and Environmental Regulation	<ul style="list-style-type: none"> Governs management of the use, service and health of water and watercourses (including beds and banks). Water licensing is required in all proclaimed areas and for all artesian groundwater wells throughout the state.

Source: Water and River Commission 2001

4.1.3 Relevant Standards, Guidelines and Policies

The Maitland SIA is subject to compliance with applicable standards and guidelines developed by the EPA to assist proponents and the public to understand the minimum requirements for the protection of elements of the environment that the EPA expects to be met during the assessment process. The following Table 10 details the key EPA standards, guidelines and state planning policies relevant to future industrial development.

4.2 Commonwealth legislation

4.2.1 *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

The EPBC Act protects MNES and is administered by the Commonwealth Minister of the Environment. If an action is likely to have a significant impact on any MNES a referral to DEE is required.

MNES that relate to the project study area are listed Threatened species and Migratory species protected under international agreements. In the EPBC Act Protected Matters Search 16 MNES species were recorded as potentially occurring within the study area. Of the species listed only six have the potential to occur in the study area as marine species have been omitted because the study area is restricted to land.

Table 10 Relevant EPA standards, guidelines and state planning policies

Document	Description
EPA Guidance	
Statement of Environmental Principles, Factors and Objectives (EPA 2016)	Referred to in the identification and assessment of Preliminary Key Environmental Factors
Sea	
Environmental Factor Guideline – Benthic Communities and Habitats (EPA 2016d) Technical Guidance – Protection of Benthic Communities and Habitat (EPA, 2016).	This guidance was consulted in the consideration of potential impacts to Benthic Communities and Habitat (BCH) (mangroves) and in the development of options to avoid or mitigate impacts though the SPP 2.6 Coastal Planning Policy.
EPA 2016, Environmental Factor Guideline – Coastal Processes, EPA, Western Australia.	This guidance was consulted in the consideration of potential impacts to geophysical processes and how these may impact natural coastal dynamics causing an impact to coastal ecosystems and associated values such as landforms.
EPA 2016, Environmental Factor Guideline – Marine Fauna, EPA, Western Australia.	This guidance was consulted in the consideration of potential impacts on marine fauna / shorebirds as a result of the construction and operation of heavy industries and associated infrastructure within the Maitland SIA
EPA 2016, Environmental Factor Guideline: Marine Environmental Quality, EPA, Western Australia. Technical Guidance – Protecting the quality of Western Australia’s marine environment (EPA, 2016).	Referred to in the assessment of potential impacts to marine water quality as a result of the construction and operation of heavy industries and associated infrastructure within the Maitland SIA
Land	
EPA 2016, Environmental Factor Guideline: Flora and Vegetation, EPA, Western Australia Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016)	Referred to in the assessment of potential impacts as a result of the construction and operation of heavy industries and associated infrastructure within the Maitland SIA
EPA 2016, Environmental Factor Guideline: Terrestrial Fauna, EPA, Western Australia. Technical Guidance - Sampling methods for terrestrial vertebrate fauna	Referred to in the assessment of potential impacts as a result of the construction and operation of heavy industries and associated infrastructure within the Maitland SIA

Document	Description
Water	
EPA 2016, Environmental Factor Guideline – Hydrological Processes, EPA, Western Australia.	This guidance was consulted in the consideration (as part of the DWMS) of the environmental values dependent upon the current surface water and groundwater regimes and the potential impacts on hydrological processes.
EPA 2016, Environmental Factor Guideline - Inland Waters Environmental, Quality EPA, Western Australia.	
Air	
EPA 2016, Environmental Factor Guideline - Air Quality, EPA, Western Australia.	
People	
EPA 2016, Environmental Factor Guideline - Human Health, EPA, Western Australia.	Referred to in the assessment of potential impacts as a result of the construction and operation of heavy industries and associated infrastructure within the Maitland SIA
EPA 2016, Environmental Factor Guideline: Social Surroundings, EPA, Western Australia.	
Other Guidance	
Environmental Assessment Guideline No. 5: <i>Protecting Marine Turtles from Light Impacts</i> (EPA 2010)	Sets out guidance on an array of approaches available for avoiding, reducing, managing and mitigating light impacts on marine turtles to be considered when preparing documentation relevant to the EIA process and during the implementation of proposals or planning schemes. Provides alternative methods for the avoidance and management of light impacts that can be applied using a risk-based approach and by applying best practice methods.
Guidance Statement No. 3: <i>Separation Distances between Industrial and Sensitive Land Uses</i> (EPA 2005)	Provides advice on the use of generic separation distances (buffers) between industrial and sensitive land uses to avoid conflicts between incompatible land uses.
Guidance Statement No. 6: <i>Rehabilitation of Terrestrial Ecosystems</i> (EPA 2006)	Provides guidance to ensure the return of biodiversity in rehabilitated areas by increasing the quality, uniformity, and efficiency of standards and processes for rehabilitation of native vegetation in Western Australia and to allow more effective monitoring and auditing of outcomes.
Guidance Statement No. 12: <i>Guidance Statement for Minimising Greenhouse Gas Emissions</i> (EPA 2002)	Addresses the minimisation of greenhouse gas emissions from significant new or expanding operations.

Document	Description
State planning policies	
State Planning Policy 2.6: <i>State Coastal Planning Policy</i> (WAPC 2006a)	Provides guidance for decision-making within the coastal zone including managing development and land use change; establishment of foreshore reserves; and to protect, conserve and enhance coastal values.
State Planning Policy 2.9: <i>Water Resources</i> (WAPC 2006b)	Provides clarification and additional guidance to planning decision-makers for consideration of water resources in land use planning strategy.
State Planning Policy 3.7 (Draft): <i>Planning for Bushfire Risk Management</i> (WAPC 2014)	Assist in reducing the risk of bushfire to people, property and infrastructure by taking a risk minimisation approach to development proposed in bushfire-prone areas.
State Planning Policy 4.1 (Draft): <i>State Industrial Buffer (Amended)</i> (WAPC 2009a)	The policy applies state wide, to planning decision-making, and proposals which seek to provide for new industrial areas and uses, and essential infrastructure, sensitive land uses in proximity to existing industrial areas.
State Planning Policy 5.4: <i>Road and Rail Transport Noise and Freight Considerations in Land Use Planning</i> (WAPC 2009b)	The policy aims to promote a system in which sustainable land use and transport are mutually compatible.

5 Land use and planning context

5.1 Maitland SIA regional overview

The Maitland SIA is located within 24 km of the Karratha town site. The location of the Maitland SIA and Improvement Scheme in relation to the surrounding environment is depicted within Figure A.

AGC Woodward-Clyde Pty Ltd prepared a Public Environmental Review (PER) in 1994 for the site and an associated marine area intended to be utilised as a port. This EAR excludes the marine component and concentrates on the mainland industrial estate area.

5.2 Existing land use zoning

Under the Shire of Roebourne's (now the City of Karratha) Town Planning Scheme No. 8 (TPS No. 8), the Maitland SIA is zoned as "Strategic Industry" (Figure C).

TPS No. 8 will no longer apply to the Maitland SIA once the Improvement Scheme takes effect. The proposed Improvement Scheme framework is outlined in the below section.

5.2.1 Future industrial proponent buffers within the Maitland Strategic Industrial Area

The nature, size and environmental impacts of future industrial developments is unknown, any future industrial proposals within the Maitland SIA will need to be referred to the EPA under section 38 of the EP Act.

Within the Maitland SIA, in particular the Strategic Industry Zone, each industrial proposal will need to assess and accommodate its own buffer within its leasehold in accordance with the EPA's recommended separation distances. For heavy industrial proposals (e.g. ammonia processing plant) within the Strategic Industry Area a specific environmental assessment for example of air quality, noise and human health risk will need to be undertaken in consultation with the EPA as part of a separate referral and assessment under Section 38 of the EP Act. This assessment would also delineate separation distances between industrial developments within the Maitland Industrial Estate.

Table 11 provides a general guide to the EPA's recommended separation distances.

Table 11 EPA recommended buffer distances between industrial and sensitive land uses (EPA 2005)

Land Use	EPA recommended separation
Ammonium nitrate import/export	Case by case
Chemical blending	300 m – 500 m (dependent on size and type of chemicals involved)
Fuel storage	300 m – 500 m (dependent on type of fuel stored and size)
Electrical power generation	3,000 m – 5,000 m (dependent on location and size)
Wastewater treatment	Buffer studies are in progress to determine appropriate separation distances

5.3 Additional environmental legislation applicable to the heavy industrial projects within the Maitland SIA

There are several environmental provisions under Part V of the EP Act, including pollution and environmental harm offences and prescribed premises, works approvals and licences, notices, orders and directions and noise provisions, in addition to the Environmental Protection (Noise) Regulations 1997. These additional environmental provisions, which will be applicable to heavy industries within the Maitland SIA, are outlined below.

5.3.1 Works approval

In addition to:

1. The Maitland SIA Scheme Text and Guide Plan – environmental requirements
2. A Section 38 referral under the EP Act and assessment by the EPA for each specific heavy industry seeking to develop in the Maitland SIA.

“Heavy” industries with significant potential to cause emissions and discharges to air, land or water (for example chemical manufacturing, electric power generation bulk storage of chemicals, processing/beneficiation of metallic or non-metallic ore) will require licencing under Part V of the EP Act.

Heavy industries which are known to generate emissions or waste are known as “prescribed premises” and therefore trigger regulation Works Approvals and licences issued by the DWER. Depending on the expected industries expected at the site it will likely be classified under, but may not be limited to, the following prescribed premises:

- Category 5 Processing or beneficiation of metallic or non-metallic ore
- Category 12 Screening, etc. of material
- Category 52 Electric power generation
- Category 73 Bulk storage of chemicals.

The Works Approval and Licences typically have operational conditions that apply to each specific premise and are intended to prevent or minimise the emissions and discharges of waste to the environment.

5.3.2 Licence (operating)

A Works Approval is effectively an authorisation to construct the project but does not permit it to operate if there are any associated emissions of waste, noise, odour or electromagnetic radiation to the environment. If a works approval is required, then a Part V licence may be required to permit and control any associated emissions to the environment.

If the project is a “prescribed premise”, a licence is required to permit that emission. The licences can carry conditions relating to the levels of the emissions and requiring monitoring and reporting. Such licences are only required to enable operation of the facility and are not a pre-requisite to commence construction.

Works Approval(s) and Licence(s) will be required when individual heavy industrial development approval is sought. This is an additional environmental management requirement separate to the environmental measures defined in the Maitland SIA Scheme text and Guide Plan.

5.4 Improvement scheme

In order to facilitate future industrial development, the state government has determined that an Improvement Scheme is the most appropriate planning instrument to govern the development of the Maitland SIA. Furthermore, an Improvement Scheme is administered by the state where as Local Planning Schemes are administered by local government.

The arrangements for Improvement Schemes are different to Local Planning Schemes administered by local government. A key difference is the requirement for an Improvement Plan to first be prepared, and for that Improvement Plan to provide for the preparation of an Improvement Scheme.

A simple comparison between the general arrangements of ordinary Local Planning Schemes and the proposed Improvement Scheme is illustrated below (Figure 1).

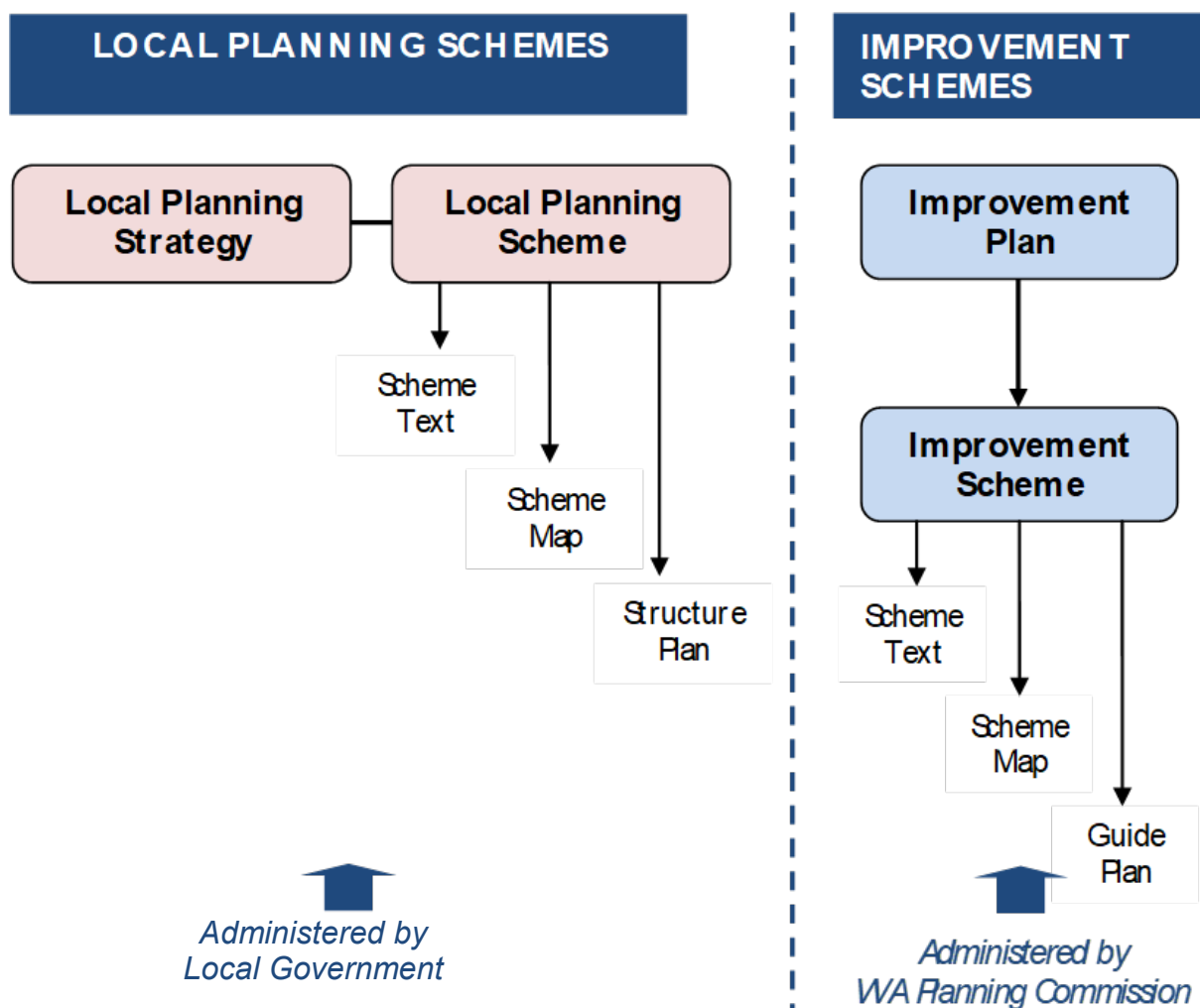


Figure 1 Flowchart of local planning schemes and improvement schemes

The Improvement Plan and Improvement Scheme arrangement differs from ordinary planning practices associated with a Local Planning Schemes in that they are regulated by the WAPC and are tailored to suit the circumstances of the project area. The role of the plan/scheme relationship is summarised.

5.4.1 Improvement plan

Improvement Plans are “strategic instruments” used by the WAPC to facilitate the development of land in areas identified as requiring special planning. An Improvement Plan authorises the making of an Improvement Scheme and sets out the area and objectives of that Improvement Scheme.

5.4.2 Improvement scheme

Improvement Schemes are “statutory instruments” used by the WAPC to control development within an Improvement Plan area. An Improvement Scheme removes land from the Local Planning Scheme. As such,

the City of Karratha's Local Planning Scheme would not have effect once the Improvement Scheme comes into effect.

Figure B presents the Improvement Scheme Map, which depicts the scheme boundary and the following two zones:

- Strategic Industry
- Industry Protection.

The draft Scheme Map is provided in Figure 2

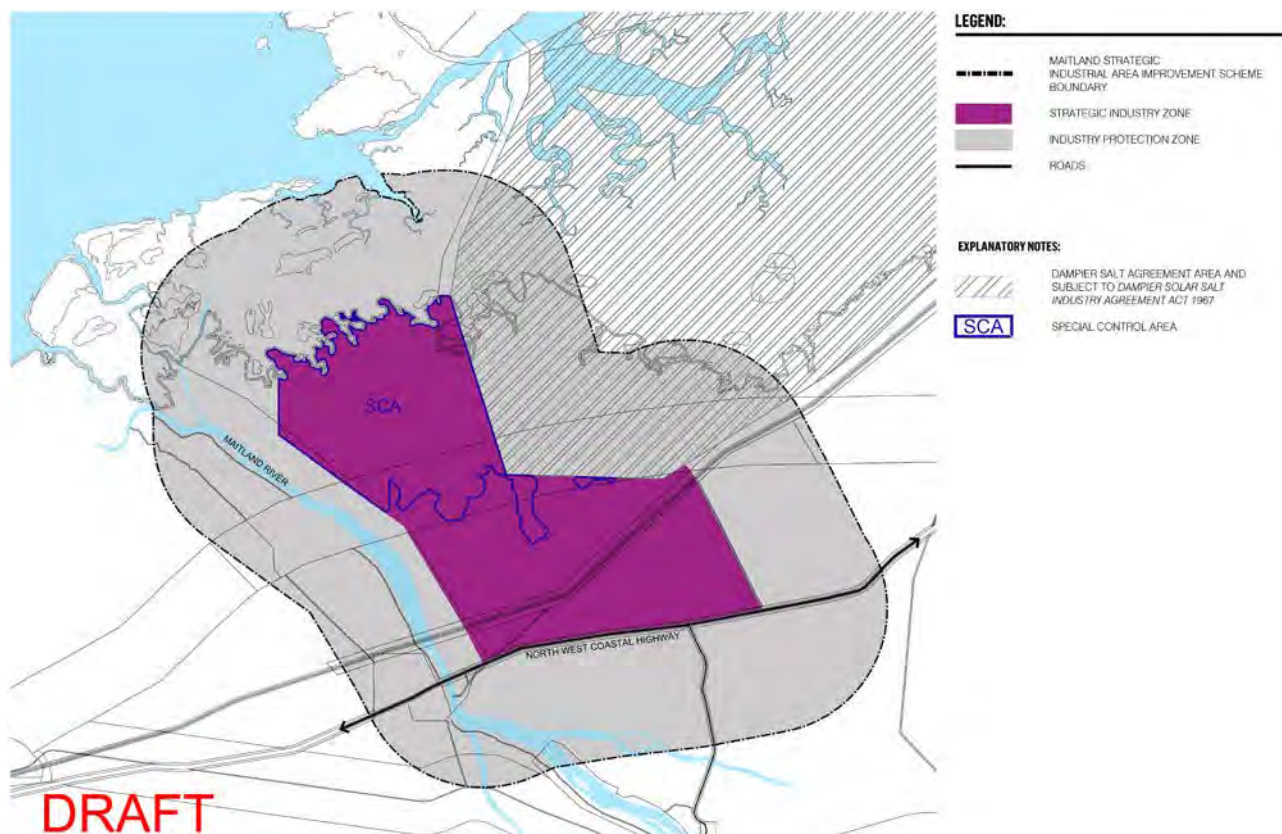


Figure 2 Improvement scheme map - draft

5.4.3 Improvement plan No. 44

Improvement Plan No. 44 was prepared under Section 119 of the PD Act to advance planning for the Maitland SIA. The purpose of the Improvement Plan is to:

- Enable the WAPC to undertake all steps to advance the planning and development of the Maitland SIA as provided for under Part 8 of the PD Act.
- Establish the strategic planning and development intent for the Maitland SIA.
- Provide for a strategic planning framework endorsed by the WAPC, Minister for Planning and Governor.
- Authorise the preparation of an Improvement Scheme for the Maitland SIA.
- Provide the objectives of the Improvement Scheme.
- Provide guidance to the preparation of statutory plans, statutory referral documentation and policy instruments.

The Maitland SIA boundary is provided in Figure B and the Improvement Plan boundary is provided in Figure 3.

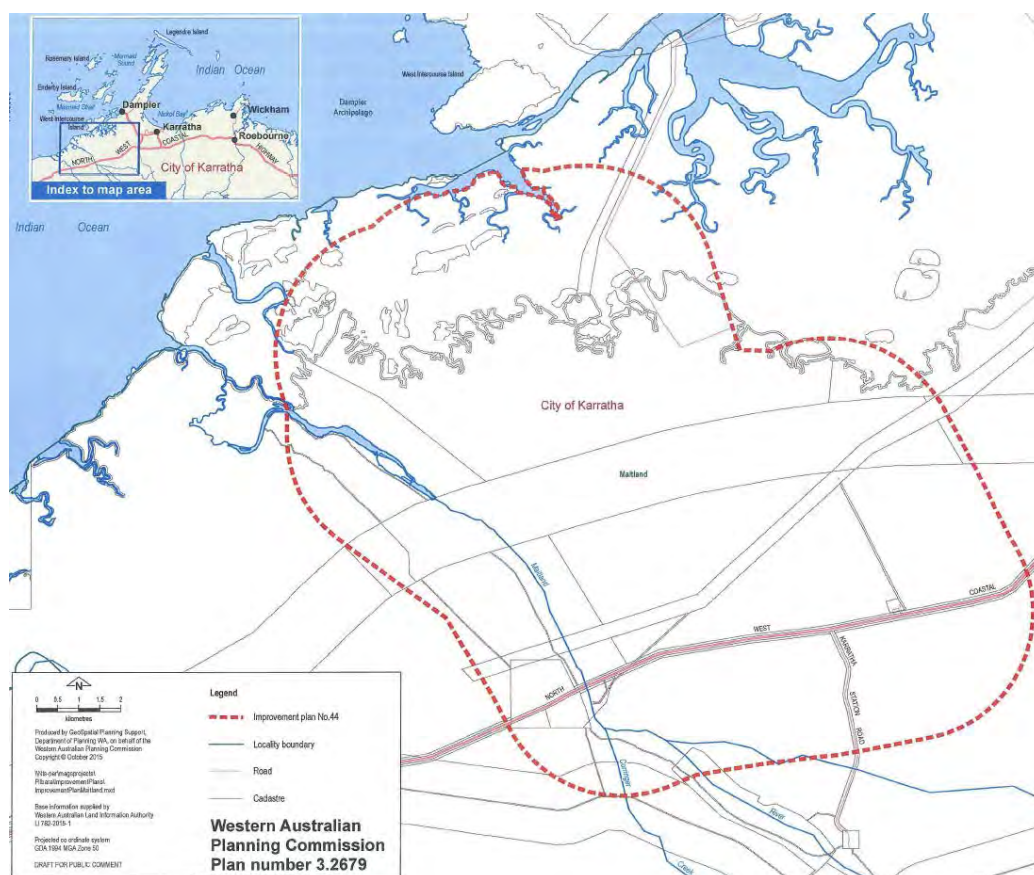


Figure 3 Maitland SIA improvement plan

5.5 Improvement scheme structure

The Improvement Scheme is the principal planning instrument, providing the statutory control of land use and development. An Improvement Scheme may provide for all matters ordinarily addressed by a local government Local Planning Scheme. Significantly, an Improvement Scheme is not obligated to conform to model scheme provisions set out within Town Planning Regulations 1967. An Improvement Scheme should be fit-for-purpose. That is, it should respond to the specific planning requirements as they apply to the area subject to the Improvement Plan.

While the PD Act allows broad discretion over the form and content of an Improvement Scheme, arrangements are proposed that will as far as relevant, correspond with model scheme provisions. In this regard, the proposed Scheme structure recognises the familiar report, text and map, with the addition of Guide Plan provisions as follows:

- **Scheme Report:** Comparable to a Local Planning Strategy, the report will set out the strategic purposes and basis of Scheme provisions.
- **Scheme Text:** The range of statutory provisions necessary to effectively achieve the project objectives.
- **Scheme Map:** Spatial definition of land zones and reserves as required.
- **Guide Plan:** In view of the circumstances associated with Maitland, the Improvement Scheme proposes a Guide Plan in lieu of a Local Structure Plan (or Development Plan), with the provisions of a Guide Plan specified by the Scheme itself. In this way, the further investigations, detailed designs and management plans can be undertaken in association with applications for subdivision.

The relationship between the components of the Improvement Scheme is illustrated in Figure 4.

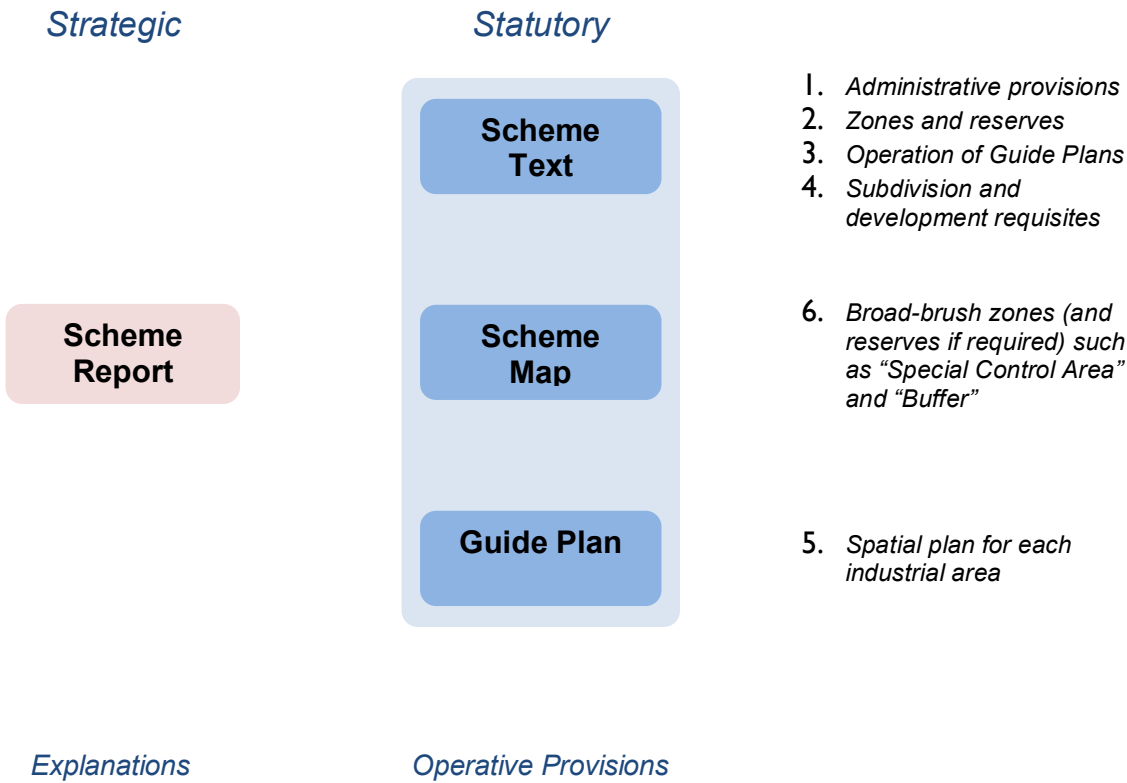


Figure 4 Improvement scheme arrangements

6 Statutory framework

6.1 Improvement scheme

The WAPC will be the responsible authority for implementing the Improvement Scheme and will also be responsible for the Guide Plan and Planning Policies prepared under the terms of the Scheme. The WAPC's primary role will be to receive, assess and determine applications for planning approval within the Maitland SIA.

The Improvement Scheme gives statutory effect to the objects and intentions set out within the Improvement Plan by:

- establishing zones and reserves along with associated land use permissibility's within those zones
- establishing criteria for the assessment of industrial synergy
- providing guidance for land subdivision
- establishing site and development requirements
- stipulating environmental management requirements
- providing for further planning instruments to guide decision-making.

Additionally, to provide further guidance on any planning or development related matters within the Maitland SIA, the Improvement Scheme enables the WAPC to establish Planning Policies.

6.2 Guide plan

The Guide Plan is intended to guide the development in terms of spatial layout, criteria and considerations to be taken into account as part of the development of the site, and to provide guidance to the WAPC for the assessment and determination of development applications.

The Guide Plan includes an outline of the criteria and considerations to be addressed by proponents, specific to each of the zones, in preparing applications for planning approval.

In providing a head of power for the specific management plans outlined within the Guide Plan, the provisions under "Management Plans" allows for the preparation of environmental management plans.

Future Industrial Developments within the Strategic Industry Zone will be subject to the environmental Scheme Provisions set out in the Table 12.

The following specific requirements of the environmental management plans are proposed to be included within the Guide Plan.

Table 12 Maitland development requirements – improvement scheme and guide plan

Zone	Improvement scheme (part 4 of text)	Guide plan (to be appended to scheme text)
Strategic Industry	If applicable, scheme text is to set out environmental conditions applicable to the scheme as a result of an assessment carried out under the <i>Environmental Protection Act 1986</i> Part IV Division 3. If no environmental conditions apply, the scheme text will state, "There are no environmental conditions imposed under the <i>Environmental Protection Act 1986</i> that apply to this Scheme".	<p>Development shall be in accordance with the following management plans (as relevant):</p> <ul style="list-style-type: none"> • Construction Environmental Management Plan • Marine Turtle Baseline Lighting Study and Design Guidelines (if required) • Terrestrial Flora and Vegetation Management Plan • Terrestrial Fauna Management Plan (in particular northern quoll) • Terrestrial Weed Management Plan • Water Management Plan • Acid Sulfate Soil and Dewatering Management Plan (if required) • Bushfire Management Plan • Noise and Air Quality Management Plan* • Coastal Hazard Risk Management Adaptation Plan

*Due regard shall be given to:

(a) Any applicable operating licence granted under Part 5 of the EP Act.

(b) Any previous advice provided by the Environmental Protection Authority as a result of Section 38 and 48 Referrals.

6.2.1 Construction environmental management plan

The objectives of a Construction Environmental Management Plan is to minimise potential impacts on surface water hydrology, soils and geomorphology, vegetation and fauna outside the clearing area and species of ethno-biological significance outside the clearing areas. The plans will also address dust emissions (air quality) during the construction phase. Plans are expected to address:

- schedule of construction activities.
- details of the construction methods to be used.
- objectives and targets.
- environmental management.
- environmental training and inductions.
- environmental monitoring, contingencies and reporting, and stakeholder consultation.

Applications for planning approval within the Strategic Industry Zone are required to be supported by a Construction Environmental Management Plan, addressing matters relevant to the nature of the particular proposal, as required by the Guide Plan.

The plan is to be submitted to the WAPC for approval (on advice from the Department of Biodiversity, Conservation and Attractions (DBCA) and DWER in accordance with the Guide Plan.

6.2.2 Marine turtle baseline lighting study and design guidelines (if required)

The objective of the Marine Turtle Baseline Lighting Study is to inform the expected cumulative lighting impacts from future industrial development, within the Strategic Industry Zone, upon marine turtles potentially nesting on Maitland sandy beach.

Applications for planning approval within the Strategic Industry zone are required to be supported by a Marine Turtle Baseline Lighting Study if it is likely that a significant impact will occur on the marine turtles. The study will be undertaken in accordance with EPA Environmental Assessment Guidance No. 5: Protecting Marine Turtles from Light Impacts (EPA 2010).

Should the Marine Turtle Baseline Lighting Study predict potential significant impacts from lighting on marine turtles from development, then the preparation and implementation of Design Guidelines for reducing light emissions will be required.

6.2.3 Terrestrial flora and vegetation management plan

The objective of a Terrestrial Flora and Vegetation Management Plan is to minimise potential impacts to conservation significant flora and vegetation as a result of developing areas within the Maitland SIA, and to mitigate impacts through flora and vegetation management strategies in conjunction with weed control and quarantine measures.

The management plan is expected to address:

- objectives, targets and associated monitoring.
- pre-clearing searches for conservation significant species.
- management actions.
- monitoring, contingencies and reporting.

Applications for planning approval within the Strategic Industry Zone are required to be supported by a Terrestrial Flora and Vegetation Management Plan, addressing matters relevant to the nature of the particular proposal, as required by the Guide Plan.

The plan is to be submitted to the WAPC for approval (on advice from the DBCA) in accordance with the Guide Plan.

6.2.4 Terrestrial fauna management plan

The objective of a Terrestrial Fauna Management Plan is to minimise potential impacts to conservation significant fauna as a result of developing areas within the Maitland SIA, and to mitigate impacts through the fauna management strategies in conjunction with weed control and quarantine measures.

The management plan is expected to address:

- objectives, targets and associated monitoring.
- pre-clearing searches for conservation significant fauna and feral species.
- management actions for native fauna and feral pests.
- monitoring, contingencies and reporting.

Applications for planning approval within the Strategic Industry Zone are required to be supported by a Terrestrial Fauna Management Plan, addressing matters relevant to the nature of the particular proposal, as required by the Guide Plan.

The plan is to be submitted to the WAPC for approval (on advice from the DBCA) in accordance with the Guide Plan.

6.2.5 Terrestrial weed management plan

The objective of a Terrestrial Weed Management Plan is to address issues around management of fragmentation and edge effects, and annual reporting on success of the control program.

The Terrestrial Weed Management Plan will address the following:

- objectives, targets and associated monitoring for weeds
- pre-clearing searches for weed(s) species

- management actions including addressing the risk of introducing weeds
- monitoring, contingencies and reporting.

The plan is to be submitted to the WAPC for approval (on advice from the DBCA) in accordance with the Guide Plan.

6.2.6 Water management plan

The objective of the Water Management Plan is to minimise potential impacts on natural ecosystems relying on pre-development hydrological regimes and prevent unacceptable flooding.

Applications for planning approval within the Strategic Industry Zone are required to be supported by a Water Management Plan as required by the Guide Plan.

The plan is to be submitted to the WAPC for approval (on advice from the DWER) in accordance with the Guide Plan.

6.2.7 Acid sulfate soil and dewatering management plan (if required)

The objectives of an Acid Sulfate Soil Management Plan will be to adequately identify “actual” and “potential” acid sulfate soils and determine appropriate management strategies and construction practices to be followed to ensure effective handling, treatment and disposal of acid sulfate soils and produced water.

Applications for planning approval within the Strategic Industry Zone are required to be supported by an Acid Sulfate Soil and Dewatering Management Plan as required by the Guide Plan.

The plan is to be submitted to the WAPC for approval (on advice from the DWER) in accordance with the Guide Plan.

6.2.8 Bushfire management plan

Proponents within the Strategic Industry Zone will require a Bushfire Management Plan in association with applications for planning approval. The strategies/plans are to be prepared to the satisfaction of the WAPC having regard for advice from the Department of Fire and Emergency Services (DFES). In this regard, proponents will reference the bush fire protection guidelines jointly prepared by the WAPC, DPLH and the Fire and Emergency Services Authority.

The plan will address:

- objectives, targets and associated monitoring
- roles and responsibilities of personnel
- risk assessment of proposed activities and associated siting and design responses that minimise exposure to hazards
- emergency service access to potential fire sources
- fire response equipment that will be available
- fire risk reduction and management measures.

The plan is to be submitted to the WAPC for approval (on advice from the DFES) in accordance with the Guide Plan.

6.2.9 Noise and air quality management plan

The objective of a Noise and Air Quality Management Plan is to detail the relevant air quality and noise and vibration impact assessment criteria, best practice management and compliance checking procedures for subsequent reporting. Where a proposal is deemed a “prescribed premises” under the EP Act, the Noise and Air Quality Management Plan will reference the DWER licensing and works approval requirements.

The management plan is expected to address:

- Identify the sources of air quality, noise and vibration emissions as a result of implementing the industrial development proposal.
- Qualify the air quality, noise and vibration emissions from the industrial development proposal.
- Identify potential sensitive receptors to air quality, noise and vibration emissions.
- Provide objective, targets and associated monitoring for the project.

Applications for planning approval within the Maitland SIA area are required to be supported by a Noise and Air Quality Management Plan, addressing matters relevant to the nature of the particular proposal, as required by the Guide Plan.

Applications for planning approval within the Industry area are required to be supported by a Noise and Air Quality Management Plan addressing EPA Guidance Statement No. 3 – Separation Distances between Industrial and Sensitive Land Uses (2005).

The plan is to be submitted to the WAPC for approval (on advice from the EPA and the DWER) in accordance with the Guide Plan.

6.2.10 Coastal hazard risk management adaptation plan (CHRMAP)

The objective of future proponent's site specific Coast Hazard Risk Management Adaptation Plans is to detail how proposed development of individual lots addresses the risk level and management strategies outlined in the MSIA CHRMAP.

The Maitland SIA CHRMAP, sets out the Framework for future development within the portion of Maitland impacted by a 500 year ARI event in 2117.

The plan is to be submitted to the WAPC for approval in accordance with the Guide Plan.

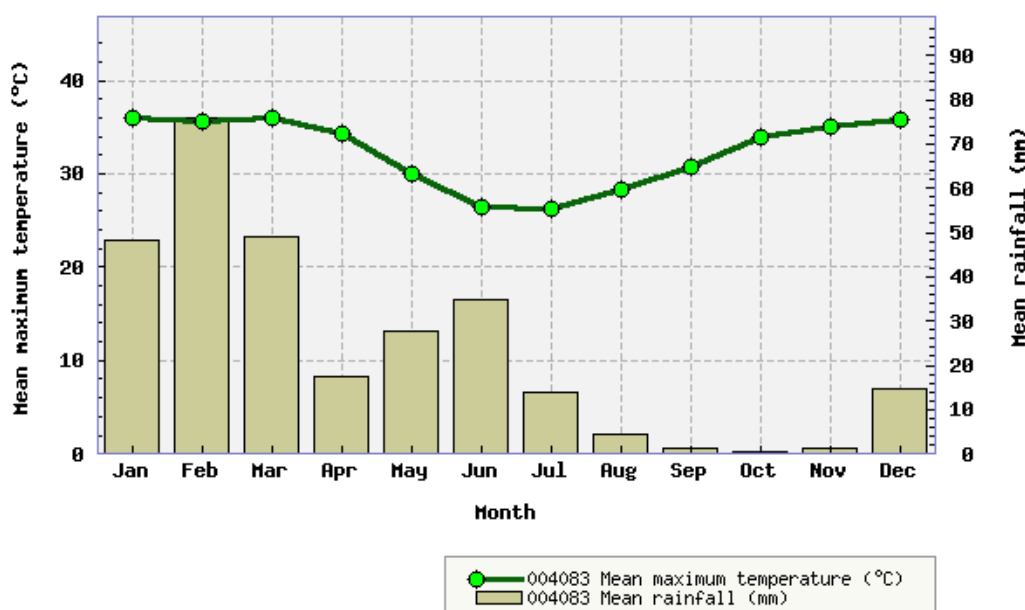
7 Maitland SIA environmental context

This section establishes the regional and local environmental context for the Maitland SIA.

7.1 Climate and weather

The Maitland SIA area experiences a hot, semi-arid climate. Summers (October to April) are very hot with average daily maximum temperatures reaching 36.1 °C. Winters are generally mild with temperatures ranging from average daily minimum temperatures of 13.8 °C to an average monthly maximum of 26.7 °C in July (BoM 2017).

The average annual rainfall for Karratha is 296.7 mm. Most of this rainfall occurs during the summer period, between January and March (Figure 5), from scattered thunderstorms and occasional tropical cyclones. A secondary peak in the rainfall occurs in June as a result of rainfall from tropical cloud bands.



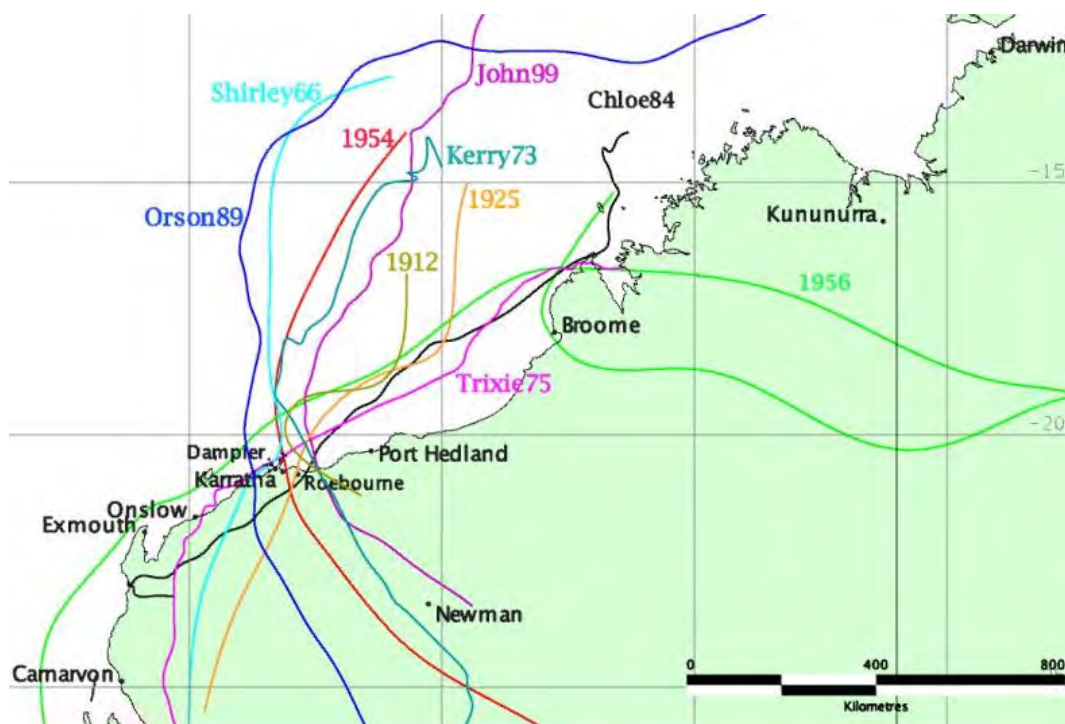
Source: BoM 2017

Figure 5 Mean rainfall for Karratha

7.1.1 Cyclones

The coastline from Port Hedland to the Exmouth Gulf is the most cyclone prone area in Australia. Since 1910 the area, which includes Karratha, Dampier and Roebourne, has been impacted by 48 cyclones that have caused damaging wind gusts in excess of 90 km/h (BoM 2013). Figure 6 shows the tracks of notable cyclones that have impacted the area.

Cyclones are most common in the Pilbara region between mid-December and April, peaking in February and March, which can result in extreme rainfall events.



(Source: BoM 2013)

Figure 6 Tracks of notable cyclones that have impacted the area

8 Sea-themed factors

The Maitland SIA is adjacent to the intertidal flats. The intertidal flats at the boundary of the Maitland SIA extend between 1.4 km and 2 km inland from the mangrove creeks and the physical coastline. North-east of the Maitland site, exists a series of salt ponds operated by Dampier Salt. No industrial development is proposed within the intertidal flats or along the coast.

In reviewing the Maitland SIA coastal and marine context the following marine habitat areas have been identified (Figure 7):

- mangrove communities
- intertidal and mudflats
- sand beaches.

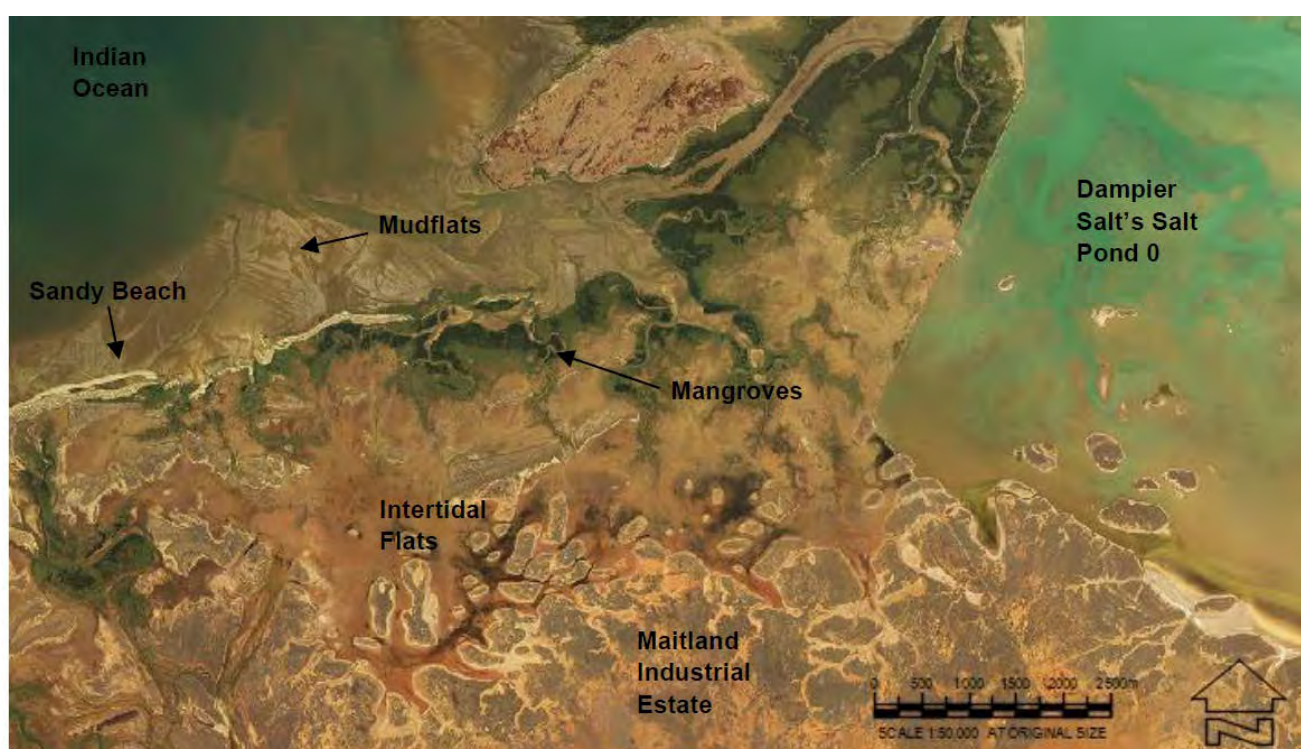


Figure 7 Maitland SIA coastal habitats

Benthic communities and habitats provide an important foundation for many ecosystem processes that underpin marine ecology. The potential impacts to benthic habitat identified relate to indirect impacts for instance from altered sediment and water flows as a result of the inland development of the Maitland SIA.

The coastal vegetation with areas of mangroves of varying density. The existing mangrove along the Maitland delta was estimated to be 2,000 ha (EPA Bulletin 855 1997). Mangrove communities are the predominant vegetation assemblages in the littoral (intertidal) zone of the study area. There are six main mangrove species present in the Maitland area (Woodward-Clyde 1994) including *Avicennia marina*, *Rhizophora stylosa*, *Bruguiera exaristata*, *Ceriops tagal*, *Aegiceras corniculatum*, and *Aegialitis annulata*.

These mangrove communities support an extensive fauna of burrowing and foraging invertebrates, whose bioturbating activities assist to make the muddy substrate conducive for mangrove growth.

8.1 Marine fauna

High conservation status species such as Turtles, Dugongs, Migratory Seabirds/ Waders and Whale Sharks all inhabit Pilbara waters. Humpback whales can traverse the Dampier coastline waters during their annual northern migration from their Antarctic feeding grounds to tropical waters between May and July, and on their return to the Antarctic between September and November. Coastal dolphin species including the Indo-Pacific humpback dolphin and the bottlenose dolphin are in the Dampier coastal region all year round.

The DBCA search results identify that flatback turtles (*Natator depressus*) may be in the Maitland coastal area, although noting nesting has not been historically recorded to occur along the Maitland coastline. However, Loggerhead, hawksbill, flatback and green turtles nest on beaches within the Dampier Archipelago. These turtles are likely to visit the waters off the Maitland coastline during breeding time.

Future industrial development within the Maitland SIA has the potential to contribute to cumulative light impacts (skyglow), to the existing night light environment, which may potentially disrupt turtle nesting. Baseline lighting studies may be required to inform the expected cumulative lighting impacts from the industrial development of the site upon marine turtles.

RPS considers the intertidal and mudflats areas and the sandy beach area would for part of foraging habitat for shorebird. RPS notes shorebirds like the Red-necked Stint or the Curlew Sandpiper would also likely use the adjacent salt works for feeding likely due to the extended availability and abundance of food sources.

A summary of the biologically important marine areas and habitat (with a focus on marine turtles) in proximity to the Maitland SIA is provided in Figure E.

8.2 Coastal processes

Storm surge and associated coastal inundation are factors that have potential to impact flood levels. Storm surge can be associated with a combination of unusually high tides, strong winds and extreme low pressure systems. Traditionally, storm surge is considered as one of the possible accompaniments to cyclones. With the study area being one of the most prone to cyclone activity in Australia, the hydraulic modelling has considered likely maximum tide elevations resulting from storm surge in determining downstream boundary conditions.

Storm surge elevations are dependent on a number of factors (including coastal bathymetry, site orientation and coastal exposure with respect to prevailing weather conditions, wind, currents, etc.) and are therefore, variable between sites. Consequently, limited storm surge prediction data is available except where site-specific studies and modelling have been undertaken.

The Bureau of Meteorology (BoM 2014) states a storm surge coinciding with a high tide in 1939 resulted in a water level of 5.7 m AHD at Port Hedland. This appears to be the highest recorded tide level in the region.

An assessment of storm surge and coastal inundation for the greater Karratha area (GEMS 2011) was undertaken as part of the Karratha Coastal Vulnerability Study (KCVS JDA et al. 2012). The modelled 100-year ARI storm surge in the KCVS is 6.2 m AHD which is slightly higher than the maximum recorded storm surge for the region (5.7 m AHD at Port Hedland in 1939). The KCVS estimated the potential water level caused by 500-year ARI (0.2% AEP) storm surge event including 0.9 m sea level rise to be 7.1 m AHD (JDA et al. 2012).

8.2.1 Damara and DHI Water (2014)

As part of a hydrological and storm surge study for the site (BG&E 2014), storm surge was modelled for the site by DHI Water and Environment using design cyclone parameters determined by Damara Pty Ltd. The modelled storm surge levels formed the downstream boundary condition for hydraulic (flood) modelling undertaken by BG&E.

As a single storm is unlikely to generate rainfall and storm surge with the same annual exceedance probability together, terrestrial flooding was modelled with a storm surge equal to one fifth of the terrestrial

flooding was used, which is a common approach in the absence of more detailed joint probability analysis and has been endorsed by the DWER. Thus, the 1% AEP (100-year ARI) terrestrial flood was combined with a 5% AEP (20-year ARI) storm surge. The results of the modelling are included in the BG&E (2014) report, which is appended to the DWMS (RPS 2018).

8.2.2 Coastal hazard study - MP Rogers & Associates (2017)

MRA completed a coastal hazard study to address the requirements of State Planning Policy Number 2.6: State Coastal Planning Policy (WAPC 2013).

The scope of work included the following:

- Completion of a coastal inundation hazard assessment to determine the potential extent of extreme inundation across the site.
- Completion of a coastal erosion hazard assessment to determine the potential extent of erosion hazards on the site.
- Prepare coastal inundation and erosion hazard plots showing the potential extent of inundation and erosion on the MIE.

The study used the SBeach and Delft3D cyclone, wave and hydrodynamic model to simulate a range of synthetic cyclones and estimate coastal inundation for the 1% and 0.2% Annual Exceedance Probability (100 year and 500-year ARI) event, also taking into account the predicted sea level rise over a 100-year planning timeframe.

The study made a distinction between typical coastal inundation (inundation flow with significant depths, reaching approximately 6-7 m AHD) and shallow, wind-driven sheet flow which reaches elevations of around 10 m AHD but with only minor water depths and constrained to lower lying flow paths.

The MRA Coastal Hazard Study (2017) provides the mapped coastal inundation extents for the 1% and 0.2% AEP events, under both current sea level conditions and inclusive of sea level rise over a 100-year planning timeframe. The coastal erosion hazard map indicates that only the very northern portions of the Maitland SIA could be impacted by coastal erosion over the 100-year planning timeframe. However, this would also require further assessment and justification through the CHRMAP process, however is far exceeded by the more critical coastal inundation risks identified. While both inundation and erosion hazards require consideration, it is expected that the main focus of further work for development in the coastal inundation areas would be on the inundation risks.

8.2.3 CHRMAP - MP Rogers & Associates (2018)

MRA has prepared a CHRMAP (2018) to address the requirements of State Planning Policy Number 2.6: *State Coastal Planning Policy* (SPP 2.6) (WAPC 2006a).

8.2.3.1 CHRMAP purpose

The potential vulnerability of the coastline and the subsequent risk to the community, economy and environment needs to be considered for any coastal development. SPP 2.6 requires that the responsible management authority prepares a CHRMAP where an existing or proposed development may be at risk from coastal hazards over the planning timeframe. The main purpose of the CHRMAP is to define areas of the coastline which could be vulnerable to coastal hazards and to outline the preferred approach for the assessment and management of these hazards where required. Specifically, the purpose of this CHRMAP is as follows.

- Confirm the specific extent of coastal hazards.
- Outline the risks associated with the MAITLAND SIA development site and how these risks may change over time.

- Establish the basis for present and future risk management and adaptation, which will be used to provide a framework for industrial proponents to complete their own CHRMAPs for each Lot.
- Provide guidance on appropriate management and adaptation planning for the future, including reviewing and updating relevant documents.

8.2.3.2 Objectives

The key objective of this plan is to assess the risks associated with the development of the Maitland SIA. Once these risks have been assessed, adaptation strategies can be developed to help mitigate the risks where necessary.

8.2.3.3 Summary of Coastal Adaptation Approach

The mitigation strategies recommended for the Maitland SIA, based on the example industry land uses and shared assets discussed in Section 2 of the CHRMAP report and are summarised below for clarity.

- **Avoidance** of coastal hazard risks will be achieved by all development and shared assets located in the southern portion of the Maitland SIA landward of the 100 and 500-year ARI inundation extent over the 100-year planning timeframe, including appropriate allowances for sea level rise.
- **Managed** retreat for the replacement of assets upon fulfilment of their design lives will be completed within Lots where space allows and when intolerable risks assets can be reduced to tolerable levels through the use of this strategy.
- **Accommodation** will be achieved through the use of appropriately designed infrastructure and systems that can withstand the impacts of coastal hazards, including inundation, over their service lives. An example of this is the design of solar panels, which are to be designed to accommodate potential loads associated with severe events and inundation depths and flow velocities.
- **Protection** may be achieved through the building up or filling of a development area above the expected depths for significant inundation events. As mentioned, industrial proponents will be required to demonstrate further assessment of inundation and impacts on adjacent landholdings in line with SPP2.6 as part of seeking Development Approval.
- **Risk** mitigation will also be achieved through the temporary relocation of easily moveable assets during the passage of severe cyclone events likely to inundate individual Lots.
- **Management** of personal safety will be achieved through the proposed management plan for the entire Maitland SIA site and to the Department of Fire and Emergency Services (DFES) requirements that require evacuation of employees and people at the Maitland SIA during cyclone or other coastal risk warnings.

8.2.3.4 Key conclusions

The CHRMAP has been completed to provide an understanding of the potential risks of coastal hazards on a range of potential industrial land uses and proposed shared assets at the Maitland SIA. It has been completed in line with the requirements of SP P2.6 and WAPC (2014).

The Coastal Hazard Study completed by MRA (2017) identified a risk of coastal hazards impacting the site, namely inundation during the passage of severe cyclone events. The risk assessment in this report, completed for example industry land uses and proposed shared assets, determined a tolerable Low risk of impact from coastal inundation over the 25-year planning horizon to 2043.

For the relatively inert example land uses Salt Ponds / Algae Farms and Solar Farms, the assessed risks over the 50 and 100-year planning timeframes to 2068 and 2118 respectively are considered to be “Medium” risk. Despite this level of risk being acceptable, the ALARP approach has been adopted for the development and a number of risk mitigation strategies have been proposed in the CHRMAP. For example, the assessed risks over the 50 and 100-year planning timeframes to 2068 and 2118 for Strategic Industrial land uses such

as Power Plant, were “High” and “Extreme” respectively based on the critical materials and facilities considered. Similarly, the Desalination Plant land use had an assessed risk of “High” over the 100-year planning timeframe to 2118. Mitigation strategies (to illustrate that intolerable risks can be managed within the Maitland SIA) proposed for these land uses include avoiding development within the northern portion of the Maitland SIA (close to the coast), protecting hazardous materials and facilities and accommodating risks for inert materials and facilities.

For the shared assets proposed within the MSIA, the risks from coastal hazards are tolerable over the 100-year planning timeframe to 2118. It is expected however, that the management of these assets will be consistent with the Lots that they service and provide access to. This plan was developed on the basis that the risks to personal safety as a result of cyclone inundation will be managed within the Maitland SIA by individual industrial proponents and DFES. It is recommended that a management plan is developed for the entire site and implemented by the industrial proponents of each Lot.

The 500-year ARI cyclone event conditions for Maitland SIA is shown in Figure D.

As the development within each individual Lot is not yet known, a framework for the completion of each individual industrial proponent’s CHRMAP report has been provided. This is outlined to ensure that land use specific risks are identified, and the appropriate mitigation strategies are proposed to ensure tolerable risks and minimal impacts to stakeholders.

The management plan addresses the following:

- specific extent of coastal hazards.
- the risks associated with the MSIA development site and how these risks may change over time.
- the basis for present and future risk management and adaptation, which will be used to provide a framework for industrial proponents to complete their own CHRMAPs for each Lot.
- guidance on appropriate management and adaptation planning for the future, including reviewing and updating relevant documents.

9 Land-themed factors

9.1 Landforms

9.1.1 Topography

The Maitland SIA is comprised of relatively flat alluvial plains and has a low relief, ranging in elevation from sea level on the coastal flats in the north to 20 m AHD to the south-west (AECOM 2013). Topography of the site is illustrated in Figure F.

9.2 Terrestrial environmental quality

9.2.1 Regional geology

The site is located in the Pilbara Block geological province, which is an Archaean granite-greenstone terrane consisting of metasedimentary and volcanic rocks, intruded by granitoid bodies. The surface geology of the site consists mainly of alluvium 38485 of gravel, sand, silt, and clay and is locally calcreted (Geological Survey of Western Australia 1970, reported in AECOM 2013).

The site is underlain by a thin veneer of surficial sediments of Quaternary age, which overly weathered granite (Appleyard 1993). Surface geological mapping as shown in Figure G, has identified the following surface geological units occurring within the SIA boundary:

- Qao – alluvial sand, silt and clay in floodplains
- Qac – claypan deposits on floodplains
- Czrf – ferricrete includes ferruginous duricrust and pisolitic ironstone on lateritic surfaces
- Qas – coastal sand deposits of mixed alluvial and eolian origin
- Qaa – sand and gravel in rivers and creeks; clay, silt and sand in channels on floodplains (alluvium)
- Qwb – sheetwash sand, silt and clay in distal outwash fans, with gilgai surface in areas of expansive clay
- Qc – sand, silt, and gravel in outwash fans and scree (colluvium).

Low-lying areas of alluvial sand and gravel are associated with the river and creek channels with adjacent flood plain areas comprising colluvium and sheetwash deposits of silt, sand and gravel.

9.2.2 Site investigations

9.2.2.1 Drilling program (Prangley 1994)

A drilling program undertaken in 1994, installed six bores, five of which are located within the site boundary. The aim of the drilling program was to determine the underlying geology and the potential for groundwater contamination to occur from the construction of heavy industrial activities on the site.

The 1994 drilling program confirmed the surface geology consisted of alluvial deposits of sand and clay and the presence of granitic rocks at depths ranging from 2 -14 m.

9.2.2.2 Preliminary geotechnical investigation (Douglas Partners 2016)

Douglas Partners completed a Preliminary Geotechnical Investigation for the Maitland SIA in 2016. This involved the excavation of 30 test pits up to 3.5 m in depth, and dynamic cone penetrometer testing adjacent to each test pit. The Geotechnical Investigation is appended to the DWMS (RPS 2018).

The site was found to consist of relatively uniform sandy clay consisting of hard red brown sandy clay with a trace of fine sized gravel and cracks near the surface (Douglas Partners 2016). Rock and gravel were generally encountered from depths between 0.9 m to 2.1 m at test pits TP01 –TP12 (except TP04), and at TP29, with sandy clayey gravel underlying the hard sandy clay at TP01, TP04, and TP09. Gravelly sand and sandy gravel (river alluvium) were encountered at four sites (TP19, TP24, TP25 and TP30) at depths of 1.5 – 2 m. Gilgai cracks and depressions were observed across most of the site.

Groundwater was not encountered in any of the test pits.

9.2.3 Acid sulfate soils

Soils within the Pilbara generally have low acid-forming potential. The DWER Acid Sulfate Soil (ASS) risk mapping indicates that the majority of the site is mapped as having a low probability of ASS occurring, while the majority of the south-eastern section of the site, outside of drainage lines is identified as having no known risk/ unmapped. The area to the north of the site is mapped as having a high probability of ASS occurring due to being located in the floodplain area (Figure H).

The ASS risk was confirmed with testing undertaken as part of the geotechnical investigation (Douglas Partners 2016), which found that the results for pH_F and pH_{FOX} were not indicative of actual or potential ASS conditions to a maximum depth of 3.5 m. However, it was recommended that further testing is undertaken to assess whether pH_{FOX} results were being masked by excess neutralising capacity within the soil.

9.3 Terrestrial flora and vegetation

Mattiske undertook a Flora and Vegetation survey of the site in 1994. The Survey undertaken by Mattiske (1994) was not completed under any specific guidance and is unlikely to conform to Level 2 survey requirements under Guidance Statement 51 (EPA 2004). Data regarding listed species and communities is well out of date and requires updating. Consequently, AECOM undertook a desktop review and a site investigation by an experienced botanist to update the flora and vegetation data so that it meets current requirements. AECOM also investigated the ecological values of the Maitland area by assessing the vegetation communities and their extent (Figure I) and developing a fauna species list.

AECOM site investigation summarised the Maitland SIA as being a large paddock of buffel grass, heavily degraded by cattle grazing and has very little original environmental features that if disturbed would constitute a significant environmental impact. Endemic species remaining were essentially confined to the creekline tributary which would potentially be retained as a drainage channel. This area also was heavily grazed by cattle and highly degraded.

Results of the Mattiske (1994) and the AECOM (2013) surveys are discussed in the sections below.

9.3.1 Bioregion

Western Australia supports 53 biogeographical subregions (Thackway and Cresswell 1995). The Maitland SIA is located within the Roebourne sub-region of the Pilbara Interim Biogeographic Regionalisation for Australia (IBRA) region. The Roebourne sub-region is found on Quaternary alluvial and older colluvial coastal and subcoastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera* (AECOM 2013). There is approximately 98.89% of the Roebourne subregion remaining compared to its pre-European extent.

9.3.2 Vegetation communities

Mattiske mapped the following plant communities in 1994:

- Sandy alluvial plain of hummock grassland of *Triodia pungens* and tussock grassland of *Eragrotis xerophila* with scattered shrubs and trees of *Acacia coriacea*, *Acacia inaequilatera* and *Hakea suberea*.

- Mosaic of tussock grassland of *Eragrostis xerophylla* and depressions of *Xerochloa barbata* with seasonal ephemerals on weakly gilgaied soils.
- Mosaic of tussock grassland of *Eragrostis xerophylla* and hummock grassland of *Triodia pungens* and *Triodia wiseana* with depressions of *Xerochloa barbata* and seasonal ephemerals on weakly gilgaied soils.
- Coastal mudflats of Chenopods such as *Halosarcia halocnemoids* ssp. *Halocnemoids*, *Halosarcia indica* ssp. *Leiostachya*, *Muellerolimon salicorniaceum*, and grasses such as *Eragrostis xerophylla* and *Sporobolus virigicus*.
- Sandy coastal plain of hummock grassland of *Triodia pungens* and *Triodia wiseana* with littoral drainage of chenopods.

In the survey undertaken by Mattiske (1994), two introduced species were recorded; *Passiflora foetida* var. *hispidula* and *Cenchrus ciliaris* (Buffel grass), with the Buffel grass being particularly widespread.

AECOM identified three vegetation communities in 2013 (Figure I), including:

- Paddock – Degraded open Buffel grass (*Cenchrus ciliaris*), *Eragrostis xerophylla* and *Eriachne aristidea* tussock grassland with *Alternanthera nudiflora*, *Hybanthus auranticatus* and *Heliotropium conocarpum* mixed herbs.
- Creekline - characterised by clay soils, *Grevillea wickhamii* and *Acacia coriacea* tall open shrubland over *Triodia wiseana*, *Triodia pungens* hummock grassland with patches of *Chrysopogon fallax*.
- Triodia - *Triodia wiseana* and *Triodia pungens* hummock grassland with *Cenchrus ciliaris* and *Eragrostis xerophylla* tussock grassland.

This site visit identified that endemic species were primarily confined to the creekline running through the site.

9.3.3 Threatened and priority flora

Mattiske (1994) found 5 vascular plant species classified on the then “Declared Rare and Priority Flora List” were expected to occur. Of these five species, *Brachychiton acuminatus* and *Triumfetta appendiculata* were recorded during the survey, but not at the Maitland site, during field surveys in April and August 1994. Both of these species are not on the Priority species list (2013) and are currently classified as Not Threatened. *Zygophyllum retivalve* (formerly known as *Zygophyllum retivalve* sp. Karratha) was expected to occur and was previously listed as a Priority 3 species. This species is currently classified as Not Threatened (AECOM 2013).

Two remaining Priority 3 species were expected to occur but were not recorded. These were *Acacia glaucochaesia* and *Terminalia supranitifolia*. These two species are currently classified as Priority 3 (AECOM 2013).

AECOM (2013), also completed a desktop search and found that there were no threatened species expected to occur in the area, but there were two P1, two P2, thirteen P3 and one P4 species potentially occurring within the site. These species are listed in Table 13. This desktop search also identified eight weed species to potentially occur in the area.

Table 13 Priority flora identified to potentially occur within the Maitland SIA

Species	Priority Rank	Preferred Habitat
<i>Acacia glaucochaesia</i>	P3	Red loam, sandy loam, clay. Floodplains.
<i>Atriplex lindleyi</i> subsp. <i>conduplicata</i>	P3	Crabhole plains
<i>Eragrostis lanicaulis</i>	P3	Red sandy clay. Flats
<i>Eragrostis surreyana</i>	P3	
<i>Gomphrena cucullata</i>	P2	Red sandy loam, clayey sand. Open floodplains.
<i>Gomphrena leptophylla</i>	P3	Sand, sandy to clayey loam, granite, quartzite. Open flats, sandy creek beds, edges salt pans and marshes, stony hillsides.
<i>Gomphrena pusilla</i>	P2	Fine beach sand. Behind foredune, on limestone.
<i>Goodenia pallida</i>	P1	Red soils
<i>Gymnanthera cunninghamii</i>	P3	Sandy soils
<i>Nicotiana heterantha</i>	P1	Black clay. Seasonally wet flats
<i>Phragmites karta</i>	P3	
<i>Polymeria distigma</i>	P3	Sandy soils
<i>Pterocaulon intermedium</i>	P3	
<i>Rhynchosia bungarensis</i>	P4	Pebbly, shingly coarse sand amongst boulders. Banks of flow line in the mouth of gully, in valley wall.
<i>Stackhousia clementii</i>	P3	Skeletal soils. Sandstone hills.
<i>Terminalia supranitfolia</i>	P3	Among basalt rocks
<i>Themeda</i> sp. <i>Hamersley</i>	P3	Red clay. Clay pan, grass plain.
<i>Vigna</i> sp. <i>rockpiles</i>	P3	

Source: AECOM 2013

9.3.4 Threatened and priority flora

Ecological communities are defined as “naturally occurring biological assemblages that occur in a particular type of habitat” (English and Blythe 1997). Threatened Ecological Communities (TECs) are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered, and Vulnerable.

Possible TECs that do not meet survey criteria are added to the DBCAs Priority Ecological Community (PEC) Lists under Priorities 1, 2 and 3 (P1, P2, P3). These are ecological communities that are adequately known are rare but not threatened or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4 (P4). These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (P5).

A Protected Matters search did not list any Threatened Ecological Communities, although the DBCA search identified two possible Priority Ecological Communities, of Roebourne Plains, gilgai grasslands (P1). However, further discussion with DBCA (by AECOM in 2013) confirmed this was unlikely.

9.4 Vegetation condition

AECOM concluded post the site investigation that the dominant vegetation type was Paddock, considered as “Degraded” in condition. This vegetation community consisted of aggressive weed species including Buffel Grass (**Cenchrus ciliaris*) and Kapok Bush (**Aerva javanica*) with mixed native grasses and herbs.

A large creekline bisects the study area, characterised by clay soils with hummock grassland and open shrubland. In addition, there were several smaller areas of *Triodia* species, lacking any mid- or upper-storey strata.

9.4.1 Introduced Flora

Mattiske (1994) recorded two species of introduced flora at the proposed MIE. These were *Passiflora foetida* var. *hispidula* and *Cenchrus ciliaris* (Buffel grass). The Buffel grass specifically, was widely distributed throughout the station, with a concentration near historical watering points (Mattiske 1994).

AECOM identified the following eight weeds to potentially occur within the Maitland SIA:

- *Cenchrus ciliaris* (Buffel Grass)
- *Jatropha gossypifolia* (Bellyache)
- *Opuntia* spp. (Prickly Pear)
- *Parkinsonia aculeate*
- *Prosopis* spp. (Mesquite)
- *Passiflora foetida*
- *Portulaca oleracea*
- *Setaria italica*

9.5 Terrestrial fauna

The surveys at Maitland consisted of broad scale fauna observations undertaken 20 years ago. The EPA would consider this survey to be out of date, particularly with regards to current listed species. Given AECOM concluded in 2013 that the Maitland SIA site is a weedy paddock it could be argued that the habitat value to fauna is not high and that future development of the area would not constitute a significant impact, but surveys may still be required, particularly with regards to conservation significant fauna.

9.5.1 Fauna habitats

Mattiske (1994) identified five main fauna habitats on site. In the field investigations completed by AECOM in 2013, they concurred with Mattiske that the site was heavily degraded. AECOM (2013) identified three fauna habitats:

- Paddock grassland consisting of *Cenchrus ciliaris*, *Eragrostis xerophila*, and *Eriachne aristidea* tussock grassland with *Alternanthera nudiflora*, *Hybanthus auranricatus* and *Heliotropium conocarpum* mixed herbs.
- Creekline community of *Grevillea wickhamii* and *Acacia coriacea* tall open shrubland over *Triodia wiseana*, *Triodia pungens* hummock grassland with patches of *Chrysopogon fallax*.
- Hummock grassland of *Triodia wiseana* and *Triodia pungens* with *Cenchrus ciliaris* and *Eragrostis xerophila* tussock grassland.

In the site survey completed by Mattiske (1994), 24 bird species, three mammal species, and ten species of reptile and frog were recorded. A desktop Threatened and Priority Fauna species search completed as part of the work undertaken by Mattiske identified that three protected vertebrate fauna were expected to occur at the site (excluding marine vertebrate fauna) which included:

- Peregrine Falcon (*Falco peregrinus macropus*)
- Grey falcon (*Falco hypoleucos*)
- Pilbara olive python (*Morelia olivacea*).

AECOM (2013) also completed a desktop review of the EPBC Protected Matters Search and identified six Threatened or Priority Species likely to occur:

- Northern Quoll (*Dasyurus hallucatus*)
- Greater Bilby (*Macrotis lagotis*)
- Northern Marsupial Mole (*Notorcytes caurinus*)
- Pilbara leaf-nosed bat (*Rhinochiropterus aurantia*)
- Southern Giant-Petrel (*Macronectes giganteus*)
- Pilbara Olive Python (*Liasis olivaceus barroni*)

A further 33 migratory bird species were recorded as potentially occurring within the Maitland SIA. The EPBC Protected Matters Search also identified sixteen invasive species were listed as potentially occurring.

The DBCA database desktop search also identified seven Priority species (excluding marine and wetland migratory species) that may occur on the site:

- Ghost Bat (*Macroderma gigas*)
- Northern Quoll (*Dasyurus hallucatus*)
- Short-Tailed Mouse (*Leggadina lakedownensis*)
- Little North-Western Mastiff Bat (*Mormopterus loriae* subsp. *cobourgiana*)
- Australian Peregrine Falcon (*Falco peregrinus* subsp. *macropus*)
- Bush Stone Curlew (*Burhinus grallarius*)
- Rainbow bee-eater (*Merops ornatus*).

9.5.2 Commonwealth significance

The “significance levels” for fauna protected under the EPBC Act, including endangered (EN), vulnerable (V) and migratory (M) are based upon the International Union for Conservation of Nature Categories (Terrestrial Ecosystems 2013).

Migratory species are also protected under the EPBC Act. The national List of Migratory Species consists of those species listed under the following international conventions:

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

All species listed under EPBC Act (including migratory species) which may potentially occur (based on desktop information) within the Maitland SIA. Descriptions of the fauna species are provided in Table 14.

- northern quoll (*Dasyurus hallucatus*) – EN

- fork tailed swift (*Apus pacificus*) – M
- white bellied sea eagle (*Haliaeetus leucogaster*) – M
- barn swallow (*Hirundo rustica*) – M
- rainbow bee-eater (*Merops ornatus*) – M
- great egret (*Ardea alba*) – M
- oriental plover (*Charadrius veredus*) – M
- oriental pranticole (*Glareola maldivarum*) – M
- Caspian tern (*Sterna caspia*) – M
- common greenshank (*Tringa nebularia*) – M
- common sandpiper (*Actitis hypoleucos*) – M
- lesser crested tern (*Sterna benghalensis*) – M
- little curlew (*Numenius minutus*) – M
- Pilbara olive python (*Liasis olivaceus barroni*) – V.

Table 14 Significant fauna and likelihood of occurrence on site (AECOM 2013 and RPS 2017)

Taxon	Significance under WC Act	Preferred Habitat	Likelihood of Occurrence on Site
Schedule Priority			
Mammals			
Dugong <i>Dugong dugon</i>		The preferred habitat of the Dugong is that of coastal shallows where sea grass is abundant.	<u>Unlikely</u>
Northern quoll (<i>Dasyurus hallucatus</i>)	1	The northern quoll is reported to den in hollow tree trunks, but it will use other spaces such as rock crevices and openings in old termite mounds. In the Pilbara, the geographic distribution of northern quolls is considered fragmented and with its numbers in decline.	<u>Possible</u>
Short tailed mouse (<i>Leggadina lakedownensis</i>)	P4	Reid (2008) indicated that the northern short-tailed mouse predominantly occurs in the central arid areas of Australia, including southern Northern Territory, northern South Australia and eastern Queensland. Reid (2008) reported that little is known of the biology and abundance of this species. There are records of northern short-tailed mice being caught immediately to the south of the project area; it is therefore possible that they are in the project area.	<u>Possible</u>
Western pebble mouse (<i>Pseudomys chapmani</i>)	P4	Start (2008) recorded the pebble-mound mouse as endemic to the Pilbara of Western Australia. Terrestrial Ecosystems" fauna database contains multiple records of this mouse and its mounds in the vicinity of the project area.	<u>Likely</u> in the area.
Little northern freetail bat (<i>Mormopterus loriae cobourgiana</i>)	P1	Milne et al. (2008) reported that this bat is confined to the mangroves along the Pilbara coast extending north to the Great Sandy Desert. Individuals roost in small spouts and crevices of the upper dead branches of <i>Avicennia marina</i> . This species can be common in suitable habitat.	<u>Possible</u> in the coastal mangroves only (this area is not subject to any development activities)
Spectacled hare wallaby	P3	The spectacled hare wallaby is found in the northern grasslands of tropical Australia and in the Pilbara (Burbidge and Johnson 2008). Ingleby (1991) reported that the spectacled hare wallaby was rare in the	<u>Possible</u> occur in the general Maitland area.

Taxon	Significance under WC Act Schedule Priority	Preferred Habitat	Likelihood of Occurrence on Site
<i>(Lagorchestes conspicillatus leichardti)</i>			
		<p>Pilbara and Kimberley regions of Western Australia, although moderately common in the appropriate habitat in the Northern Territory.</p> <p>There are no records of the spectacled hare wallaby being recorded in the project area, however, during the field survey near the project a burrow created under the spinifex was found which was potentially created by the spectacled hare wallaby.</p>	
Birds			
Fork tailed swift <i>(Apus pacificus)</i>	3	In Western Australia, they are known to occur from Eyre Bird Observatory to Denmark. They are widespread in coastal and sub-coastal areas between Augusta and Carnarvon, including some on near shore and offshore islands. The fork-tailed swift prefers habitat in coastal areas. They prefer cliffs and beaches and sometimes they are found in treeless grassland and sand plains.	<u>May infrequently</u> be seen in the general area. The potential impact on this species is considered low due to their aerial nature
White bellied sea eagle <i>(Haliaeetus leucogaster)</i>	3	The white-bellied sea eagle is found in coastal habitats and it tends to occupy dunes, tidal flats, woodlands, forests and grasslands, (generally in areas associated with large bodies of water). When not migrating, the home range of the sea eagle can be up to 100 km ² ; although breeding adult birds are generally sedentary, (breeding season runs from June to January). The nests of these birds are large and conspicuous, generally constructed in large trees, cliffs, rocky outcrops, mangroves, caves or on artificial structures.	<u>Possible</u> , breeding known to occur within area. However, clearing a small quantity of vegetation is unlikely to impact significantly this species.
Barn swallow <i>(Hirundo rustica)</i>	3	The barn swallow's non-breeding range occurs along the north coast of Australia. The preferred habitat includes open country with low vegetation, such as pasture, meadows and farmland preferably with nearby water.	<u>May infrequently</u> be seen in the general area; however, the potential impact on this species is considered low due to its predominantly aerial nature.
Rainbow bee-eater <i>(Merops ornatus)</i>	3	The rainbow bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It can be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels.	<u>Possible</u> . Given their abundance and wide spread distribution, ground disturbance activities on a localised scale is unlikely to significantly impact on rainbow bee-eaters. However, where nest burrows are detected during fauna assessments, these

Taxon	Significance under WC Act Schedule Priority	Preferred Habitat	Likelihood of Occurrence on Site
			should be avoided where practical during the breeding period, which is October to January.
Great egret (<i>Ardea alba</i>)	3	Great egrets are dependent upon floodwaters, rivers, shallow wetlands and intertidal mudflats	<u>Possible</u> in the area. However, the potential impact on this species is considered low due to the amount of suitable habitat elsewhere and the species ability to move away from disturbance.
Oriental plover (<i>Charadrius veredus</i>)	3	Immediately after arriving in non-breeding grounds in northern Australia, oriental plovers spend a few weeks in coastal habitats such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands, before dispersing further inland. Thereafter they usually inhabit flat, open, semi-arid or arid grasslands, where the grass is short and sparse, and interspersed with hard, bare ground, such as claypans, dry paddocks, playing fields, lawns, or open areas that have been recently burnt.	<u>Possible</u> in the area. However, the potential impact on this species is considered low due to the amount of suitable habitat elsewhere and the species ability to move away from disturbance.
Oriental pratincole (<i>Glareola maldivarum</i>)	3	The oriental pratincole prefers open plains, flood plains or short grasslands, often occurring near terrestrial wetlands. It also occurs on the coast, inhabiting beaches, mudflats and islands.	<u>Present</u> in the area, however the potential impact on this species is considered low due to the amount of suitable habitat elsewhere and the species ability to move away from disturbance.
Caspian tern (<i>Sterna caspia</i>)	3	The Caspian tern is most often seen in sheltered estuaries, inlets, bays and lagoons with either a sandy or muddy substrate, but occasionally is seen on inland salt and freshwater lakes, rivers, sewage ponds, etc.	<u>Present</u> in the area, however the potential impact on this species is considered low due to the amount of suitable habitat elsewhere and the species ability to move away from disturbance.
Australian bustard (<i>Ardeotis australis</i>)	P4	Australian bustards are tall birds that live on open grassy plains and low shrubby areas in northern Australia	<u>Present</u> in the area, however the potential impact on this species is considered low as this species is able to move readily away from disturbances.
Common greenshank (<i>Tringa nebularia</i>)	3	The common greenshank occurs on coastal mudflats, riverbanks and inland wetlands.	<u>Present</u> in the area, however the potential impact on this species is considered low due to the amount of suitable habitat elsewhere and the species ability to move away from disturbance.

Taxon	Significance under WC Act Schedule Priority	Preferred Habitat	Likelihood of Occurrence on Site
Common sandpiper (<i>Actitis hypoleucos</i>)	3		<u>May infrequently</u> be seen in the general area; however, the potential impact on this species is considered low due to the amount of suitable habitat elsewhere and the species ability to move away from disturbance.
Lesser crested tern (<i>Sterna benghalensis</i>)	3	The lesser crested tern breeds on the offshore islands and is seen around coastal seas, sandy beaches, exposed reefs and mudflats of estuaries	<u>Present</u> in the area, however the potential impact on this species is considered low due to the amount of suitable habitat elsewhere and the species ability to move away from disturbance.
Little curlew (<i>Numenius minutus</i>)	3	The little curlew is found in coastal swamps, billabongs, flood plains and occasionally in grassy pastures in northern Australia.	<u>May infrequently</u> be seen in the general area; however, the potential impact on this specie is considered low due to the amount of suitable habitat elsewhere and the species ability to move away from disturbance.
Peregrine falcon (<i>Falco peregrinus</i>)	4	Johnstone and Storr (1998) reported the peregrine falcon as being widespread including on some off-shore islands, but was absent from most deserts. They went on to suggest it was mainly seen about cliffs along coasts, rivers and ranges and wooded watercourses and lakes, but Terrestrial Ecosystems has seen them in a variety of other habitats (Terrestrial Ecosystems 2013).	<u>Likely</u> to occur in the general area. Ground disturbance activities are unlikely to impact this species, however should nesting sites be detected these should be protected while being used for breeding.
Bush stone curlew (<i>Burhinus grallarius</i>)	4	Johnstone and Storr (1998) reported the bush stone-curlew as being found in the western half of Western Australia and the Kimberley, but they are absent from the sandy deserts and the interior east of Leonora and Southern Cross. There are no records of bush stone-curlew being seen in the vicinity of the project area, therefore, there is low probability that they are present (Terrestrial Ecosystems 2013).	<u>Likely</u> to occur in the general area, however the potential impact on this species is considered low as it will readily move to adjacent areas and away from disturbance.
Star finch (<i>Neochmia ruficauda subclarescens</i>)	4	Johnstone and Storr (1998) recorded the star finch being around the western end of the Ashburton, Fortescue and De Grey rivers in the Pilbara, and preferring long grass, rushes, shrubs around swamps, lagoons and permanent water bodies (Terrestrial Ecosystems 2013).	<u>Likely</u> to occur in the general area, however the potential impact on this species is considered low as impacts will only occur if breeding sites are disturbed.

Taxon	Significance under WC Act	Preferred Habitat	Likelihood of Occurrence on Site
Schedule Priority			
Reptiles			
Lined soil crevice skink (<i>Notoscincus butleri</i>)	P4	<i>Notoscincus butleri</i> inhabits the arid, rocky, near coastal Pilbara area and is associated with <i>Spinifex</i> dominated areas near creek and river margins.	<u>Likely</u> to occur in the general area, clearing activities may potentially impact on individuals. however potential impacts on the species is considered low due to the amount of habitat elsewhere
Pilbara olive python (<i>Liasis olivaceus barroni</i>)	1	Pilbara olive pythons are found throughout the Pilbara and north as far as the Gregory Range. They are most often seen at night and are generally found around rocky areas, rocky outcrops and cliffs, particularly in the vicinity of watercourses and water holes, but they also shelter in logs, flood debris, caves, tree hollows and thick vegetation.	<u>May</u> be seen in the general area, however the potential impact on this specie in a regional context is considered low
Flatback Turtle <i>Natator depressus</i>	1	The flatback turtle is endemic to Australia and all known breeding sites of this species occur only in Australia. They feed in the northern coastal regions of Australia, extending as far south as the Tropic of Capricorn.	<u>Possible</u> . There is a sandy beach adjacent to the Maitland SIA but there has been no historical recording of flatback turtles at Maitland.
Green Turtle <i>Chelonia mydas</i>		Green turtles occur in coral reefs that are rich in seaweeds, and in coastal seagrass pastures in tropical and subtropical areas worldwide	<u>Unlikely</u>

9.6 Key conservation significant species

Conservation significant species in the project area that could be impacted by vegetation clearing and infrastructure development can be divided into two categories:

- terrestrial species
- aerial species.

Conservation significant aerial species include migratory birds protected under the EPBC Act and WC Act. Conservation significant terrestrial species likely or possibly to be in the Maitland SIA include:

- northern quoll (*Dasyurus hallucatus*)
- northern short-tailed mouse (*Leggadina lakedownensis*)
- pebble-mound mouse (*Pseudomys chapmani*)
- lined soil-crevice skink (*Notoscincus butleri*)
- Pilbara olive python (*Liasis olivaceus barroni*)
- spectacled hare wallaby (*Lagorchestes conspicillatus leichardti*).

Of these species, the northern quoll has the highest threatened species status.

The northern quoll and migratory bird species' habitat areas and implications for the Maitland SIA.

Bird and bat species known or potentially occurring in the project area include:

- common sandpiper (*Actitis hypoleucos*)
- fork-tailed swallow (*Apus pacificus*)
- Caspian tern (*Hydroprogne caspia*)
- great egret (*Ardea alba*)
- lesser crested tern (*Sterna benghalensis*)
- little curlew (*Numenius minutus*)
- Oriental plover (*Charadrius veredus*)
- Oriental pratincole (*Glareola maldivarum*)
- rainbow bee-eater (*Merops ornatus*)
- white-bellied sea-eagle (*Haliaeetus leucogaster*)
- peregrine falcon (*Falco peregrinus*)
- Australian bustard (*Ardeotis australis*)
- star finch (*Neochmia ruficauda*)
- bush stone-curlew (*Burhinus grallarius*)
- little northern free-tail bat (*Mormopterus loriae cobourgiana*).

Most of these species are focused in the coastal habitats and are not subject to development activities or clearing and will be separated from any development through a coastal setback in accordance with State Planning Policy (SPP) 2.6 State Coastal Planning Policy.

9.6.1 Northern quoll

The northern quoll is listed as an endangered species under the EPBC Act. In Western Australia it occurs in the Pilbara and Kimberley regions, island populations include the Adolphus, Augustus, Bigge, Boongaree, Capstan, Storr, Dolphin, Hidden, Koolan, Purrungku, Uwins and Wollaston islands (Figure 8) (Terrestrial Ecosystems 2013).

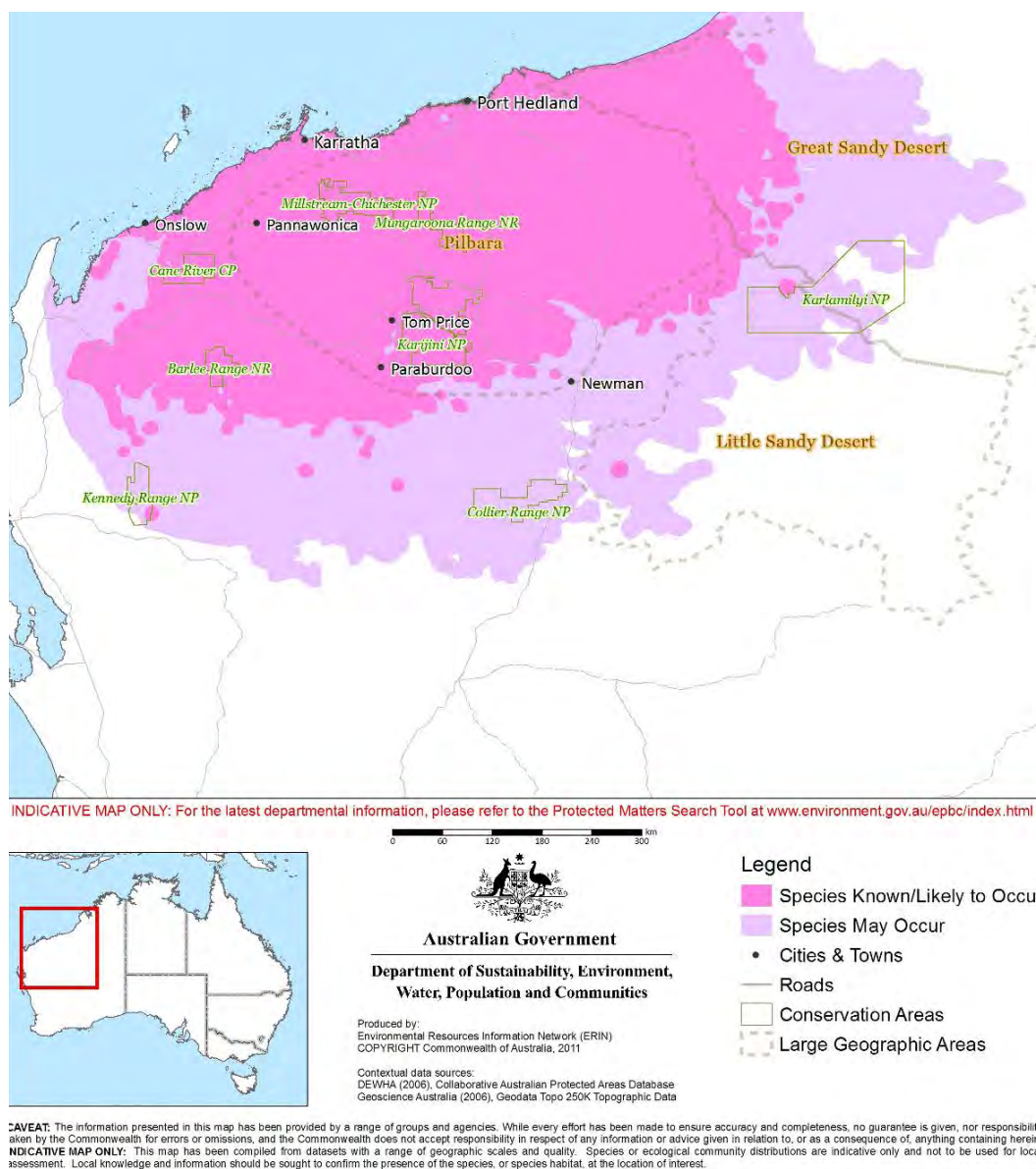


Figure 8 Modelled distribution of the northern quoll (DSEWPC 2011)

The northern quoll records for the Pilbara bioregion demonstrate that the species is widespread throughout the majority of this region, having been recorded from 220 locations, across a wide range of Land Systems (Biota 2010).

In the Pilbara Bioregion records are scattered across the four subregions (Hamersley, Fortescue Plains, Chichester and Roebourne plains) though the majority of recent records have come from the Rocklea, Macroy and Robe land systems (Biota 2008c) and in particular the Chichester subregion (Ecologia Environment 2011). The land systems where the species has most commonly been recorded comprise habitats such as rocky hills, mesas, plateaux, major drainages and granite tor fields (Biota 2010).

Northern quolls are short lived, with males generally living for a year and the oldest female recorded from the wild being three years of age (Threatened Species Scientific Committee 2005). While males and females have similar sized home ranges outside of the breeding season, home ranges of the males expand significantly during the breeding season and can overlap several other ranges, both male and female.

Habitat critical to the survival of the northern quoll occurs in three forms across the species range, which includes (DEE 2017):

- rocky habitats such as ranges, escarpments, mesas, ranges, gorges, breakaways, boulder fields, major drainage lines or treed creek lines
- structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs
- off shore islands where the northern quoll is known to exist.

9.6.2 Feral animals

RPS in reviewing the AECOM 2013 report and fauna reports from surrounding areas (i.e. Anketell) consider the following feral animals are likely or potentially occur within the Maitland SIA:

- Cat - *Felis catus*
- Mouse - *Mouse Mus musculus*
- Rabbit - *Oryctolagus cuniculus*
- Fox - *Vulpes vulpes*
- Pigeon - *Columba livia*.

10 Water-themed factors

10.1 Surface drainage

The site is located in the Coastal Catchment of the Port Hedland Coast Basin of the Indian Ocean Division. All streams and creeks in the area are ephemeral, and stream flows are highly variable from year to year, with most runoff occurring from January to March in response to cyclonic activity.

The Maitland River runs adjacent to the western boundary of the site, from the confluence of the Maitland River, Cockatoo Creek and Corringer Creek to the mouth of the Maitland River. The site is likely to receive significant breakout flow from the Maitland River during major rainfall events as well as runoff from local catchments (BG&E 2014). The Maitland River headwaters are in Chichester Range to the south and the river discharges to the Indian Ocean in the north.

The major breakout channel from the Maitland River runs in a west-east direction across the centre of the site, receiving flows from a number of smaller, local catchment streams that flow in a north-westerly direction, and discharges to the Indian Ocean to the north-west of the site via tidal creeks or Dampier Salt's ponds. Figure J shows the drainage features of the site and surrounding area.

10.2 Wetlands

There are no Ramsar wetlands or wetlands of National importance within the site boundary (Aecom 2013). The closest Ramsar wetland is Eighty Mile Beach, approximately 350 km to the north-east.

10.3 Surface water monitoring

The DWER has a gauging station on the Maitland River located at Miaree Pool (Gauging Station 709004), on the Bridge 845 on the North-West Coastal Highway, which has data from 1972, although this gauging station was moved following damage to the bridge during a cyclone in 2004. The data collected over 41 years (from 1972 to 2013) has had ten years of no flow, and the maximum recorded flow was 4,645 m³/s (BG&E 2014). There are no surface water gauging sites within the site boundary.

A tide gauging station is located at King Bay Service Wharf, approximately 6 km north-east of Dampier. Tides in the Dampier archipelago are semi-diurnal (with two high tides and two low tides a day of similar height). The range of the tide has been determined to range from -2.6 m AHD and +2.5 m AHD. The highest tide recorded from this was 2.44 m AHD, and the mean high water spring tide is 1.78 m AHD.

GHD monitored water depths from three surface water sites as part of their monitoring program from December 2015 to June 2017. All sites were dry for the majority of the monitoring period, with a peak water depth of 4.7 m recorded from SW1 in February 2017, the result of a 211mm rainfall event.

10.4 Flood studies

10.4.1 JDA (2009)

JDA completed a preliminary hydrological assessment using a one-dimensional hydraulic model, using the maximum flow rate of 4,600 m³/s recorded at Miaree Pool from Cyclone Monty (50 year ARI flood event), which occurred in February 2004. JDA estimated the flows for the 10, 50 and 100 year ARI events for the Maitland River at Miaree Pool to be 2000 m³/s, 4500 m³/s and 6000 m³/s respectively, with the breakout of the river over the site boundary in a 100 year ARI event to have a flow of 1,500 m³/s. JDA estimated that the Maitland River channel could convey up to 4,100 m³/s.

10.4.2 BG&E (2014)

BG&E completed 2D hydraulic modelling for the Maitland River floodplain surrounding the Maitland SIA, extending from the confluence of the Maitland River, Cockatoo Creek and Corringer Creek to the Maitland River mouth.

A runoff and stream-flow routing model (RORB) was used to determine hydrographs for the Maitland River Catchment upstream of the site and found that the critical peak flows are generated from the 24 hour storm for flood events up to and including the 20 year ARI, and the 12 hour storm event for the 50, 100 and 500 year ARI events (BG&E 2014).

The BG&E model identified a large breakout stream running north-east from the Maitland River to the Dampier Salt ponds, intersecting the Maitland SIA. The water depths and velocities for this area have been classified as extreme, and as such BG&E recommended that this area is excluded from development and that specific areas are developed above pre-development flood levels. For the 1% AEP event without storm surge, the maximum depth of water over the site was modelled to be up to 2 m, with flood levels ranging from approximately 4 m AHD to 24 m AHD. Maximum flow velocities were up to 1-1.5 m/s. A 1% AEP terrestrial flood with a 5% AEP storm surge was found to have similar results as without the storm surge. The DWMS (RPS 2018) in Figures H (1-5) (sourced from the BG&E 2014 report), show the 1% AEP flood depths and levels without storm surge (H1 and H2), and with storm surge (H3 and H4), as well as the flood hazard mapping (H5).

Flooding has been identified as the major water related constraint for development. The key mitigation and management recommendations from the BG&E study are:

- Development should be located outside of the natural drainage lines to protect ecological flows and minimise requirements to protect infrastructure.
- The modelling undertaken indicates that a lot of the site is underwater during a peak event so protection and fill will be required to raise infrastructure above flood levels.
- BG&E did not recommend raising the entire area or building levees to prevent breakout from the Maitland River, but rather recommended the option proposed by JDA, to provide floodway corridors through the site running north-east, which would minimise back water effects.
- The risk of contamination of breakout flood waters should be considered to prevent contaminant from being conveyed to the Dampier Salt Ponds.

10.5 Surface water management

The site is located within the Pilbara Surface Water Area proclaimed under the RIWI Act.

10.6 Groundwater levels and flows

10.6.1 Regional

Appleyard (1993) reported that groundwater flow at the site is to the north and north-west, discharging to the saline coastal flats in the north. A drilling program completed for the site in 1994 confirmed this (Prangle 1994). However; when the Maitland River is flowing, groundwater mounds in the alluvial sediments below the river which causes groundwater to flow away from the river. The hydraulic gradient across the site has been calculated to be approximately 0.001, and the regional hydraulic conductivity is likely less than 1 m/d, resulting in a groundwater flow rate which is likely to be less than 10 m/year (Appleyard 1993).

Consequently, there are no significant supplies of freshwater in the area; the adjacent townships of Wickham and Port Samson are supplied by the Water Corporation's West Pilbara Scheme Supply, which sources its water primarily from Harding Dam and the Millstream Aquifer. Appleyard (1993) previously indicated that as the majority of the site is underlain by silty or clayey lithologies, it would likely be suitable for industrial

development based in hydrogeological grounds but would be poor draining. The areas of alluvial sediment, were considered less suitable for development based on an increased risk of groundwater contamination.

Depth to water ranges from approximately 3-6 m below ground level (mbgl) across the site, except near the Maitland River where groundwater may occur in shallow alluvial sediments while creeks are flowing (Appleyard 1993).

10.6.2 DWER monitoring bores

A search of the DWER Water Information Reporting database (2016a) identified seven bores within the site boundary (AWRC number: 70910060, 70910062, 70918601, 70918602, 70918603, 70918604, 70918605), and an additional bore located immediately to the north-east of the site boundary (70910068). The DWER search also identified a total of 25 bores within a 10 km radius of the site. There have been minimal water level readings from the bores on and adjacent to the site. For bores 70910060 and 70910062 the last water level reading was in 1971 and 1931 respectively. The other five bores are from the drilling program completed for the site (Prangley 1994), but only have a water level reading recorded in 1994. Groundwater levels measured from these bores ranged from 11.5 m AHD (70918604) to 16.9 m AHD (70918602), and the depth to water ranged from 3.1 mbgl (70918602) to 7.2 mbgl (70918605). The drilling program indicated that there is preferential groundwater flow in permeable zones of weathered bedrock and sediments and paleochannels (Prangley 1994).

Table 15 shows the depth to groundwater information provided by DoW (2016b).

Table 15 DOW groundwater elevation data

AWRC No.	Easting	Northing	Date	Depth to water (m)	Water level (m AHD)
70910060	465151	7698940	15/06/1971	3.15	-
70910062	465776	7696175	30/06/1931	4.88	-
70918601	461489	7698905	19/08/1994	5.6	-
70918602	463239	7697606	21/08/1994	3.1	16.9
70918603	460939	7695206	22/08/1994	5.1	14.9
70918604	458989	7697405	22/08/1994	8.5	11.5
70918605	461889	7696606	24/08/1994	7.2	12.8
70910068	460978	7699372	30/06/1931	5.64	-

Source: DoW 2016b

10.6.3 Site groundwater level monitoring

GHD has undertaken more recent monitoring of seven on-site bores (MW1-MW7) between December 2015 and June 2017. The groundwater monitoring locations and full details of the monitoring program are provided in an appendix to the DWMS (RPS 2018). Pressure transducer loggers were installed in each monitoring bore to provide high resolution data of the groundwater levels and manual groundwater level dips were also completed to confirm the accuracy of the logger data.

Groundwater elevations ranged from 1.24 m AHD at bore MW7 recorded in March 2016 to a maximum water level of 9.06 m AHD in the February 2017 from MW2. It was noted by GHD that this high water level reading for MW2 in February 2017 was actually above the top of the bore casing and was the result of the site being flooded due to the high rainfall received in February 2017. The greatest depth to water was 8.54 m below the top of casing from MW1 in May 2016.

10.7 Groundwater quality

Groundwater quality in the area is variable, depending on the permeability of the strata (Appleyard 1993). Salinity measured as part of the 1994 drilling program ranged from 2,500 mg/L to 188,000 mg/L. The high salinity at 70918600 was thought to be a result of infiltration of brine from the salt evaporation pond, while 70918604 with a recorded salinity of 2,500 mg/L is located closer to the Maitland River and would likely receive freshwater recharge from this. Analysis of groundwater samples taken from three bores found the pH to range from neutral to slightly alkaline (DWER 2016a).

The bore 70918601 recorded an EC value of 26,000 $\mu\text{S}/\text{cm}$ (Calculated Total Dissolved Solids (TDS) of 16,900 mg/L) whilst the bore 70918604 recorded an EC value of 2,700 $\mu\text{S}/\text{cm}$ (Calculated TDS of 1,755 mg/L). This classifies the groundwater as brackish to hypersaline according to the Australian Water Resources Council (AWRC) Salinity Classifications.

10.8 District water management strategy (DWMS) (RPS 2018)

The proposed development site is subject to a number of environmental and engineering constraints, particularly in relation to flood risk mitigation and the potential impacts of earthworks and drainage design on the local environment. Subsequently, a DWMS has been prepared by RPS to support the Improvement Scheme and Guide Plan.

The purpose of the DWMS is to demonstrate that the area is capable of supporting the industrial development and is able to achieve appropriate urban water management outcomes, particularly as there have been areas identified that will be subject to significant depths of flooding at high velocities.

In addition to identifying and addressing these constraints, the preparation of the DWMS will identify and discuss other significant environmental factors pertaining to the development of the site.

10.9 Groundwater management area

The site is located in the Pilbara Groundwater Area and the Ashburton Subarea, which consists of the Pilbara Fractured Rock Aquifer. The Pilbara Fractured Rock aquifer consists of Precambrian granite-greenstone terrain overlain by superficial sediments in the river valleys. The major aquifers are in quartz veins and chert layers (DWER 2016b).

A search of the Water Register (DWER 2016c) indicates that groundwater is available in the area, although bore abstraction yields are expected to be low. An allocation limit for this sub-area has not been identified as this aquifer is classed as a "non-target" aquifer under the *Pilbara Groundwater Allocation Plan* (DoW 2013b). As such, groundwater allocations are to be managed on a case-by-case basis.

The Water Register (DWER 2016c) indicates there are three bore licences in the vicinity of the site, with an allocation of 25,000 kL/yr, 12,000 kL/yr and 50 kL/yr.

Table 16 shows the licence details.

Table 16 Nearby bore users

Licence number	Issue date	Expiry date	Allocation (kL/yr)	Aquifer	Licence holder
182382	23.02.2016	22.02.2026	12,000	Pilbara – Fractured Rock	Supagas Pty Ltd
177355	30.05.2013	27.05.2023	25,000	Pilbara – Fractured Rock	Kimberley Quarry Pty Ltd
174699	30.11.2011	29.11.2012	50	Pilbara – Fractured Rock	Achillies Pty Ltd

11 Air-themed factor

11.1 Air quality

The EPA (2005) identifies the industrial land uses with a potential or generic separation distance for air emissions in excess of 3 km are:

- ammonium importation – storage (case by case)
- electric power generation – >20 megawatts (total) for natural gas fired facilities and >10 megawatts (total) for facilities using other fuels (between 3 km to 5 km separation)
- gold roaster (5 km separation)
- mineral sands – synthetic rutile plant (between 3 km to 5 km separation).

Should these land uses be considered within the Strategic Industry Zone, a site specific assessment may need to be undertaken to determine an appropriate separation distance for the specific industrial land use.

11.1.1 Dust emissions

AECOM 2013 identified dust as a potential issue during construction and operational phase of the Maitland SIA development.

Dust is generally characterised by three size ranges: less than 50 µm, less than 10 µm and less than 2.5 µm with the particulate matter (PM) in each range abbreviated as PM50, PM10 and PM2.5 respectively. PM50 is also referred to as Total Suspended Particulates (TSP). The following construction and/or operational phase activities or works may result in dust emissions:

- physical disturbance on the land surface during construction of infrastructure (removal of vegetation, blasting, earthmoving, cutting and filling)
- haulage and light traffic on unsealed roads
- dust lift-off from dry, cleared areas and stockpiles.

These dust emissions have the potential to create a dust nuisance for workers and adjacent land users. Most airborne particles likely to originate from the proposed construction and operation are larger than PM10 and are more associated with nuisance than public health problems (AECOM 2013).

Maitland SIA is situated at some distance from any sensitive receptors it is unlikely that dust will be an issue. Impacts on traffic and any environmentally significant habitat will require management.

The Construction Environmental Management Plan will address dust management and aim to minimise offsite dust impact from construction activities.

11.1.2 Air emissions

11.1.2.1 Strategic industrial zone

Each heavy industrial proposal within the Strategic Industrial Zone is likely to be subject to a Section 38 referral and assessment by the EPA. In regard to air quality the EPA will consider as part of the Section 38 assessment the following:

- the significance of the likely change to air quality as well as the environmental values affected by those changes, in the context of existing and predicted cumulative impacts
- whether proposed mitigation is technically and practically feasible

- whether siting of the proposal's main emission sources takes into consideration current and future sensitive land uses.

Lastly, once a heavy industry has been approved through the Section 38 assessment process it will be subject to operation licence issued by DWER under Part V of the EP Act. This licence will require air quality emissions to be controlled (in accordance with the licence) and include monitoring, audits and reporting of the emissions.

11.1.2.2 Noise and vibration

Noise would be generated during the construction phase as a result of excavation, construction activities and vehicle movements. The Construction Environmental Management Plan will address noise management and aim to minimise noise impact from construction activities.

During the operation phase noise emissions will be regulated (including audits) in accordance with each heavy industry Part V DWER licence approval.

12 People-themed factors

12.1 Social surrounds

12.1.1 Aboriginal heritage

The AH Act defines Aboriginal heritage sites and provides for the preservation of places and objects customarily used by or traditionally important to Aboriginals, and prohibits the concealment, destruction or alteration of any Aboriginal heritage sites.

A search of the then Department of Aboriginal Affairs (DAA) Aboriginal Heritage Enquiry System identified 15 Registered Aboriginal Heritage Sites within the site boundary (Figure K), which are listed as follows:

- Site ID 16579 – artefacts/scatter, grinding patches/grooves
- Site ID 16257 – artefacts
- Site ID 10683 – modified tree, artefacts/scatter
- Site ID 10684 – artefacts/scatter
- Site ID 10685 – artefacts/scatter, midden/scatter
- Site ID 10686 - artefacts/scatter
- Site ID 16570 - artefacts/scatter, grinding patches/grooves
- Site ID 16571 - artefacts/scatter, grinding patches/grooves, shell
- Site ID 16260 - artefacts/scatter, midden/scatter, grinding patches/grooves
- Site ID 16261 - artefacts/scatter, midden/scatter, shell
- Site ID 16258 - artefacts/scatter, grinding patches/grooves, midden/scatter
- Site ID 8066 – artefacts/scatter
- Site ID 8067 - artefacts/scatter
- Site ID 8068 - grinding patches/grooves
- Site ID 16259 – quarry, artefacts/scatter, grinding patches/grooves.

12.1.2 Indigenous land use agreement and native title

12.1.2.1 Agreement and title details

In 2003, the Western Australian government entered into the Burrup and Maitland Industrial Estates Agreement Implementation Deed.

The site is located within the Native Title area of the Ngarluma / Yindjibarndi people. As of 2013 they had a determination of Native Title claim over the area (Aecom 2013).

12.1.2.2 Aboriginal heritage surveys

Two Aboriginal Heritage investigations have been undertaken within the site. A survey undertaken by Murphy et al. in 1994 identified three sites within the study area:

- P04398 – quarry and artefact scatter
- P04617 – artefact scatter
- P01471 – artefact scatter and tree.

A further 17 sites were identified in close proximity to the study area.

Additional surveys were carried out in 1997 by the Land Council and the Department of Resources Development over 33% of the site and identified 27 Aboriginal Heritage Sites and 198 artefact scatters (Vinnicombe 1997).

12.1.3 European heritage

A search of the Heritage Council's inHerit database and the Shire of Roebourne's Local Government Heritage Inventory identified no heritage sites within the Maitland SIA (Government of Western Australia 2018). The nearest heritage place is located 5.5 km from the southern edge of the Maitland SIA. Karratha Station Homestead Group (Place Number 04024) is of exceptional significance and in good condition.

12.2 Human health

A search of the then DER contaminated sites database did not identify any contaminated sites within the Maitland SIA, nor within 1 km of the site. As the area is currently primarily used as pastoral land, it is anticipated that there haven't been potentially contaminating land uses / activities over the majority of the site. However, the small LNG plant located on the site has the potential to create contamination.

It is noted that the DBNGP crosses through the central portion of the Site in an east - west direction. The pipeline is clearly sign-posted and is buried within the area it traverses at the Site.

A mini LNG gas plant is located along the eastern boundary of the Site. Operations undertaken at the Gas plant potentially include the storage of dangerous goods such as hydrocarbons and other chemicals. The gas plant was unable to be accessed during the site visit, however several large above-ground storage tanks (ASTs) were observed at the Plant from outside the boundary fence. It is not known what is stored in the ASTs or what processes (if any) take place at the site.

13 Relevant environmental factors identified

This section details potential environmental impacts, how these will be managed during the next project planning and design phase.

Environmental Objective – The environmental issue is placed in context of the appropriate policy framework.

Potential Impacts – Describes the identified potential environmental impacts that might arise from future industrial development. This may take the form of impacts of the development on the environment, or constraints the environment might represent to future development.

Management Response – Details the environmental management plans proposed and the specific requirements of each management plan to address the potential environmental impacts that might arise from future industrial development.

13.1 Sea-themed factors

13.1.1 Benthic communities and habitat

13.1.1.1 Environmental objective

To protect benthic communities and habitat so that biological diversity and ecological integrity are maintained.

13.1.1.2 Applicable legislation and/or guidelines

- *Biodiversity Conservation Act 2016* (BC Act)
- WC Act
- EP Act
- Environmental Factor Guideline – Benthic Communities and Habitat (EPA 2016).
- Technical Guidance – Protection of Benthic Communities and Habitat (EPA 2016).

13.1.1.3 Potential impacts

The Maitland SIA's coastal frontage consists of the following intact marine habitat areas:

- mangrove communities
- intertidal and mudflats
- sand beaches.

The development activities that have the potential to impact on benthic communities and habitats include, but are not necessarily limited to:

- Unmanaged surface and groundwater drainage into the coastal environment from the industrial development causing scouring and impacting on the creek and coastal sediment.
- Toxicity in the sediments or accumulation of metals and other chemicals as a result of construction and operational activities may be deposited in intertidal coastal areas during storm events.

13.1.1.4 Management response

Potential environmental impacts to and through the preparation and implementation of the following environmental management plans:

- Water Management Plan.

13.1.1.5 Guide plan

The Guide Plan, as relevant, will require future proponents to prepare a Water Management Plan as part of the next planning phase, which in this instance is subdivision design and approval.

13.1.2 Marine environmental quality

13.1.2.1 Environmental objective

To maintain the quality of water, sediment and biota so that environmental values are protected.

13.1.2.2 Applicable legislation and/or guidelines

- Environmental Factor Guideline – Marine Environmental Quality (EPA 2016).
- Technical Guidance – Protecting the quality of Western Australia's marine environment (EPA 2016). EP Act.

13.1.2.3 Potential impacts

The activities that have the potential to impact on marine environmental quality include, but are not necessarily limited to:

- surface water runoff from the industrial areas and entering the marine environment directly via drains or indirectly via groundwater carrying contaminants such as heavy metals, nutrients, oils and pesticides, and pathogens.
- Unplanned releases of chemicals or hydrocarbons associated with heavy industrial activities such as oil and gas production, transfer and storage of bulk commodities. Generally, these accidents have a low probability of occurring.

13.1.2.4 Management response

Potential environmental impacts to flora and vegetation will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans:

- Construction Environmental Management Plan
- Terrestrial Flora and Vegetation Management Plan
- Terrestrial Weed Management Plan
- Water Management Plan.

13.1.2.5 Guide plan

The Guide Plan, as relevant, will require future proponents to prepare a Construction Environmental Management Plan, Terrestrial Flora and Vegetation Management Plan, Terrestrial Weed Management Plan and Water Management Plan as part of the next planning phase, which in this instance is subdivision design and approval (see Section 4.1).

The specific requirements of the Construction Environmental Management Plan, Terrestrial Flora and Vegetation Management Plan, Terrestrial Weed Management Plan and Water Management Plan are detailed in Section 4.2.

13.1.3 Coastal processes

13.1.3.1 Environmental objective

To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.

13.1.3.2 Applicable legislation and/or guidelines

- Environmental Factor Guideline – Coastal Processes (EPA 2016).
- State Planning Policy No.2.6: *State Coastal Planning Policy* (SPP2.6).

13.1.3.3 Potential impacts

Activities that have the potential to impact coastal processes include, but are not necessarily limited to:

- activities that remove natural communities and habitats that protect the coastline and increase exposure to the action of coastal processes.

13.1.3.4 Management response

Potential environmental impacts to flora and vegetation will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans:

- Coastal Hazard Risk Management Adaptation Plan
- Construction Environmental Management Plan
- Terrestrial Flora and Vegetation Management Plan
- Terrestrial Weed Management Plan
- Water Management Plan.

13.1.3.4.1 CHRMAP

A CHRMAP (MRA 2018; Appendix B) has been prepared as part of the Improvement Scheme process.

The purpose of the CHRMAP is to demonstrate an understanding of the potential risks of coastal hazards for different potential industrial land uses at the Maitland SIA. These risks are assessed to provide adaptation strategies to assist in mitigating the risks for the project.

Proponents seeking to develop in the northern portion of the Strategic Industry zone (as defined by the Special Control Area) will require site specific CHRMAPs to outline how the future development of each industrial Lot fits into the risk assessment detailed in the CHRMAP. The objective of the Coastal Hazard Risk Management Adaptation Plan is to detail and assess relevant land use, specific risks and to outline subsequent mitigation plans.

13.1.3.5 Guide plan

The Guide Plan, as relevant, will require future proponents to prepare a Construction Environmental Management Plan, Terrestrial Flora and Vegetation Management Plan, Terrestrial Weed Management Plan and Water Management Plan as part of the next planning phase, which in this instance is subdivision design and approval (see Section 4.1).

The specific requirements of the Construction Environmental Management Plan, Terrestrial Flora and Vegetation Management Plan, Terrestrial Weed Management Plan and Water Management Plan are detailed in Section 4.2.

13.1.4 Marine fauna

13.1.4.1 Environmental objective

To protect marine fauna so that biological diversity and ecological integrity are maintained.

13.1.4.2 Applicable legislation and/or guidelines

- BC Act
- WC Act
- EP Act
- Environmental Factor Guideline – Marine Fauna (EPA 2016).

13.1.4.3 Potential impacts

Potential impacts include:

- Construction activities may cause temporary displacement of marine fauna through noise impacts
- Potential indirect impact to marine fauna habitat, including foraging habitats for shorebirds from light and noise.
- Future industrial development within the Maitland SIA has the potential to contribute to cumulative light impacts (skyglow), to the existing night light environment (operational phase).

13.1.4.4 Management response

Potential environmental impacts to flora and vegetation will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans:

- Construction Environmental Management Plan
- Terrestrial Flora and Vegetation Management Plan
- Terrestrial Weed Management Plan
- Water Management Plan.

Potential environmental impacts to marine turtles will be addressed by requiring any future planning applications within the Strategic Industry Zone that may have a significant impact on marine turtles to undertake baseline lighting studies. The purpose of this study will be to inform the expected cumulative lighting impacts from the proposed industrial development on turtles.

13.1.4.5 Guide plan

The Guide Plan, as relevant, will require future proponents within the Strategic Industry Zone to undertake a Marine Turtle Baseline Lighting Study in support of any applications for planning approval.

Should the Marine Turtle Baseline Lighting Study predict potential significant impacts from lighting on marine turtles from development, then the preparation and implementation of Design Guidelines for reducing light emissions will be required.

The Guide Plan, as relevant, will require future proponents to prepare a Construction Environmental Management Plan, Terrestrial Flora and Vegetation Management Plan, Terrestrial Weed Management Plan

and Water Management Plan as part of the next planning phase, which in this instance is subdivision design and approval.

13.2 Land-themed factors

13.2.1 Flora and vegetation

13.2.1.1 Environmental objective

To maintain representation, diversity, viability and ecological function at the species, population and community level.

13.2.1.2 Applicable legislation and/or guidelines

- BC Act
- WC Act
- EP Act
- Environmental Protection (Clearing of Native Vegetation) Regulations 2004
- Environmental Factor Guideline: Flora and Vegetation (EPA 2016)
- Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).

13.2.1.3 Potential impacts

Specific conclusions made by AECOM based on the Matiske report and their 2013 survey are summarised below:

- No Declared Threatened Flora species were recorded.
- Unlikely the Maitland SIA supported any TECs or PEC based on DBCA advice (AECOM 2013)
- The AECOM 2013 survey identified that development of the site would not constitute a significant impact on native flora and vegetation. Most of the vegetation observed was in a “degraded” state due to historical clearing and cattle grazing.

13.2.1.4 Management response

Potential environmental impacts to flora and vegetation will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans:

- Construction Environmental Management Plan
- Terrestrial Flora and Vegetation Management Plan
- Terrestrial Weed Management Plan
- Water Management Plan.

13.2.1.5 Guide plan

The Guide Plan, as relevant, will require future proponents to prepare a Construction Environmental Management Plan, Terrestrial Flora and Vegetation Management Plan, Terrestrial Weed Management Plan and Water Management Plan as part of the next planning phase, which in this instance is subdivision design and approval (see Section 4.1).

The specific requirements of the Construction Environmental Management Plan, Terrestrial Flora and Vegetation Management Plan, Terrestrial Weed Management Plan and Water Management Plan are detailed in Section 4.2.

13.2.2 Terrestrial fauna

13.2.2.1 Environmental objective

To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.

13.2.2.2 Applicable legislation and/or guidelines

- BC Act
- WC Act
- EP Act
- EPBC Act
- Environmental Protection (Clearing of Native Vegetation) Regulations 2004
- Environmental Factor Guideline: Terrestrial Fauna (EPA 2016)
- Technical Guidance - Sampling methods for terrestrial vertebrate fauna.

13.2.2.3 Potential impacts

Species identified that may be potentially impacted by the proposal include:

- northern quoll (*Dasyurus hallucatus*)
- northern short-tailed mouse (*Leggadina lakedownensis*)
- pebble-mound mouse (*Pseudomys chapmani*)
- lined soil-crevice skink (*Notoscincus butleri*)
- Pilbara olive python (*Liasis olivaceus barroni*).

The remainder of species identified on site or potentially occurring on site were not considered likely to be impacted due to their ability to move away from disturbances.

Potential impacts to fauna on the site are summarised below:

- animal deaths during the clearing process and the destruction of burrows and retreat sites. Conservation significant fauna that would potentially be harmed during this process includes the northern quoll, Pilbara olive python, pebble mound mouse, northern short tailed mouse and lined soil-crevice skink
- habitat fragmentation
- an increased abundance of introduced species (cats and wild dogs)
- road fauna deaths, in particular this is likely to impact kangaroos, nocturnal birds and ground dwelling large carnivorous predators. Conservation significant fauna that may be impacted includes the northern quoll, bush stone-curlew and Pilbara olive python
- loss of migratory and shorebird habitat. The area of shorebird habitat in the site represents a very small fraction of similar habitat present in the area and therefore impacts are considered low
- loss of significant northern quoll habitat.

13.2.2.4 Management response

Potential environmental impacts to fauna will be addressed at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans:

- Construction Environmental Management Plan
- Terrestrial Fauna Management Plan
- Terrestrial Weed Management Plan.

13.2.2.5 Guide plan

The Guide Plan, as relevant, will require future proponents to prepare a Construction Environmental Management Plan, Terrestrial Fauna Management Plan and Terrestrial Weed Management Plan as part of the next planning phase, which in this instance is subdivision design and approval (see Section 4.1).

The specific requirements of the Construction Environmental Management Plan, Terrestrial Fauna Management Plan and Terrestrial Weed Management Plan are detailed in Section 4.2.

13.2.3 Terrestrial environmental quality – acid sulfate soils

13.2.3.1 Environmental objective

To maintain the quality of land and soils so that the environmental values, both ecological and social, are protected.

13.2.3.2 Applicable legislation and/or guidelines

- EP Act 1986
- *Contaminated Sites Act 2003*
- Assessment Levels for Soil, Sediment and Water (Department of Environment and Conservation [DEC] 2010)
- Acid Sulfate Soils Guideline Series. Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DEC 2011)
- Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DER 2013).

13.2.3.3 Potential impacts

Acid Sulfate Soil (ASS) risk mapping indicates that the majority of the site is mapped as having a low probability of ASS occurring, while the majority of the south-eastern section of the site, outside of drainage lines is identified as having no known risk/ unmapped. The area to the north of the site is mapped as having a high probability of ASS occurring due to being located in the floodplain area (Figure G).

The ASS risk was confirmed with testing undertaken as part of the geotechnical investigation (Douglas Partners 2016), which found that the results for pH_F and pH_{FOX} were not indicative of actual or potential ASS conditions to a maximum depth of 3.5 m. However, it was recommended that further testing is undertaken to assess whether pH_{FOX} results were being masked by excess neutralising capacity within the soil.

13.2.3.4 Management response

If ASS is identified as occurring and is proposed to be disturbed by construction works, a detailed Acid Sulfate Soil and Dewatering Management Plan is required to be prepared to the satisfaction of the WAPC on advice from the DWER.

The objectives of the Acid Sulfate Soil and Dewatering Management Plan will be to adequately identify “actual” and “potential” acid sulfate soils and determine appropriate management strategies and construction practices to be followed to ensure effective handling, treatment and disposal of acid sulfate soils and produced water.

13.2.3.5

The Guide Plan, as relevant, will require future proponents to prepare an Acid Sulfate Soil and Dewatering Management Plan as part of the next planning phase, which in this instance is subdivision design and approval.

13.3 Water-themed factors

13.3.1 Hydrological processes

13.3.1.1 Environmental objective

To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.

13.3.1.2 Applicable legislation and/or guidelines

- EP Act
- RIWI Act
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ 2000)
- Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives (DoE 2006)
- State Planning Policy 2.9: Water Resources (WAPC 2006b)
- Better Urban Water Management (WAPC 2008).

13.3.1.3 Potential impacts

Potential impacts to hydrology on the site include:

- groundwater level changes that occur as a result of a change in land use
- removal of vegetation and installation of impervious surfaces that lead to an increase in run-off during rainfall events
- development may result in an increase in the potential for industrial generated pollutants, such as nutrients, hydrocarbons, litter and sediment, being transported, through surface water run-off, into the local storm water drainage system
- development may result in changes to surface water flows.

In terms of potential impacts to proposed development on the site due to on-site hydrological conditions, the subject land may be impacted by flooding during high rainfall or less frequent extreme events, such as tropical cyclones (during site surveys, parts of the site were flooded due to high rainfall).

13.3.1.4 Management response

13.3.1.4.1 DWMS

A DWMS has been prepared by RPS (2018) as part of the Improvement Scheme process.

The purpose of the DWMS is to demonstrate that the area is capable of supporting the industrial development and is able to achieve appropriate urban water management outcomes, particularly as there have been areas identified that will be subject to significant depths of flooding at high velocities.

In addition to identifying and addressing these constraints, the preparation of the DWMS will identify and outline the key hydrological works required for future industrial development(s).

13.3.1.5 Guide plan

The Guide Plan, as relevant, will require future proponents to prepare a Water Management Plan as part of the next planning phase, which in this instance is subdivision design and approval.

The specific requirements of the Water Management Plan are detailed in the DWMS.

13.4 Air-themed factor

13.4.1 Air quality

13.4.1.1 Environmental objective

To maintain air quality and minimise emissions so that environmental values are protected.

13.4.1.2 Applicable legislation and/or guidelines

- Environmental Factor Guideline: Air Quality (EPA 2016).
- Environmental Factor Guideline - Human Health (EPA 2016).

13.4.1.3 Potential impacts

Development activities that have the potential to impact air quality include, but are not necessarily limited to:

- waste to energy plants where the emissions from the combustion of waste is discharged to the air
- the capture, processing and refining of oil and gas
- the burning of fossil fuels for the production of energy
- heavy industries that emit atmospheric waste such as metal smelting and refineries
- bulk handling and transport (both road and rail) of materials, including the loading and unloading of bulk materials
- stockpiling of bulk material
- the crushing and screening of materials
- chemical manufacturing and processing.

13.4.1.4 Management response

Potential environmental impacts to air quality will be addressed both at subdivision using the mitigation sequence (i.e. avoidance, minimise, rectify, reduce, offset) and through the preparation and implementation of the following environmental management plans:

- Construction Environmental Management Plan.

The Scheme Text, will require these management plans to be prepared (as relevant) as part of future subdivision and approval. The specific requirements of the management plans will be included in the Guide Plan.

Post-construction, air emissions and noise for heavy industries are primarily regulated under Part V of the EP Act. Emissions will be managed in accordance with operating Licence issued under Part V of the EP Act.

13.5 People-themed factors

13.5.1 Social surroundings

13.5.1.1 Environmental objective

To ensure that historical and cultural associations, and natural heritage, are not adversely affected.

13.5.1.2 Applicable legislation and/or guidelines

- AH Act
- *Heritage of Western Australia Act 1990*
- *Native Title Act 1993*
- Environmental Factor Guideline: Social Surroundings (EPA 2016).

13.5.1.3 Potential impacts

A search of the DPLH Aboriginal Heritage Enquiry System identified 15 Registered Aboriginal Heritage Sites within the site boundary (Figure K), which are listed as follows:

- Site ID 16579 – artefacts/scatter, grinding patches/grooves
- Site ID 16257 – artefacts
- Site ID 10683 – modified tree, artefacts/scatter
- Site ID 10684 – artefacts/scatter
- Site ID 10685 – artefacts/scatter, midden/scatter
- Site ID 10686 - artefacts/scatter
- Site ID 16260 - artefacts/scatter, midden/scatter, grinding patches/grooves
- Site ID 16261 - artefacts/scatter, midden/scatter, shell
- Site ID 16584 - artefacts/scatter, grinding patches/grooves,
- Site ID 16258 - artefacts/scatter, grinding patches/grooves, midden/scatter
- Site ID 8066 – artefacts/scatter
- Site ID 8067 - artefacts/scatter
- Site ID 8068 - grinding patches/grooves
- Site ID 8069 – artefacts/scatter
- Site ID 16259 – quarry, artefacts/scatter, grinding patches/grooves.

Two Aboriginal Heritage investigations have been undertaken within the site. A survey undertaken by Murphy et al. in 1994 identified three sites within the study area:

- P04398 – quarry and artefact scatter
- P04617 – artefact scatter
- P01471 – artefact scatter and tree.

A further 17 sites were identified in close proximity to the study area.

Additional surveys were carried out in 1997 by the Land Council and the Department of Resources Development over 33% of the site and identified 27 Aboriginal Heritage Sites and 198 artefact scatters (Vinnicombe 1997).

13.5.1.4 Management response

A heritage survey will need to be undertaken within the industrial areas prior to development.

13.5.1.5 Guide plan

The Guide Plan will set out the Aboriginal Heritage and Native Title compliance requirements within:

The specific requirements for heritage management will be included within the Guide Plan. Under the Guide Plan, applications for planning approval within the Maitland SIA are to be accompanied by a site identification survey. Where there is the potential for future development to impact on a site of significance, a management plan addressing the heritage value of the site to be conserved is required to be prepared and submitted with the application for planning approval.

14 Conclusions

A key conclusion of this EAR is that, based on RPS' experience in the region, none of the identified key environmental risk factors alone present as being a "fatal flaw" to the Maitland SIA.

Based on a high-level review, the key environmental factors (or risks) identified include:

- benthic communities and habitat
- coastal processes
- marine environmental quality
- marine fauna
- flora and vegetation
- terrestrial environmental quality – acid sulfate soil
- terrestrial fauna
- hydrological processes
- air quality
- social surroundings (Aboriginal Heritage).

Other environmental factors identified include:

- landforms
- inland waters environmental quality.

14.1 Environmental management framework

There are a number of environmental factors identified in this assessment such as hydrological process and terrestrial environmental quality which are capable of being resolved (i.e. avoided or managed) through site specific investigations and detailed engineering drainage design. A DWMS has been prepared for the Maitland Improvement Scheme to guide future industrial developments hydrological management requirements at the subdivision and development stages. A CHRMAP has been prepared to guide the preparation of CHRMAPs for future industrial developments' coastal hazard risk management and adaptation requirements at the subdivision and development stages.

Potential impact to the key factors of flora and vegetation and terrestrial fauna may require resolution through detailed investigations and liaison with the state regulatory authorities, based on design, mitigation and management measures that will be proposed as part of future development (but are not currently known).

At a future time when the nature and land requirements for industrial development(s) are more comprehensively known (i.e. detailed planning design/ subdivision stage) the developments will be subject to the following environmental Scheme Provisions.

All applications for planning approval are to demonstrate conformity with the following environmental management plans that are approved by the WAPC under advice from the Director General of the relevant state regulatory authorities, and as relevant to the particulars of the application:

- Construction Environmental Management Plan
- Marine Turtle Baseline Lighting Study and Design Guidelines (if required)
- Terrestrial Flora and Vegetation Management Plan
- Terrestrial Fauna Management Plan (in particular northern quoll)

- Terrestrial Weed Management Plan
- Water Management Plan
- Acid Sulfate Soil and Dewatering Management Plan
- Bushfire Management Plan
- Noise and Air Quality Management Plan
- Coastal Hazard Risk Management Adaptation Plan.

Table 6 provides a summary of the environmental factors and objectives, the potential impacts, and proposed management measures.

14.2 Additional proponent environmental considerations

14.2.1 Commonwealth EPBC Act

This assessment also identified potential impacts to MNES (e.g. northern quoll). Subject to further project planning and site-specific design detail, a referral and likely Ministerial approval under the Commonwealth EPBC Act may be required by future proponents.

14.2.2 Proponent industrial buffers

Within the Maitland SIA, in particular the Strategic Industry Zone, (which is proposed to accommodate mineral and hydrocarbon processing activities) each industrial development proposal will need to assess and accommodate its own buffer within its leasehold in accordance with the EPA's recommended separation distances. For heavy industrial development proposals (e.g. ammonia processing plant) within the Strategic Industry Zone a specific environmental assessment for example of air quality, noise and human health risk will need to be undertaken in consultation with the EPA as part of a separate referral and assessment under Section 38 of the EP Act. This assessment would also delineate separation distances between industrial developments within the Maitland SIA.

A DWER works approval and licence would also be required for heavy industrial proposals, to prevent or minimise the emissions and discharges of waste to the environment.

A likely key outcome for the Maitland SIA particularly in the Strategic Industry Zone is each industrial development will require a buffer from neighbouring industries. This outcome will create "pods" of industrial development(s), connected by roads and common infrastructure within the Maitland SIA landscape.

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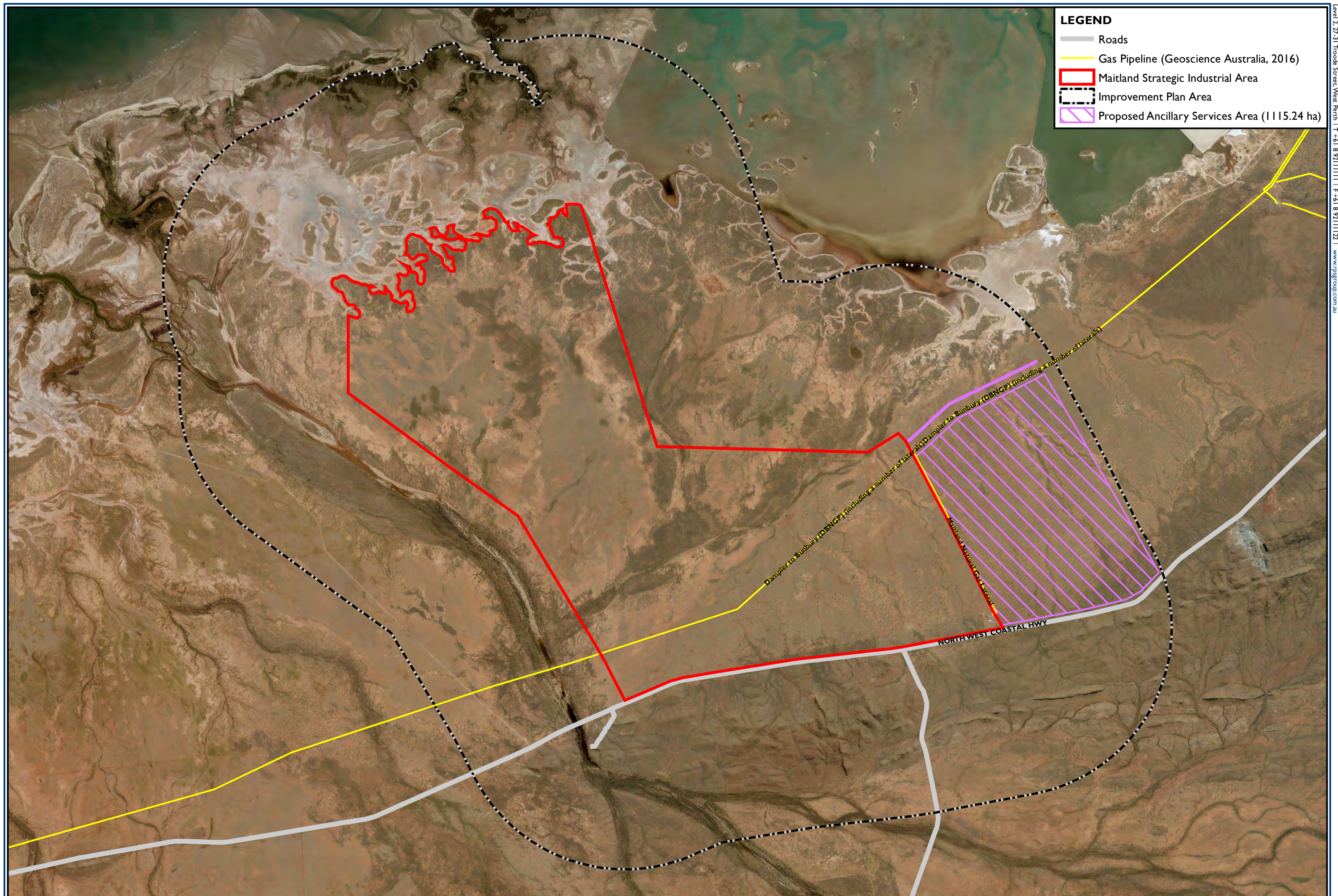
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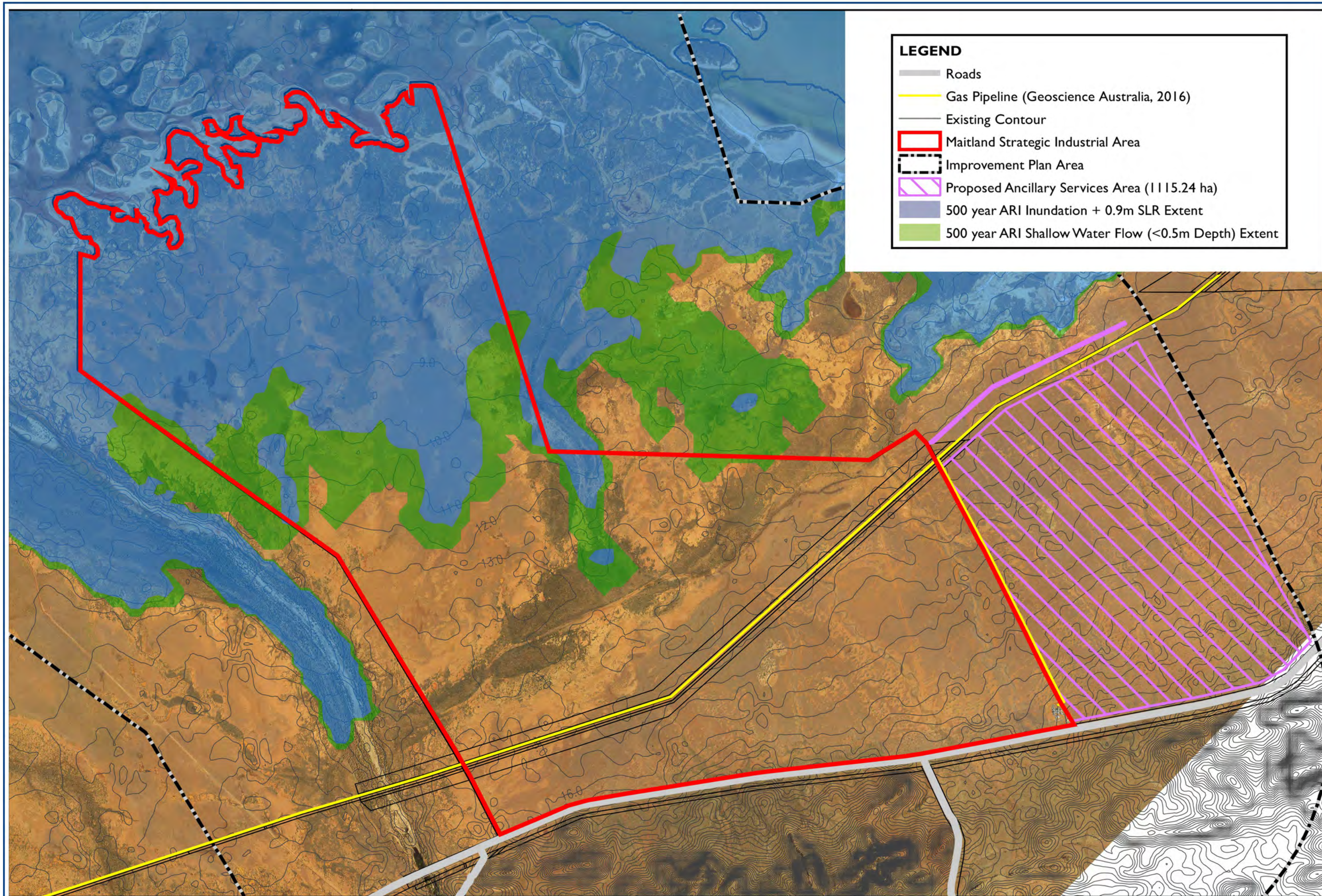
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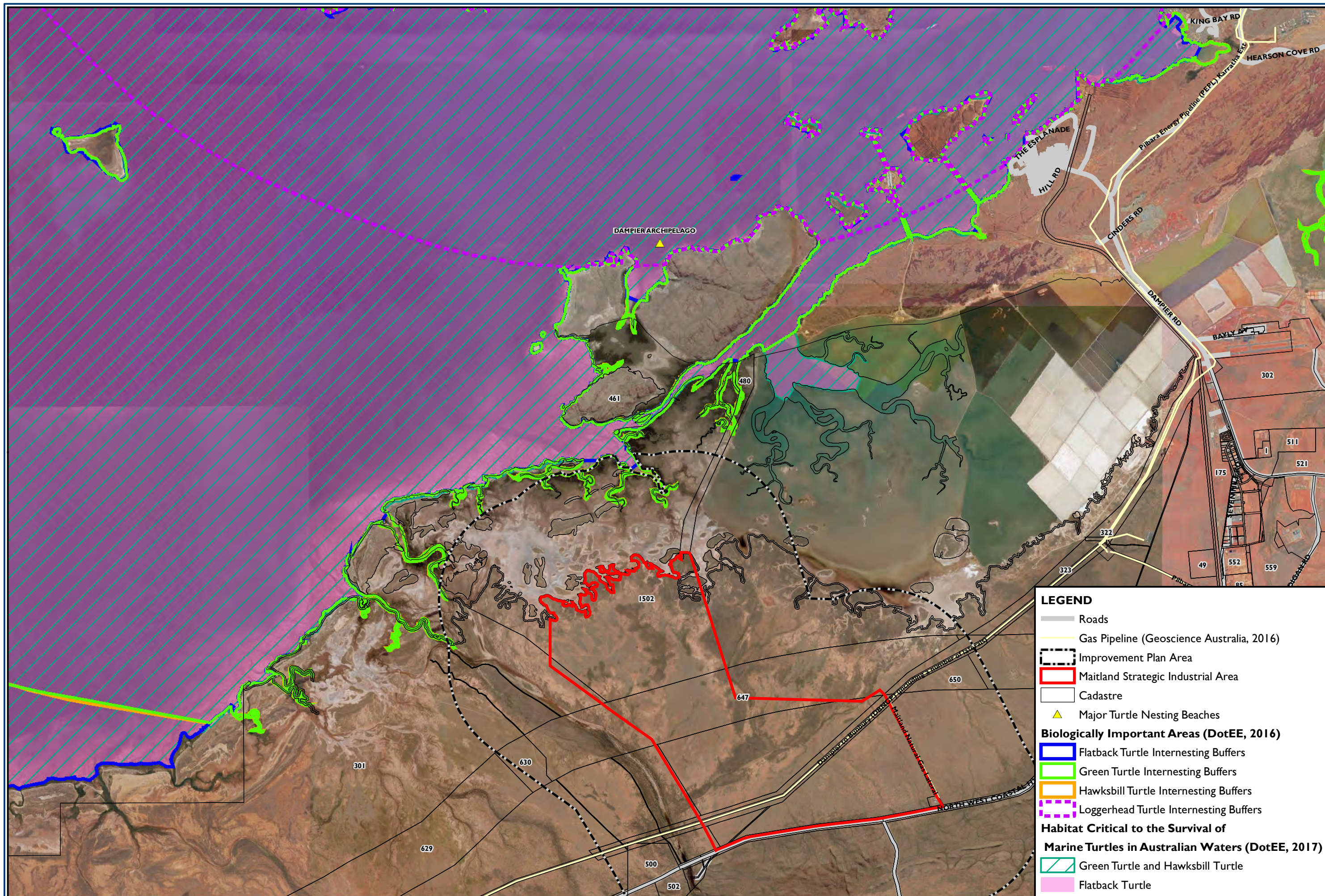
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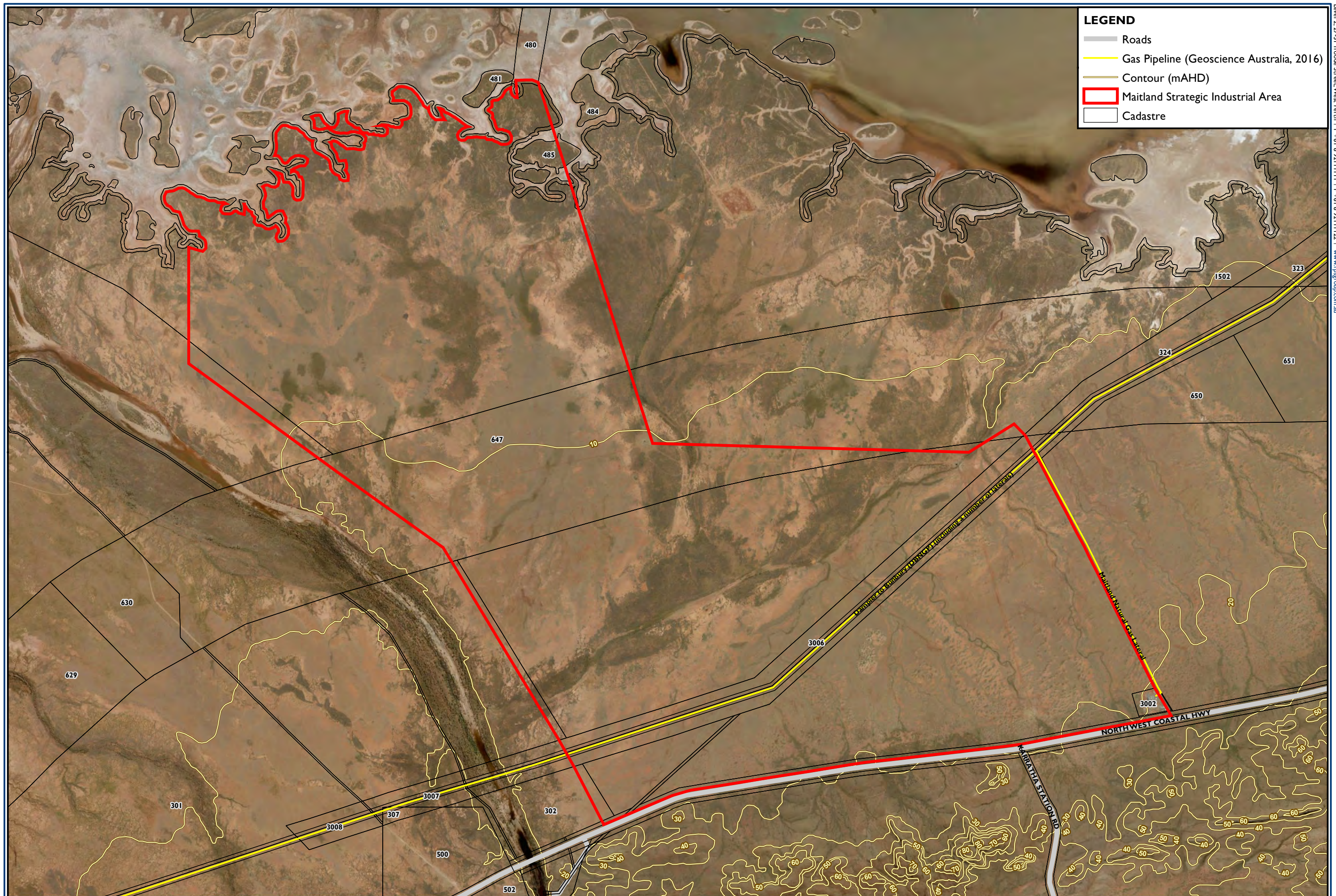
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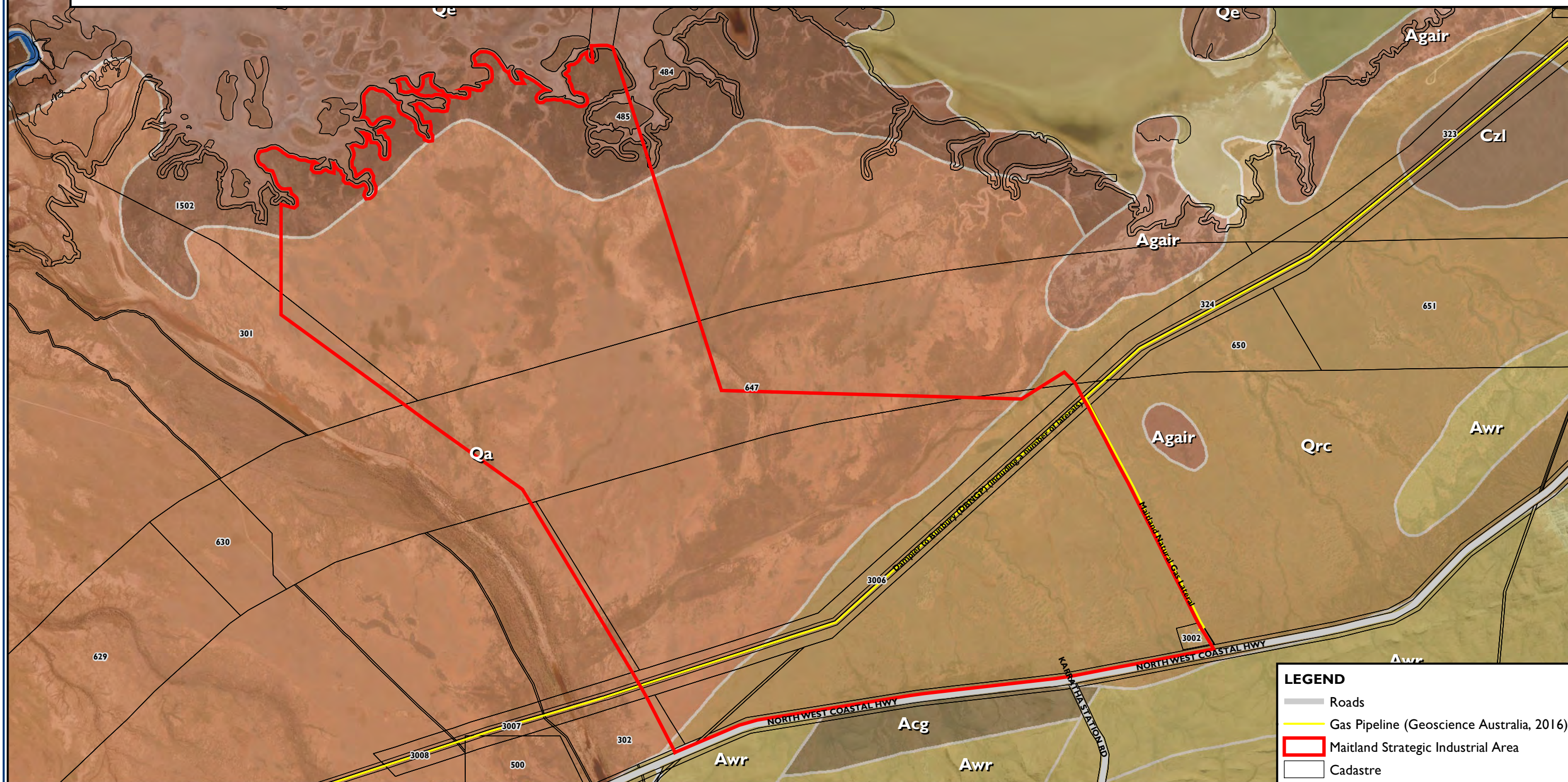




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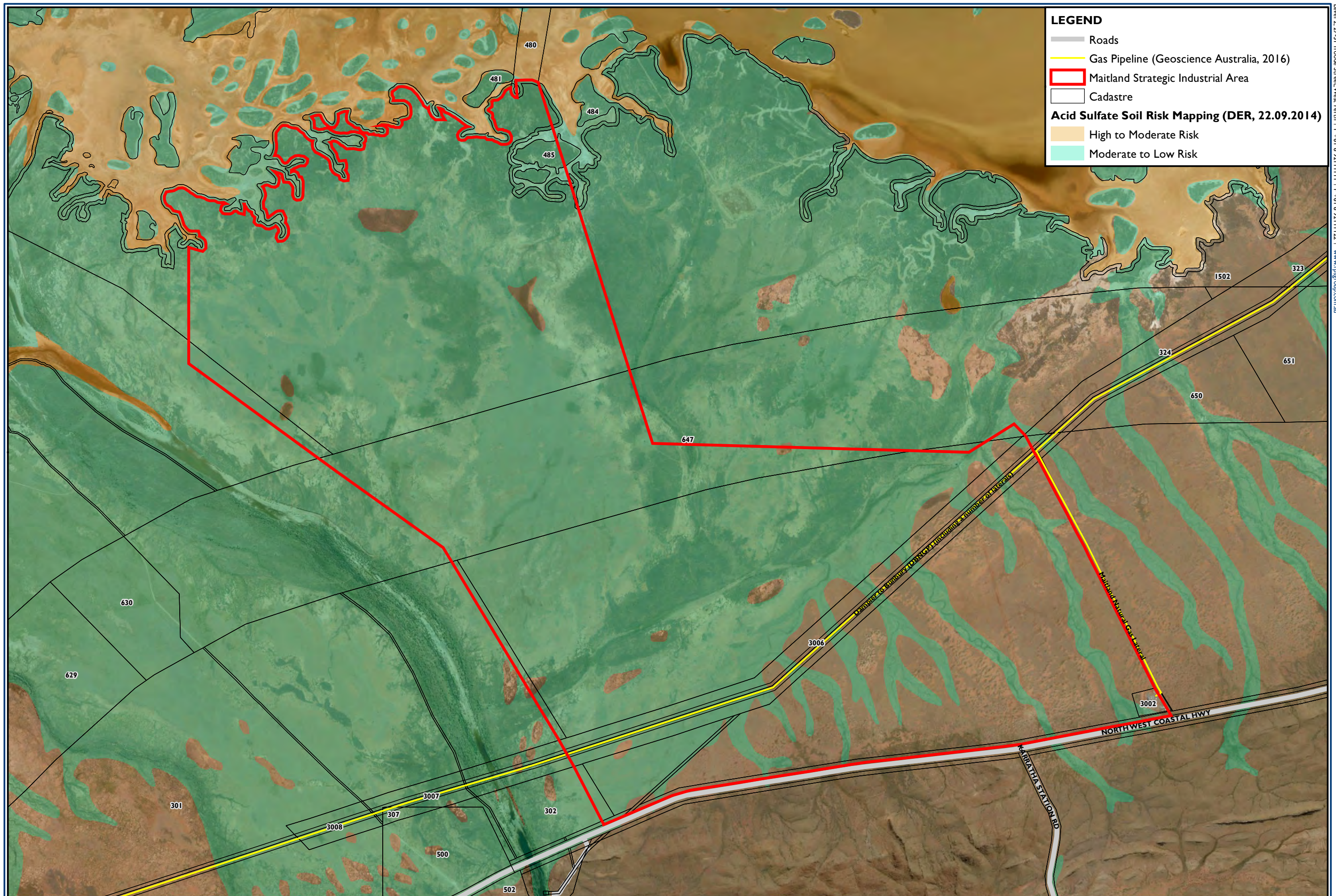
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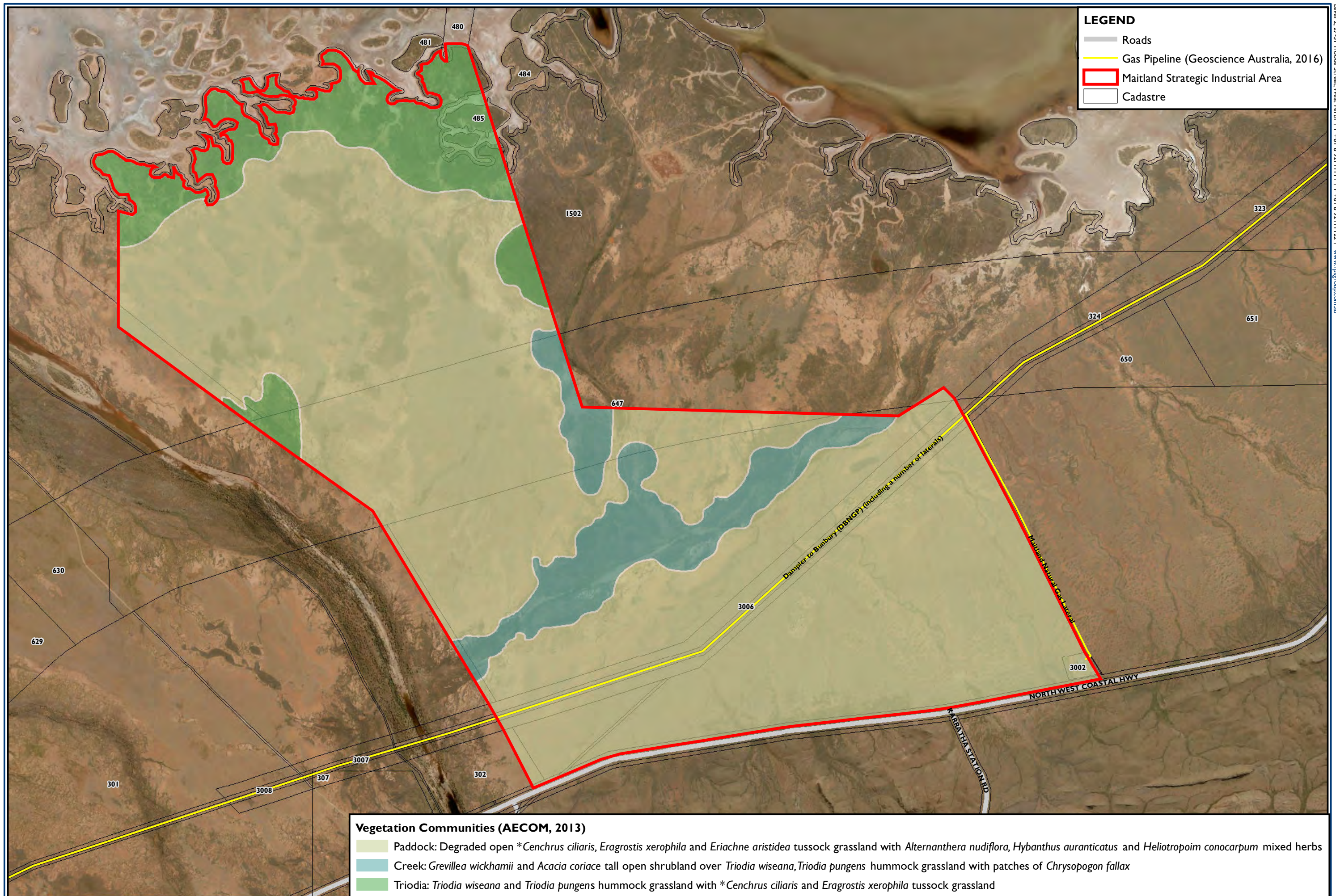
- Acg -- Chert, ferruginous chert, banded iron formation, jaspilite; minor siltstone, shale, sandstone, pebbly sandstone, quartzite, polymictic conglomerate, felsic volcaniclastic rock, basalt, ultramafic schist, mafic schist
- Adgy -- Gabbro
- Agair -- Monzogranite, syenogranite
- Awr -- Basalt, komatiite, serpentinised peridotite, chert, banded iron formation, carbonate, ferruginous clastic rocks, felsic volcanic and intrusive rocks, amphibole schist, quartz-mica schist, jaspilite; metamorphosed, locally sheared and foliated
- Czl -- Pisolithic, nodular or vuggy ferruginous laterite; some lateritic soils; ferricrete; magnesite; ferruginous and siliceous duricrusts and reworked products, calcrete, kaolinised rock, gossan; residual ferruginous saprolite
- Qa -- Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted
- Qe -- Coastal silt and evaporite deposits; estuarine, lagoonal, and lacustrine deposits
- Qrc -- Colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite
- Qt -- Lacustrine or residual mud, clay, silt and sand, commonly gypsiferous and/or saline; playa, claypan, and swamp deposits; peat; peaty sand and clay; halitic and gypsiferous evaporites
- Water

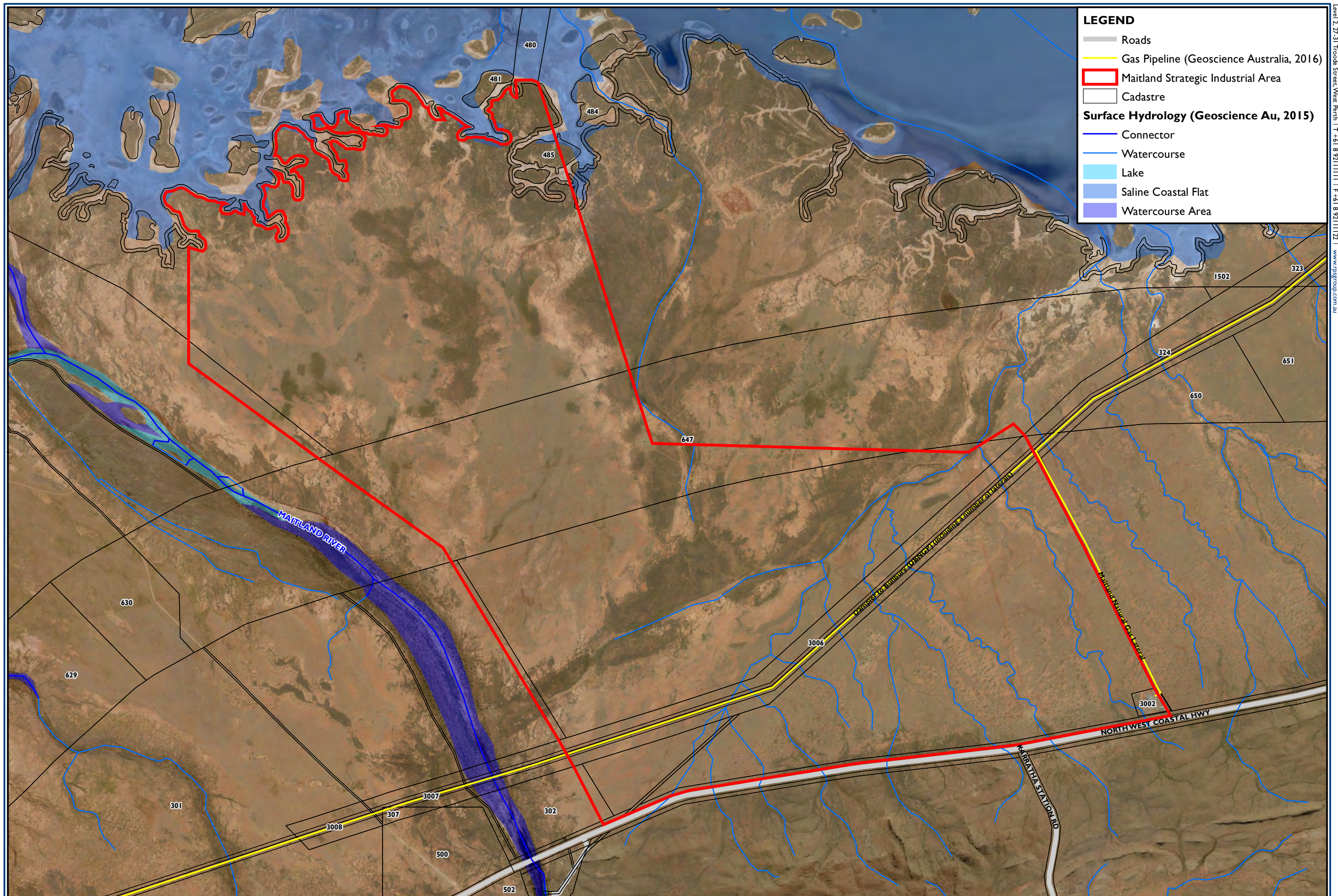


LEGEND

- Roads
- Gas Pipeline (Geoscience Australia, 2016)
- Maitland Strategic Industrial Area
- Cadastre







Appendix A

Maitland environmental due diligence – Maitland Industrial Estate

Environmental Due Diligence

Maitland Industrial Estate



Environmental Due Diligence

Maitland Industrial Estate

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Quality Information

Document Environmental Due Diligence


Ref 60305233

Date 04-Dec-2013

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Reviewed by Linda Kirchner

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Executive Summary

The Maitland Industrial Estate (MIE) comprises approximately 2,500 hectares of land and is part of the State's network of Strategic Industrial Area's (SIA's) in key locations positioned to promote and facilitate the processing of the State's natural resources. The site has been identified as a long-term industrial development site capable of accommodating industries unable to be located on the Burrup Peninsula.

The purpose of the desktop environment due diligence (EDD) is to describe the existing environment, describe the approvals process, make recommendations on the likely approvals required for the project and recommend further environmental studies for the development of the Maitland Industrial Estate, Karratha if and where necessary for approval.

Bulletin 855 16 (e) advice was reviewed to see what advice may still be applicable to the revised MIE.

Surface Water

Surface water assessments are conducted for both EPA impact assessments and EPBC referrals. Baseline surveys of catchment flows and predicted flood studies based on rainfall and storm surge assist with the placement of infrastructure and management of stormwater. Further flood modelling is then undertaken to predict any issues due to the placement of infrastructure and to plan water flows across the site. The BG&E Two-dimensional Flood Modelling and Storm Surge Investigation (2013) will also assist with lot concept planning for the development.

Groundwater

A search of the DoW Water Information System (WIN) database was undertaken for groundwater bores within a 5km radius of the Site. Thirteen groundwater bores were identified within a 5km radius of the Site. It has been 20 years since groundwater testing has occurred within the study area, meaning data may be out-dated and invalid. Discussions with Karratha Station manager have identified the bores that are open and in use for station purposes. Contamination of groundwater may be a factor for environmental impact assessment for the MIE.

Flora and vegetation

The Survey undertaken by Mattiske (1994) was not completed under any specific guidance and is unlikely to conform to Level 2 survey requirements under Guidance Statement 51. Data regarding listed species and communities is well out of date and requires updating. No Threatened flora or TECs are likely to be found at the MIE. There is a possibility that the area is a Roebourne Plains PEC although this is unlikely. This area also was heavily grazed by cattle and highly degraded. The desktop survey presented above may be used to demonstrate that development of the site will not constitute a significant impact on native flora and vegetation. Weed management and rehabilitation of open areas will need to be addressed also, but this can be addressed by individual proponents.

Fauna

Guidance Statement 56 recommends that for Level 2 Surveys several surveys are to be undertaken over different seasons until a high percentage of the faunal assemblage has been recorded. In practice the survey effort required to achieve this is extensive and usually beyond the time and resources of the project. In reality surveys are required to be undertaken at a minimum over two different seasons with sufficient/comprehensive sampling intensity for the species expected to occur. The surveys at Maitland consisted of broad scale fauna observations undertaken 20 years ago. DER/DPaW would consider this survey to be out of date, particularly with regards to current listed species. Given that the site is a weedy paddock it could be argued that the habitat value to fauna is not high and that development of the area would not constitute a significant impact. It is unlikely that surveys would be required at this stage of the project, but this should be reviewed when a development footprint is finalised, particularly with regards to matters of National Environmental Significance, including Northern quoll, Pilbara olive python and the Greater Bilby.

Contaminated sites

The Site is largely undeveloped and has historically and is currently used for the grazing of cattle. There is a mini LNG gas plant operating in the south eastern portion of the site. Apart from the mini LNG plant, the site history review has identified that the historical and current land use of the site has been for pastoral purposes with no development having occurred on the site. As such AECOM considers that there are limited potential sources of contamination across the remainder of the site.

Recommendations for investigations

Investigations are required where impacts are likely or possible. For this site due to the degraded environmental values of the receiving environment they are likely to include:

- detailed surface water catchment study, completed
- baseline monitoring to establish baseline conditions at the site (at proponent stage)
- Archaeological and Ethnographic surveys (at proponent stage)
- sufficient flora and fauna mapping for clearing permit purposes (at proponent stage)
- further assessment of the mini LNG plant could be undertaken to ascertain what (if any) processes occur, the condition of the site and determine if any chemicals are used or stored at the site.

Investigations completed as part of due diligence included a level one flora and fauna survey including a desktop study and a preliminary site investigation to review the potential for contaminated areas at the MIE.

Approvals

While there is a choice to refer the scheme under section 48 of the EP Act, early advice from the EPA based on current data recommends submitting the structure plan to the OEPA for informal feedback prior to lodgement with the WAPC.

The new guidelines for defining a proposal (EAG 1 Defining the key characteristics of a proposal) and for determining significance of an impact (EAG 9 Application of a significance framework in the environmental impact assessment process and EAG 8 Environmental factors and objectives) now encourage proponents to only consider factors which are likely to have a significant impact on the environment after mitigation and management have been taken into account. Using this as a reference it would seem that the list of key factors at this site could be reduced to the point that referral may not be necessary.

Potential referral of the MIE to DOTE under the EPBC Act is dependent on:

- The presence or likely presence of threatened species (most likely to be fauna).
- The potential for activities at the site to have a significant impact on the threatened species or its habitat.

While it appears that it is unlikely that threatened species do regularly inhabit the area, maps in the Northern Quoll survey guidelines (DSEWPac 2011) do show the area to be potential habitat. Baseline studies would help to confirm the lack of habitat and of populations of threatened species. It is recommended that these studies are undertaken prior to making a decision whether to refer the MIE under the EPBC Act. It may be premature to refer the project at this stage as the Department of the Environment will expect the project footprint to be well defined. Species on the listed Matters of National Environmental Significance do change and surveys become quickly out of date.

1.0 Introduction

1.1 Purpose

The purpose of the desktop environment due diligence (EDD) is to describe the existing environment, describe the approvals process, make recommendations on the likely approvals required for the project and recommend further environmental studies for the development of the Maitland Industrial Estate, Karratha (MIE) if and where necessary for approval.

1.2 Project Description

1.2.1 Background

The MIE comprises approximately 2,500 hectares of land and is part of the State's network of Strategic Industrial Area's (SIA's) in key locations positioned to promote and facilitate the processing of the State's natural resources. The site has been identified as a long-term industrial development site capable of accommodating industries unable to be located on the Burrup Peninsula. Examples of suitable industries include gas or petroleum processing, power production, other downstream processing industries (Urea, Ammonia, Ammonium Nitrate etc.) and iron ore stockpiling.

The Project is already home to one project, Energy Development Limited's (EDL) mini-LNG plant which supplies bottled LNG to the North-Kimberley Power Plant. The EDL plant is located on approximately 9ha in the south-east corner of the Project area.

1.2.2 Location and Access

The MIE is located approximately 1,500km's north of Perth, 24km west of the Karratha Townsite and 39km south of Dampier Port on the Pilbara Coast (Figure 1). A 2km Special Control Area surrounds the Estate ensuring incompatible land uses do not hinder the development potential of the Estate. The North-West Coastal Highway runs along the southern boundary of the Estate and the Dampier-to-Bunbury Natural Gas Pipeline traverses the site. The Maitland River forms the western boundary of the Estate while Dampier Salt is located along the eastern boundary. It sits within Karratha Station Pastoral lease.

1.3 Scope

Numerous studies and investigations have been completed for the MIE, but on the whole these were undertaken during the early 90s and are generally out of date. These documents were reviewed in light of Bulletin 855 Section 16(e) advice to the Minister for the Environment and comparison with current EPA survey guidance documents. A Level 1 flora and fauna survey and preliminary site investigation were undertaken to bring the level of data for the site up to present requirements to evaluate the need for further investigations to support the preparation of approval documentation to permit development to occur on the site.

The report reviews the existing data and investigations to consider whether developing the land at the MIE has the potential to have a significant impact on the environmental values of the area and whether it may need to be referred to the Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986* (EP Act) or to the Department of the Environment (DOTE) (formerly DSEWPaC) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The existing Section 16(e) advice is strategic advice only and does not place any environmental obligations or conditions on the site that are not already existing under the EP Act.

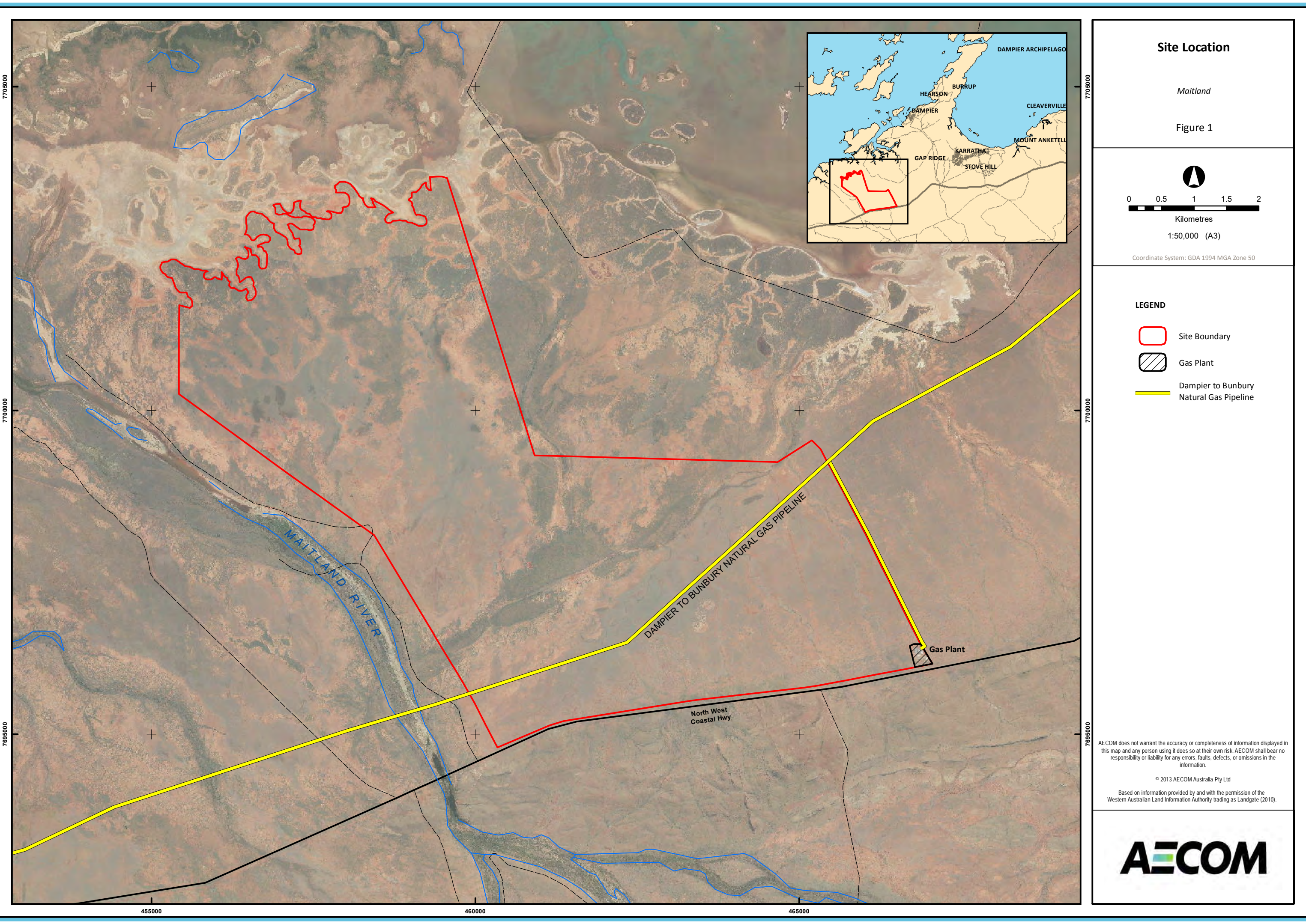
A Gap Analysis and approvals strategy is required to evaluate the need for further up-to-date studies and investigations to determine the opportunities and constraints of the site and to determine which studies and data would be required to support referral of the MIE under Part IV of the EPBC Act if necessary.

1.4 Legal Framework

This review considers the key legislation governing the protection and management of Western Australia's environment and heritage (Table 1).

Table 1 Relevant legislation and potential clearance requirements

Legislation	Purpose	Requirement
Western Australia		
<i>Wildlife Conservation Act 1950</i> (WC Act)	Provides for the conservation and protection of Western Australia's wildlife	License to take protected flora and fauna, consent to take rare or endangered flora
<i>Environmental Protection Act 1986</i> (EP Act)	Preventing, controlling and abating environmental harm and conserving, preserving, protecting, enhancing and managing the environment	Approval to undertake an assessed proposal Permit to clear native vegetation
<i>Rights in Water and Irrigation Act 1914</i> (RWAI Act)	Provides for regulation, management, use and protection of water resources and irrigation schemes	Rights and licenses to take water; permit to obstruct or interfere with a watercourse or wetland including its bed or banks
<i>Aboriginal Heritage Act 1972</i> (AH Act)	Preservation of places and objects customarily used by the original inhabitants of Australia	Consent to disturb Aboriginal sites
<i>Mining Act 1978</i>	Provides for permission to take minerals from Crown Lands	Approval to undertake exploration Approval to commence mining Mine closure planning
<i>Heritage of Western Australia Act 1990</i>	Conservation of places having significance to Western Australia's cultural heritage	Permit to disturb, damage or demolish heritage sites
<i>Agriculture and Related Resources Protection Act 1976</i>	Provides for the management, control and prevention of certain plants and animals, and for the protection of agriculture and related resources generally	Control of weeds declared under the act (Declared Plants)
<i>Contaminated Sites Act 2003</i>	Identification, recording, management and remediation of contaminated sites	Ensure that development complies with site classification and any restrictions that may apply
Commonwealth		
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	Provides for the protection of the environment and the conservation of biodiversity of matters of national environmental significance	Approval required for activities likely to have a significant impact on any matter of national environmental significance



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2.0 Site Description

2.1 Ownership and Zoning

Hamersley Iron purchased Karratha Station in 1966, essentially to facilitate access to the Port of Dampier. Subsequent land excisions for the town of Karratha and transport infrastructure, has reduced the size of the property to around 100,300ha. The pending development of the Maitland Heavy Industry Estate will reduce the size of Karratha Station by at least 2,500 hectares.

Site identification, planning and baseline technical studies carried out in the 1990's resulted in the MIE being incorporated into the Shire of Roebourne's Town Planning Scheme no. 8 (2000) and zoned for 'Strategic Industry'.

2.2 Site Layout and Use

The Site is largely undeveloped and has historically and is currently used for the grazing of cattle. There is a mini LNG gas plant located in the south eastern portion of the Site which is operational. Review of historical aerials indicates that the LNG plant was constructed between 2004 and 2008.

2.3 Site History

Karratha Station was established as a sheep station in 1873, covering at that time an area of 27,500 ha. Following a series of amalgamations and partial surrenders, the property had grown to an area of 146,350 ha, when Hamersley Iron purchased the property in 1966.

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3.0 Gap Analysis

3.1 Assessment Approach

The gap analysis approach includes reviewing:

- the adequacy of current studies in relation to Environment Protection Authority (EPA) guidance
- any specific areas or factors requiring further investigation
- a summary of existing studies for reference purposes
- environmental aspects likely to trigger a referral of the industrial estate and associated infrastructure and advise on the likely need to refer to the Environmental Protection Authority (EPA)
- Matters of National Environmental Significance (MNES) and whether a significant impact is likely and whether referral to DOTE is likely to be required.

This report also includes a review of the status of environmental and heritage assessments for the project and recommendations for studies and investigations relevant to furthering environmental impact assessment to get the site to 'Project Ready' status.

Studies and investigations have been reviewed in terms of the requirements of EPA guidance statements and the type and level of data required to prepare environmental impact assessment documentation.

3.2 Gap Analysis Methodology

3.2.1 Potential Key Environmental factors

The following are the most common key factors for environmental impact assessments:

- Flora and vegetation
- Fauna
- Surface water
- Groundwater
- Heritage.

These factors have been reviewed in detail in this report to determine whether sufficient studies have been undertaken or whether further investigations may be required. Much of the data is more than five years old and may be considered out of date by the regulators.

3.2.2 Investigations

Investigations are required where impacts are likely or possible. To get the site to project ready status they are likely to include:

- detailed surface water catchment study (Maitland Industrial Estate: Two-Dimensional Flood Modelling and Storm Surge Investigation, completed by BG&E 2013)
- groundwater modelling or baseline groundwater monitoring report to establish baseline conditions at the site
- Level 2 flora survey (in accordance with EPA Guidance Statement 51) to establish presence/absence of threatened and priority flora species and ecological communities
- Level 2 fauna survey (in accordance with EPA Guidance Statement 56) or targeted fauna surveys to evaluate presence/absence of listed threatened fauna species or their habitat
- consultation with Native Title holders if requiring transfer from crown land.

At structure planning stage the project will need:

- local water management strategy in accordance with WAPC's *Better Urban Water Management* (2008)
- environmental assessment and management strategy
- water supply.

Native title can be claimed for unallocated crown lands and non-exclusive pastoral and agricultural leases (depending on the legislation they were issued under). Native title does not apply where activities have been undertaken that extinguish native title. This includes freehold land, some pastoral leases and land that is used for public works.

At detailed subdivision stage additional studies to be likely to be undertaken by proponents will include:

- Archaeological and Ethnographic surveys
- Dust studies.

Investigations completed as part of due diligence included a level one flora and fauna survey including a desktop study and a preliminary site investigation to review the potential for contaminated areas at the MIE.

The review is discussed by environmental factor, similar to the structure of an EPA impact assessment document, to facilitate review of existing documentation relevant to each factor.

The conclusions and recommendations are compiled and summarised to provide an overview of investigations required and likely approval pathway.

3.2.3 Consultation with Government departments

Communication with the OEPA indicates that they are likely to prefer that noxious industries are located at a distance from the Burrup Peninsula. They are also concerned about contaminating industries being located near the water. OEPA was also concerned about buffer zones for particular industries, but that upfront modelling of the buffer not required because the nature, size of operation and location of industries is unknown at this time.

4.0 Environmental Factors

4.1 Key Environmental Factors

An environmental factor is described as the part of the environment that may be impacted upon by an aspect of the proposal. There are 15 environmental factors which have been selected to be relevant and practical to the EIA process. In addition, there are two integrating factors – rehabilitation and closure and offsets, which are important considerations in determining the environmental acceptability of proposals (*Environmental Assessment Guideline (EAG) 8 Environmental Factors and Objectives - 2013*).

The EPA released guidance in June 2013, *EAG No. 9, Application of a Significance Framework in the EPA process*, in which they indicate that they only intend to assess key environmental factors. Key environmental factors are those where the EPA's objectives may be met, but there is a lack of confidence, data or conditions related to implementation. If there is early confidence that none of the factors are key factors or that another regulatory process can ensure that the EPA objective can be met then that factor will receive no further consideration by the EPA. Also the proponent will only be required to carry out further necessary studies for the preliminary key environmental factors.

4.2 Background

AGC Woodward-Clyde Pty Ltd prepared a Public Environmental Review (PER) in 1994 for the site and an associated marine area intended to be utilised as a port. This due diligence excludes the marine component and concentrates on the mainland industrial estate area, the Maitland Industrial Estate (MIE). Factors listed in the Section 16 (e) advice (Bulletin 855) for the terrestrial part of the referred project included: rare and priority flora and vegetation communities, fauna and threatened and priority fauna, air quality, greenhouse gases, dust and particulate emissions, noise and vibration, surface water, liquid and solid wastes, public health and safety and cultural surroundings.

4.2.1 Physical Environment

The physical environment includes the geology, climate and general environmental setting of the MIE.

4.2.1.1 Interim Biogeographic Regionalisation for Australia

The national and regional planning framework for the systematic development of a comprehensive, adequate and representative National Reserve System is provided by the Interim Biogeographic Regionalisation for Australia (IBRA). Australia's landscapes are classified into 89 geographically distinct bioregions based on similar climate, landform, geology and biological composition (Australian Government 2012). At a finer scale each bioregion is broken up into 419 sub-regions that are more homogenous. IBRA has been set up to assess the adequacy of the national reserve system, but it also provides a biogeographical context for a place.

The study area is located in the Roebourne sub-region of the Pilbara IBRA region. The Roebourne sub-region is found on Quaternary alluvial and older colluvial coastal and subcoastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands. Samphire, *Sporobolus* and mangal occur on marine alluvial flats and river deltas. Resistant linear ranges of basalts occur across the coastal plains, with minor exposures of granite (DEC 2002). The Roebourne subregion has 98.98% of its pre-European extent remaining, with 1,825,336.52 ha of 1,844,157.25 ha remaining (Table 12).

Table 2 Pre-European and Current Extent of Vegetation that occurs within the IBRA Region and IBRA Subregion

Region	Pre-European Extent (ha)	Current Extent (ha)	Percentage Remaining (%)
Pilbara region	17,804,193.01	17,785,000.82	99.89
Roebourne subregion	1,844,157.25	1,825,336.52	98.98

4.2.1.2 Climate

The study area is located within the Karratha region which has a climate of hot summers with cyclonic weather from November to March, and mild, dry winters. Seasonal temperature variations range from mean daily maximum and minimum temperatures of 36°C and 26°C respectively in summer (January) to a mean daily maximum and minimum temperature of 27°C and 13°C respectively in winter (July) (Bureau of Meteorology 2013). Long term climatic data obtained from the Karratha Airport, approximately 5.7 km north of the facility, indicated that the long term average annual rainfall is 289 mm, which falls usually over the summer months. The wettest month is February; with a long term average rainfall of 80 mm. Mean annual evaporation for the region (Port Hedland) is 3,590 mm, exceeding annual rainfall by more than 3,300 mm. Mean annual wind speed at 3:00 pm recorded at Karratha Airport between 2003 and 2010 was 25.6 km/h, with average monthly wind speeds ranging from 22 km/h in April to 30 km/h in November (Bureau of Meteorology 2013).

4.2.2 Geology

4.2.2.1 Regional Geology

The Pilbara region is a major mineral province with numerous large scale iron ore mining operations. The three major geological provinces of the Pilbara region are the Pilbara Block, the Hamersley Basin and the Canning Basin (Figure 2).

The Pilbara Block contains the oldest rocks in the world, up to 3.5 billion years old and is an Archaean granite-greenstone terrane consisting of metasedimentary and volcanic rocks that have been intruded by granitoid bodies. These granitic rock complexes are exposed in the eastern Pilbara, and comprise of deformed and metamorphosed granitic phases that are locally intruded by veins and dykes (Van Vreeswyk et al 2004).

The Canning Basin is a Phanerozoic sedimentary basin covering much of the north east Pilbara (Van Vreeswyk et al 2004). The south western part of the Canning Basin overlaps part of the Pilbara Craton, up to the Oakover River. The Canning Basin is more recently formed than the Pilbara Block and comprises of shale, mudstone, sandstone, conglomerate, siltstone and coal.

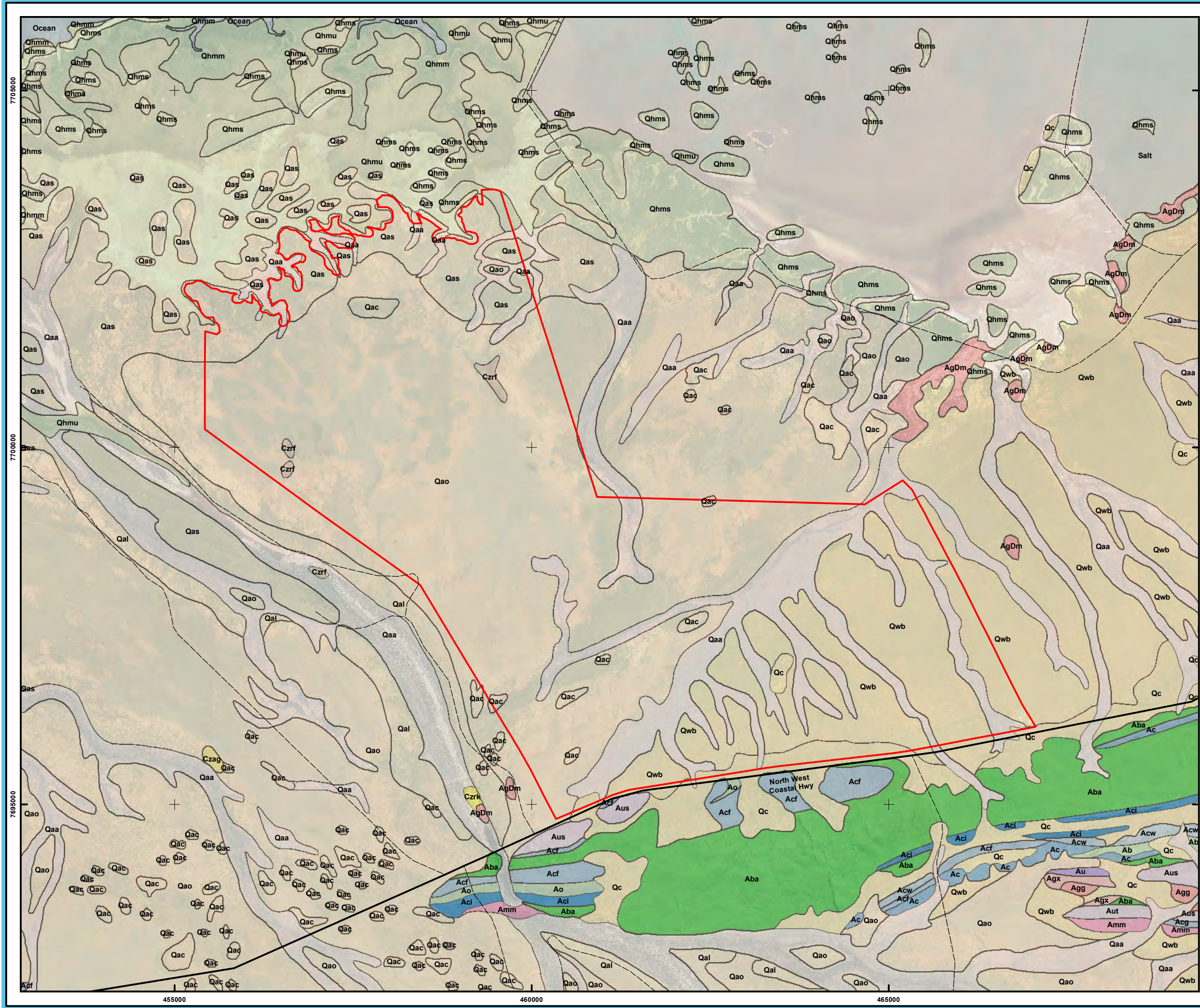
The Hamersley Basin lies to south of the Pilbara Block. It has experienced major faulting and folding, with much of the region being extensively deformed. The Hamersley Basin overlies the older Archaean Pilbara Craton and comprises of mafic and felsic volcanic, shale, siltstone, sandstone, conglomerate, dolomite and banded iron formations (Van Vreeswyk et al 2004).

4.2.2.2 Local Geology

The MIE is located within the Pilbara Block. The surface geology of the study area consists mainly of alluvium 38485. The alluvium 38485 is described as channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted (Geological Survey of Western Australia 1970). There is a section to the north of the study area that contains estuarine and delta deposits 38489. The estuarine and delta deposits category 38489 is described as coastal silt and evaporite deposits; estuarine, lagoonal, and lacustrine deposits (Geological Survey of Western Australia 1970).

The soils within the study area are considered to consist mainly of alluvial plains with occasional stony residuals of basic and ultrabasic rocks: chief soils are deep cracking clays (Ug5.38) but extensive areas of (Dr2.33) and (Uf6.71) soils occur. (Uc5.32) and (Uc1.22) soils occur as narrow bands along stream channels (Geological Survey of Western Australia 1970). There is a section of the study area to the south that contains soil type Fa19, Fa19 consists of steep stony hills and ranges on metamorphosed basic and ultrabasic rocks, with some iron ore formations. There may also be small areas of granite. Limited areas of steep dissected pediments and valley plains are included. The soils are generally shallow and stony and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with (Um6.23) soils. (Dr2.33) soils occur on the pediments; (Uf6.71) and (Ug5.37) soils occur on the plains.

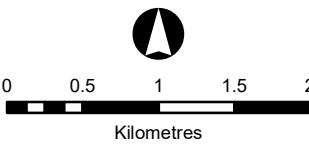
The Project is located on the coastal plain and has low relief, rising from sea level to a maximum elevation of 20m AHD in the south-west corner of the estate. The plain is dissected by a series of ephemeral alluvial channels, predominantly flowing north — east towards the coast (AGC Woodward-Clyde Pty Ltd. 1994).



Surface Geology

Maitland

Figure 2



1:50,000 (A3)

Coordinate System: GDA 1994 MGA Zone 50

LEGEND

Site Boundary	AaRu	AgCp	AyGo
Afa	Ab	AgDm	AyGox
AFR	Aba	AgDp	AyGr
AFRs	Abgp	Agka	Ayx
Afs	Abo	Agg	Czag
AaAd	Abp	Agm	Czak
AaAl	Abs	Agp	Czrf
AaAo	Abx	Agr	Czrk
AaAob	Ac	Agx	Made grd
AaAu	Acb	Alm	Mining
AaAx	Acc	Amm	Ocean
AaBl	Acf	Ao	Qaa
AaBo	Acg	Aod	Qab
AaBob	Aci	Apf	Qac
AaBu	Acj	As	Qal
AaBus	Acw	Asc	Qao
AaDo	Af	Asi	Qas
AaDob	Afd	Asq	Qc
AaDus	Afr	Ass	Qhmm
AaDx	Afs	Ast	Qhms
AaHo	Aft	Au	Qhmu
AaHus	Afv	Aub	Qhmb
AaHut	Ag	Auk	Qrg
AaHx	AgC	Aus	Qs
AaNd	AgCg	Aut	Qwb
AaNo	AgCm	Auv	Salt
AaRd	AgCmh	Aux	d
AaRo	AgCn	AyG	p

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4.3 Surface Water and Drainage

4.3.1 Introduction

The major rivers within the Pilbara region include the De Grey that has the largest shallow estuary in northwest Australia, the Ashburton, Fortescue, Yule, Sherlock, Cane, Robe, Harding, Maitland and Turner rivers (Max Van Weert 2009). The stream flows in these major rivers are mostly a direct response to rainfall in the Pilbara region and are highly seasonal and variable, general discharge of flows over coastal flats towards the Indian Ocean. Most runoff within the Pilbara region occurs from January to March due to episodic cyclone activities. All watercourses are ephemeral, drying up for at least part of each year (DoW 2008). Rainfall totals of more than 100mm are common within the Pilbara region due to tropical lows that move over land, and when tropical lows occur within a few weeks of each other the chance of flooding is enhanced (Max Van Weert 2009). Intense flooding and large cyclones have the potential to reshape the landscape, in particular streamlines, pools, rivers and sandy channel beds, making the Pilbara region varied and inconsistent in terms of surface water and drainage.

EPA Objectives and Guidance For Water

To maintain the quantity and quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

To ensure that emissions do not adversely affect environmental values or the health, welfare or amenity of people and land uses by meeting statutory requirements and acceptable standards.

For marine, surface and wastewaters to meet the requirements of the Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC)

These objectives relate directly to all the aspects of the potential surface water related impacts and partly overlap with the objectives of the DEC and DoW, as discussed in the following sections.

4.3.2 Data Available

The following reports and databases have been referenced for this section of the report given that no specific studies have been undertaken (Table 2).

Table 3 Surface Water Data Available

Report	Summary
Max Van Weert 2009. Pilbara Integrated Water Supply, Pre-Feasibility Study. Prepared for Department of Water.	<p>This document is a prefeasibility study that identifies water supply integration opportunities in the Pilbara Region of Western Australia.</p> <p>This report identified a range of options for water in the Pilbara:</p> <ol style="list-style-type: none"> 1) use of water extracted by mine dewatering operations 2) supplemental groundwater for water supply schemes 3) development of aquifers near the coast 4) construction of transfer pipelines from source to demand locations 5) desalination options.
Department of Water. 2009a. Surface water Proclamation Areas. Rights in Water and Irrigation Act 1914. Department of Water. Government of Western Australia.	This maps indicate Surface water Proclamation Areas within Western Australia.
Astron. 2002. <i>The Maitland Heavy Industrial Estate – Assessment and Comparison with the Burrup Peninsula Industrial Estate</i> . Prepared for the Shire of Roebourne	This report is a literature survey and costing exercise for the study area. The report briefly summarises the environmental aspects within the study area and compares the area with the Burrup Industrial Estate

Report	Summary
AGC Woodward-Clyde Pty Ltd. 1994. <i>Maitland Heavy Industry Estate Public Environmental Review</i> . Prepared for LandCorp and Department of Resources Development.	This report is a technical review of the proposed estate development, incorporating input from the public consultation process. The report outlines both key issues and potential impacts.
BG&E 2013 Maitland Industrial Estate – Storm Surge and Flood Study	Report in preparation with a 2D 100 year ARI terrestrial flood and 20 year ARI Storm Surge model showing the site to be underwater in the worst case scenario.
EPA 1997 Bulletin 855	Recommends protection of the estate from stormwater from the Maitland River and prevention of industrial run-off water entering the Maitland River.

BG&E were consulted during the preparation of this review and the implications of their flood and storm surge model (2013) were discussed. With the worst-case-scenario indicating much of the site to be underwater during an extreme event, they have recommended development occurs in areas of the site that are located on less flood-prone areas and the major floodways and drainage channels are left undeveloped.

4.3.3 Hydrological Setting

The Project is located in the Coastal catchment, within the Port Hedland Coast Basin of the Indian Ocean Division (Figure 3).

There are no Public Drinking Water Source Areas (PDWSAs) within the study area, so the DoW has no regulatory role in surface water quality associated with the area. The closest PDWSA is the Harding Dam Catchment Area located approximately 43km south east of the study area. The Harding Dam Catchment Area is a Priority 1 classification area, which is managed to ensure that there is no degradation of the drinking water source.

There are no major watercourses within the study area. The closest major watercourse to the study is the Maitland River that runs adjacent to the study area to the west. The Yanyare River is located approximately 11km west of the study area. Both these major rivers discharge into the Indian Ocean. The study area is dissected by a number of small, ephemeral streams, most running north-west that flow after heavy rain (AGC Woodward-Clyde Pty Ltd. 1994).

There are no Ramsar wetlands or wetlands of National Importance within the study area. The closest Ramsar wetland to the study area is Eighty Mile Beach located approximately 350km north east. Eighty Mile Beach is not located in the same catchment, basin or division as the study area.

The project area is located in a Surface Water Proclamation Area, that being the Pilbara Surface Water Area (DoW 2009a).

4.3.4 Data gaps

Surface water assessments are conducted for both EPA impact assessments and EPBC referrals. Baseline surveys of catchment flows and predicted flood studies based on rainfall and storm surge assist with the placement of infrastructure. Further flood modelling is then undertaken to predict any issues due to the placement of infrastructure and to plan water flows across the site. Studies that have been undertaken for the MIE area would fall into the baseline category.

The impact assessment process uses surface water studies to determine impacts on vegetation and fauna habitat due to changes in water flow regime. Changes in water availability can be detrimental to some flora species such as mulga and this generally needs management to reduce impacts.

Potential impacts on surface water features are assessed from the following hydraulic criteria:

- design for a flood of the 100-year ARI
- reproduction of pre-development flood levels
- stable flow profile
- continuously draining channel
- limiting the disturbance footprint.

The BG&E Two-dimensional Flood Modelling and Storm Surge Investigation (2013) does address these criteria and does recommend optimum areas for development where impacts to infrastructure would be minimised.

In terms of environmental impact, the following needs to be taken into consideration:

- Flora and fauna are unlikely to be impacted due to changes in site hydrology.
- Impacts on surface water bodies are likely to be ephemeral if infrastructure is not placed within drainage and sub-drainage lines and banks are not damaged, because the drainage lines are only periodically flooded.
- Contamination may be an impact on surface and ultimately marine waters if contaminating materials are washed into drainage lines and out to sea. Appropriate management controls and monitoring will be required, particularly regarding spill response and cleanup, but this will be the responsibility of individual proponents.

In terms of studies required, the 100 years studies will assist with the definition of suitable development area and the 1-year and 5-year studies/modelling are required for determining water management and road design.

4.3.5 Recommendations

General recommendations for surface water after discussion with BG&E are as follows:

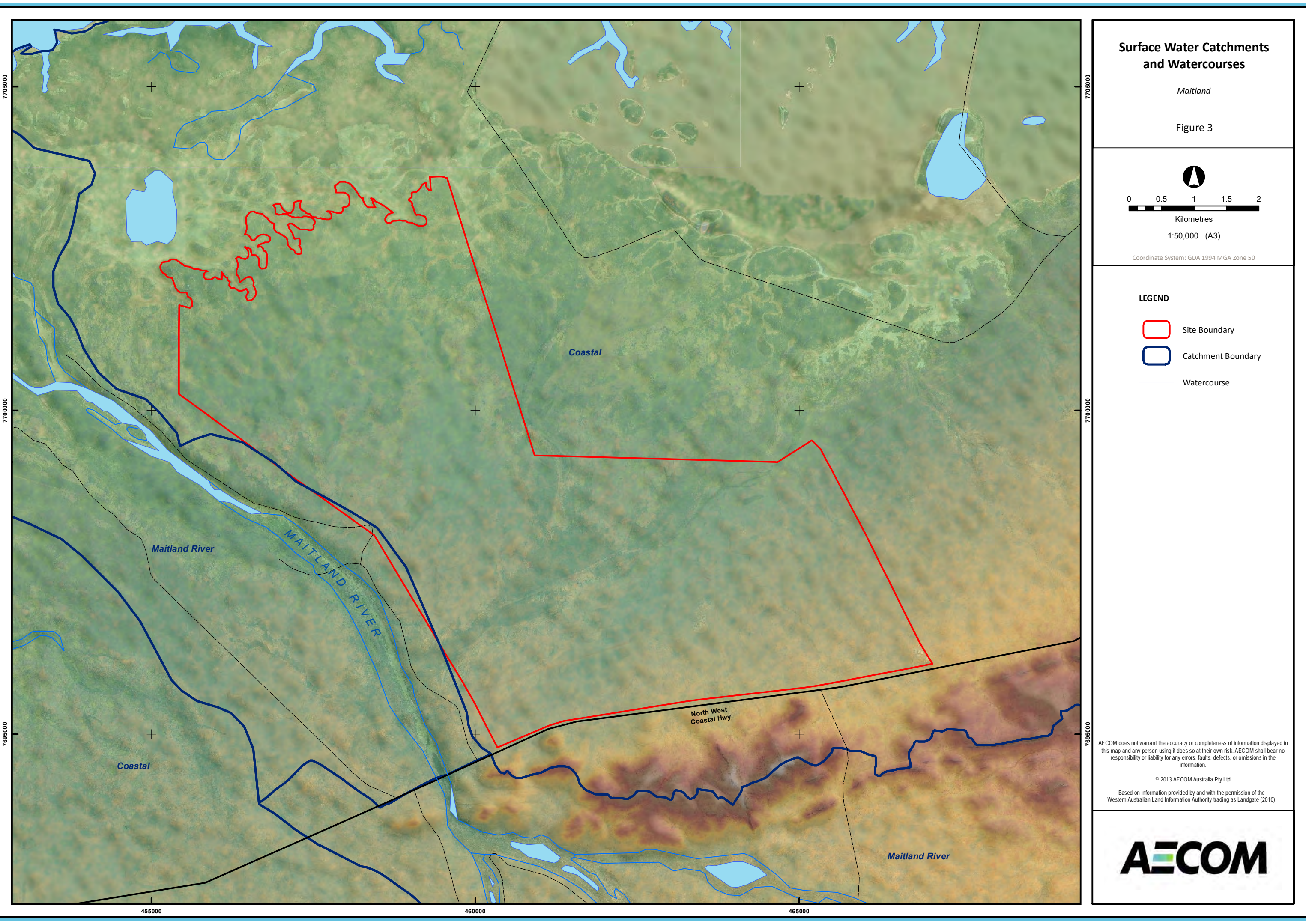
- Development should be located out of natural drainage lines where possible to minimise alterations to natural water flows. This protects ecological flows and minimises modifications required to protect infrastructure.
- Stormwater and storm surge should be diverted around infrastructure areas. Modelling indicates that much of the site is underwater during a peak event so protection systems and fill will be required to bring infrastructure above flood levels to reduce damage.
- Stormwater run-off from potentially contaminated infrastructure areas (refuelling and maintenance areas) should be contained and treated prior to release into the environment.
- Discuss with the Department of Regulation (formerly DEC) to determine the thresholds where the potential for contaminants entering the Maitland River Delta is likely to be considered significant. This has implications particularly with regards to threatened species (Section 4.5, 4.6 and 4.7).

Recommendations for project ready status studies involve:

- 1-year and 5-year runoff studies to assist with the planning of civil infrastructure and for input into the Local Water Management Strategy.
- Local Water Management Strategy at Structure Plan stage.

Recommendations for individual proponents include:

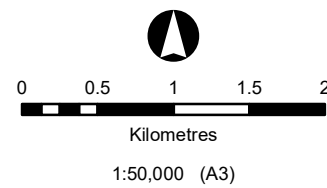
- The detailed survey should be used to design the required water management structures such as channels and/or diversions.
- Monitoring will be difficult to undertake as the drainage lines are dry most of the time. Good housekeeping and audits of management practices may be the best way to track compliance in this regard.
- Individual industries will require works approvals and licencing which may also require surface water management and monitoring.



Surface Water Catchments
and Watercourses



Maitland

Figure 3



Coordinate System: GDA 1994 MGA Zone 50

LEGEND

-  Site Boundary
-  Catchment Boundary
-  Watercourse

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4.4 Groundwater

4.4.1 Introduction

Groundwater occurs throughout the Pilbara, however the quality and quantity of the groundwater varies depending on the hydrogeology of the location. Aquifers range from surficial and sedimentary aquifers to weathered and fractured rock aquifers (Van Vreeswyk et al 2004).

EPA objectives and guidance for water

To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

To ensure that alterations to groundwater flows and quality do not have an adverse impact on beneficial or environmental uses of the water and that the integrity, functions and environmental values of watercourses are maintained.

The *Pilbara Region Water Plan 2010 – 2030* sets strategic directions for the management and development of the Pilbara region water resources. The plan has a long-term view to 2030 and identifies priority actions for implementation over the period to 2015.

DoW has an extensive range of second order policies that apply to its administration of licensing under the RWI Act, and these can be found on the Department website (<http://www.water.wa.gov.au>).

4.4.2 Data Available

The following reports and databases have been referenced for this section of the report given that no specific studies have been undertaken in the study area (Table 3).

Table 4 Groundwater data available

Report	Summary
Van Vreeswyk, A.M.E., A.L. Payne, K.A. Leighton and P. Hennig 2004, An inventory and condition survey of the Pilbara region, Western Australia, Technical Bulletin No. 92, Department of Agriculture, South Perth, Western Australia.	This report is a detailed survey that provides a comprehensive description of the biophysical resources of the Pilbara region, together with an evaluation of the condition of the soils and vegetation throughout.
Appleyard, S.J. 1993, Hydrogeological Assessment of a Proposed Heavy Industry Site Near Karratha, Western Australia, Geological Survey, Perth	This report summarises and analyses the hydrogeological setting within the proposed study area. Information on ground water quality, depth to watertable, groundwater salinity, climate, groundwater use within the area is presented.
AGC Woodward-Clyde Pty Ltd. 1994. Maitland Heavy Industry Estate Public Environmental Review. Prepared for LandCorp and Department of Resources Development.	AGC Woodward-Clyde Pty Ltd. 1994 PER used groundwater data from Appleyard 1993.
Prangle, C.J. 1994, Results of Drilling Investigations at the Proposed Heavy Industry Site Karratha, Western Australia, Geological Survey, Perth	This report presents the results of a drilling program carried out in August 1994 within the study area to determine the underlying geology and the potential for groundwater contamination to occur as a result of industrial activities at the site.
Astron. 2002. <i>The Maitland Heavy Industrial Estate – Assessment and Comparison with the Burrup Peninsula Industrial Estate</i> . Prepared for the Sire of Roebourne	This report is a literature survey and costing exercise for the study area. The report briefly summarises the environmental aspects within the study area and compares the area with the Burrup Industrial Estate.
Department of Water 2013, Hydrogeological Atlas, Data Atlas, Groundwater, (DoW), Government of Western Australia.	This database provides data and information on the hydrogeological setting within the study area. It provides current data and was used to cross-check the Appleyard, 1993 and report and provides further information where information was not valid or relevant anymore.

4.4.3 Department of Water (DoW) groundwater bore database search

A search of the DoW Water Information System (WIN) database was undertaken for groundwater bores within a 5km radius of the Site. Thirteen groundwater bores were identified within a 5 km radius of the Site and are shown on Figure 4. Available information on the groundwater bores are detailed in Table 5.

Given the regional direction of groundwater flow is towards the north-west (refer Section 4.4.4), seven of the bores identified are up gradient of the southern site boundary (and mini LNG Gas Plant). Bore 20050790 is used to water the cattle, with the bore feeding the water tanks within the Site boundary via an underground poly pipe. This bore is located approximately 1 km to the west of the mini LNG gas plant.

Table 5 Registered groundwater bores within 1 km of the Site

WIN Bore ID	Approx. distance from the centre of the Site	Name and Owner	Bore depth (mbgl)	Depth to GW (mbgl)	Current Status	pH	Total alkalinity (mg/L)	TDS (mg/L)	Additional Information
12483806	3500 m north (bore located off Site)	KHIS1. Department of Water (DoW)	18.5	2.8	Operating	7	89	79000	
12501555	2000 m north (bore located within Site)	KHIS2. DoW	10.6	5.6	Operating	8	190	13500	
12503224	600 m northeast (bore located south of central drainage channel)	KHIS3. DoW	3.6	3.1	Operating	Unknown	Unknown	Unknown	
12503298	2500 m southwest (bore located in the south western portion of the Site)	KHIS4. DoW	8.07	5.1	Operating	Unknown	Unknown	Unknown	
12503303	3750m west (bore located along western boundary of Site north of central drainage channel)	KHIS5. DoW	15.2	8.5	Operating	8	180	1800	
12503308	1500m southwest (bore located in the centre of the Site)	KHIS6. DoW	15.2	7.2	Operating	Unknown	Unknown	Unknown	

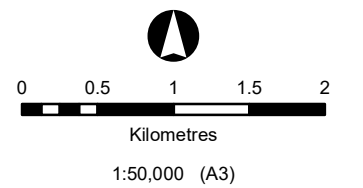
WIN Bore ID	Approx. distance from the centre of the Site	Name and Owner	Bore depth (mbgl)	Depth to GW (mbgl)	Current Status	pH	Total alkalinity (mg/L)	TDS (mg/L)	Additional Information
20050784	4000m north (bore located north of Site boundary)	Shirley- No owner	11.94	3.66	Unknown	Unknown	Unknown	Unknown	Advised by Station Manager this bore is no longer in use
20050785	7500m northeast (bore located north east of Site boundary)	Lawns- No owner	9.45	4.83	Unknown	Unknown	Unknown	Unknown	Advised by Station Manager that this is an old well that has been pushed in
20050788	2750m northeast (bore located within the north eastern corner of Site)	Cheddy No owner	7.01	4.57	Operating	Unknown	Unknown	12120	Advised by Station Manager that this bore is no longer in use.
20050790	3000m southeast (bore located in south eastern portion of site)	Walters- No owner	8.84	4.88	Operating	Unknown	Unknown	1960	Advised by Station Manager that this bore supplies the water for the cattle water tanks.
20050791	4500m southeast (bore is located south of the Site boundary).	Normie- No owner	8.41	6.1	Operating	Unknown	Unknown	Unknown	Advised by Station Manager that this bore is on the opposite side of highway to Site.
20050800	3000m northwest (bore located on the northern boundary)	Crystal – No owner	6.93	5.64	Operating	Unknown	Unknown	3360	Advised by Station Manager that this bore is no longer in use.

WIN Bore ID	Approx.distance from the centre of the Site	Name and Owner	Bore depth (mbgl)	Depth to GW (mbgl)	Current Status	pH	Total alkalinity (mg/L)	TDS (mg/L)	Additional Information
80050801	8500m southwest (bore is located on the western side of Maitland River)	Claypan No owner	6.40	5.38	Operating	Unknown	Unknown	1100	

Department of Water
Groundwater Bore Database
Search

Maitland

Figure 4



Coordinate System: GDA 1994 MGA Zone 50

LEGEND

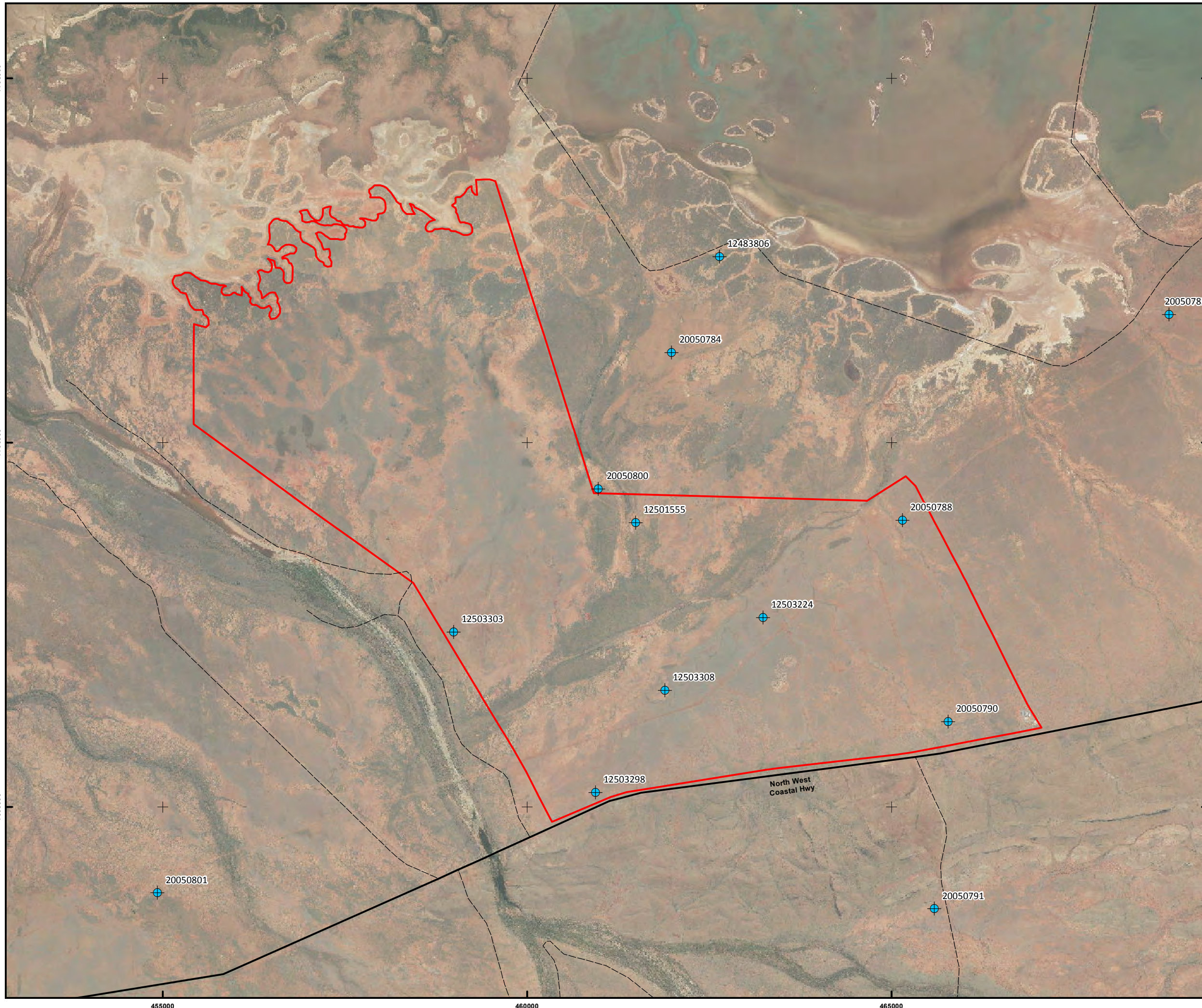
 WIN Bores

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4.4.4 Hydrogeological Setting

There is limited groundwater literature and information regarding the study area. The Appleyard (1993) report suggests the direction of groundwater flow beneath the study area is to the north and northwest. A drilling program was undertaken within the study area in 1994. The program involved 6 boreholes drilled at certain sections using an Edson Versadrill rig (Prangley 1994). The drilling program undertaken in 1994 further confirmed that groundwater flow beneath the study area is to the north and northwest (Prangley 1994). When the Maitland River is flowing, groundwater flows in the western section of the study area tend to reverse as groundwater mounds form in alluvial sediments below the riverbed which causes groundwater to flow away from the river (Appleyard 1993).

Groundwater within the study area generally discharges into the saline coastal flats to the north, and locally by transpiration of vegetation associated with the Maitland River (Appleyard 1993). The hydraulic gradient across the area is approximately 0.001, and the regional hydraulic conductivity is probably less than 1 m/d. This results in a groundwater flow rate of less than 10m/year within the study area (Appleyard 1993).

The quality of groundwater beneath the study area varies greatly depending on the permeability of strata and the position of groundwater in the regional flow system (Appleyard 1993). The drilling program concluded that the best quality groundwater exists at sites to the west of the study area where sediments receive fresh water recharge from the Maitland River (Prangley 1994).

The study area is located within the Pilbara fractured aquifer which consists of Precambrian granite-greenstone terrain overlain by superficial sediments in the river valleys (DoW 2013). The major aquifers within these rocks are quartz veins, and chert layers. Groundwater is mainly fresh, ranging up to brackish towards the coast. Bore yields vary depending on intersection of fractures (DoW 2013). Appleyard 1993 consider groundwater salinity within the study area to be fresh to brackish near the southern boundary and brackish to saline near the northern boundary. Recent data from DoW 2013 indicate that groundwater salinity ranges between 1000-3000mg/L, making it brackish.

The depth of the watertable ranges between approximately 3 to 6m over much of the study area, except near the Maitland River and associated creeks where groundwater may occur at shallow depths in alluvial sediments (Appleyard 1993 and Prangley 1994). Groundwater beneath the area receives recharge during infrequent heavy rainfall associated with tropical cyclones and intense thunderstorms. The sediments throughout the study area generally have low permeability, meaning groundwater recharge results from leakage through alluvial sediments when creeks are flowing (Appleyard 1993).

The aquifers on the Pilbara's coast are relatively small, typically receiving an annual recharge of less than 10 GL/yr. Yet a number of these aquifers are significant because they are the only water sources for the coastal towns and ports (DoW 2010).

They also play an important role during periods of low or no recharge, in sustaining permanent pools – which in turn support ecosystems in an otherwise arid environment.

4.4.5 Data Gaps

A lack of borehole data and other investigative work means that the hydrogeological setting of the study area is not well known (Astron 2002). An original desktop study of the hydrogeological setting was undertaken by the Geological Survey in 1993 (Appleyard 1993), which prompted a drilling program in 1994 (Prangley 1994). It has been 20 years since groundwater testing has occurred within the study area, meaning data may be out-dated and invalid. The Public Environmental Review (PER) (AGC Woodward-Clyde Pty Ltd. 1994) contained the same information as the Appleyard (1993) report.

4.4.6 Recommendations

Prangley (1994) indicates that there is the potential for contamination of groundwater within the site, and this combined with the minimal information on groundwater within the study area indicates further investigations would be useful to inform a groundwater management strategy and to establish a baseline against which to monitor for potential contamination and to bring the understanding of hydrogeology of the area up to the current expected standards.

If EAG 9 is applied and it can be shown that impacts to groundwater are unlikely then Groundwater would not be assessed as a key factor. This will depend on whether it is likely that groundwater will be extracted for the estate water supply.

If landusers are going to be using groundwater for their industrial needs then further studies will provide data on potential yields, water quality and recharge in response to drawdown. Alternatively, if it can be proved that impacts will be assessed under the RIWI Act, then Groundwater will not be assessed as a key factor by the EPA.

In terms of planning recommendations to bring the site to project ready status include:

- Two wet seasons of monthly groundwater level monitoring (additional bores may be required for sufficient density and this can be confirmed with DoW).
- One round of water quality monitoring to establish baseline water quality.

This is likely to be relevant at proponent stage.

4.5 Flora and Vegetation

4.5.1 Introduction

The native flora of Western Australia is protected under the provisions of the *Wildlife Conservation Act 1950*, making it an offence to remove or harm any native flora species without approval. Any clearing of native vegetation is controlled under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Where there is a significant impact on threatened flora, threatened ecological communities or large areas of clearing are required, approval under the EP Act and/or EPBC Act may be required.

This section incorporates the desktop study completed for the Level 1 Flora Assessment completed by AECOM as part of this project review.

4.5.2 Objectives and Guidance for Flora and Vegetation

To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

Other EPA guidance for flora and vegetation studies is the Guidance for the assessment of environmental factors – Terrestrial flora and vegetation surveys for Environmental Impact Assessment in Western Australia, Guideline 51 (EPA 2004).

A Detailed Survey (EPA 2004) is one that:

- incorporates background research and a Reconnaissance survey
- verifies the accuracy of the background study
- further delineates and characterises the flora and the range of vegetation units present in the target area
- identifies potential impacts
- involves a target area visit by suitably qualified personnel to undertake selective low intensity sampling of the flora and vegetation; and to produce maps of vegetation units and vegetation condition at an appropriate scale
- enhances the level of knowledge at the locality level
- includes one or more visits in the main flowering season and visits in other seasons
- includes replication of plots in vegetation units, and greater coverage and displacement of plots over the target area.

4.5.3 Data Available

The following data sources have been reviewed for this gap analysis (Table 6).

Table 6 Data available for flora and vegetation

Report	Summary
AGC Woodward-Clyde Pty Ltd. 1994. <i>Maitland Heavy Industry Estate Public Environmental Review</i> . Prepared for LandCorp and Department of Resources Development.	This report is a technical review of the proposed estate development, incorporating input from the public consultation process. The report outlines both key issues and potential impacts.
Mattiske Consulting Pty Ltd. 1994. <i>Karratha Heavy Industry Site Study – Flora, Vegetation and Vertebrate Fauna</i> . Prepared for AGC Woodward-Clyde Pty Ltd	This survey was undertaken in 1994. The methods used are consistent with what is currently referred to as Level 1 assessment under EPA Guidance Statement 51 (EPA 2004)
Astron. 2002. <i>The Maitland Heavy Industrial Estate – Assessment and Comparison with the Burrup Peninsula Industrial Estate</i> . Prepared for the Shire of Roebourne	This report is a literature survey and costing exercise for the study area. The report briefly summarises the environmental aspects within the study area and compares the area with the Burrup Industrial Estate
Department of Environment and Conservation, 2009. <i>Records held in DEC's Declared Flora Database</i> . Perth, Western Australia: DEC.	This is a search of the proposed study area against records in the DPaW's Declared Flora Database
Department of Environment and Conservation. 2013. <i>Naturemap – Mapping Western Australia's Biodiversity Search</i> . Search created on 31 July 2013	This is a search using DPAW's Naturemap service, providing records of not just Threatened and Rare Flora but all species recorded in a given area
Environmental Protection Authority, 2004. Guidance for the Assessment of Environmental Factors. Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 51, June, 2004.	This is a guidance statement by the EPA on assessment for fauna surveys in Western Australia for Environmental Impact Assessment.
EPBC Act Protected Matters Search Report. Report created: 18/02/13	This is a search of Protected Matters under the EPBC act, within the study area of Maitland.

4.5.4 Desktop Assessment

4.5.4.1 Vegetation Assemblages of the MIE

Thirty-four vascular plant species, including two weeds, from 16 families and 30 genera were recorded at the proposed MIE and service corridor during a site visit in April 1994 by Mattiske and Associates (1994). The species composition in this area was considered low, due to the poor condition of the rangeland (Mattiske 1994).

Typical of the area were hummock grasslands of *Triodia pungens* and tussock grasslands of *Eragrostis xerophila*, with low-lying areas dominated by the grass *Xerochloa barbata* and seasonal ephemerals. Emergent shrubs of *Acacia inaequilatera*, *Acacia coriacea* and *Hakea suberea* occur in drainage lines. Pockets of snakewood (*Acacia xiphophylla*) were considered to formerly exist at the site but had been eliminated by stock (Mattiske 1994).

Plant communities mapped by Mattiske (1994) for the MIE were:

- Sandy surfaced alluvial plain of hummock grassland of *Triodia pungens* and tussock grassland of *Eragrostis xerophila* with scattered shrubs and trees of *Acacia coriacea*, *Acacia inaequilatera* and *Hakea suberea*. Some parts were considered severely degraded and eroded (Mattiske 1994).
- Mosaic of tussock grassland of *Eragrostis xerophila* and depressions of *Xerochloa barbata* with seasonal ephemerals on weakly gilgaied soils (Mattiske 1994).
- Mosaic of tussock grassland of *Eragrostis xerophila* and hummock grassland of *Triodia pungens* and *Triodia wiseana* with depressions of *Xerochloa barbata* and seasonal ephemerals on weakly gilgaied soils (Mattiske 1994).

- Coastal mudflats of Chenopods such as *Halosarcia halocnemoides* ssp. *Halocnemoides*, *Halosarcia indica* ssp. *Leiostachya*, *Muellerolimon salicorniaceum*, and grasses such as *Eragrostis xerophila* and *Sporobolus virginicus* (Mattiske 1994).
- Sandy coastal plain of hummock grassland of *Triodia pungens* and *Triodia wiseana* with littoral drainage of chenopods. Some parts were considered severely degraded and eroded (Mattiske 1994).

4.5.4.2 Threatened and Priority Flora

Mattiske (1994) found 5 vascular plant species classified on the then “Declared Rare and Priority Flora List” were expected to occur. Of these five species, *Brachychiton acuminatus* and *Triumfetta appendiculata* were recorded during the survey, but not at the Maitland site, during field surveys in April and August 1994. Both of these species are not on the Priority species list (2013) and are currently classified as Not Threatened.

Zygophyllum retivalve (formerly known as *Zygophyllum retivalve* sp. Karratha) was expected to occur and was previously listed as a Priority 3 species. This species is currently classified as Not Threatened.

Two remaining Priority 3 species were expected to occur but were not recorded. These were *Acacia glaucochaesia* and *Terminalia supranitfolia*. These two species are currently classified as Priority 3 (DPAW 2013).

Table 7 Priority listing classifications

Priority level	Explanation
Priority One: Poorly-known species	Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation and under threat of habitat destruction or degradation.
Priority Two: Poorly-known species	Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation.
Priority Three: Poorly-known species	Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat.
Priority Four: Rare, Near Threatened and other species in need of monitoring	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
Priority Five: Conservation Dependent species	Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

4.5.4.3 Introduced Species

Mattiske (1994) recorded two species of introduced flora at the proposed MIE. These were *Passiflora foetida* var. *hispidula* and *Cenchrus ciliaris* (Buffel grass). The Buffel grass specifically, was widely distributed throughout the station, with a concentration near watering points (Mattiske 1994).

4.5.5 Regional Vegetation

The study area is located in the Roebourne sub-region of the Pilbara IBRA region. The Roebourne sub-region is found on Quaternary alluvial and older colluvial coastal and subcoastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands. Samphire, *Sporobolus* and mangal occur on marine alluvial flats and river deltas. Resistant linear ranges of basalts occur across the coastal plains, with minor exposures of granite (DEC 2002). The Roebourne subregion has 98.98% of its pre-European extent remaining.

Table 8 Pre-European and Current Extent of Vegetation that occurs within the IBRA Region and IBRA Subregion

	Pre-European Extent (ha)	Current Extent (ha)	Percentage Remaining (%)
Pilbara region	17,804,193.01	17,785,000.82	99.89
Roebourne subregion	1,844,157.25	1,825,336.52	98.98

4.5.6 Land Systems

A land system is an area of land, distinct from surrounding terrain, within which particular classes of land features are consistently associated and are expressed as a recurring sequence of particular land components. These land components generally occur in similar proportions and have similar interrelations in each occurrence of a particular land system.

Approximately 81% of Australia is considered rangelands, and holds cultural significance to the Indigenous people (DSEWPac 2008). Rangelands spread across low rainfall and variable climates. These climates include arid, semi-arid and some seasonally high rainfall conditions north of the Tropic of Capricorn (DSEWPac 2008). Rangelands consist of a diverse group of moderately undisturbed ecosystems such as woodlands, shrublands, savannahs and grasslands. Rangelands cover a huge diversity of habitats and ecological communities with 53 of Australia's 85 bioregions including some form of rangeland ecosystems (DSEWPac 2008).

There are four land systems within the Maitland study area as listed in Table 9.

Table 9 Land Systems within the study area

Land Systems	Description	Land Type	Area (ha)	% of Study Area
Cheerawarra Land System	Sandy coastal plains and saline clay plains supporting soft and hard spinifex grasslands and minor tussock grasslands	Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation	738	16.1
Horseflat Land System	Gilgaied clay plains supporting tussock grasslands and minor grassy snakewood shrublands.	Alluvial plains with tussock grasslands	3431	74.9
Littoral Land System	Bare coastal mudflats with mangroves on seaward fringes, samphire flats, sandy islands, coastal dunes and beaches.	Coastal plains, cliffs, dunes, mudflats and beaches; various vegetation	4	<0.1
Mallina Land System	Sandy surfaced alluvial plains supporting soft spinifex (and occasionally hard spinifex) grasslands.	Alluvial and sandy plains with soft spinifex grasslands	405	8.8
Totals	-	-	4578	100

4.5.7 Habitat Types

There are three main habitat types in the area as noted in the field visit. These consist of:

- 1) Open grassland consisting of aggressive weed species including Buffel Grass (**Cenchrus ciliaris*) and Kapok Bush (**Aerva javanica*) with mixed native grasses and herbs;
- 2) Open grassland consisting of dominant vegetation type Paddock, considered as degraded in condition, and several smaller areas of *Triodia* species, lacking any mid- or upper-storey strata.
- 3) Open creekline which bisects the study area, characterised by clay soils with hummock grassland and open shrubland.

4.5.8 Threatened and Priority Flora

There are no threatened species in the area as per 2013 lists, but there are two P1, two P2, 13 P3 and one P4 species potentially occurring in the MIE. These are listed in Table 10.

Table 10 Threatened and Priority Flora

Species	DEC Priority Rank	Habitat	Flowering Period
<i>Acacia glaucocaesia</i>	P3	Red loam, sandy loam, clay. Floodplains.	Jul-Sep
<i>Atriplex lindleyi</i> subsp. <i>conduplicata</i>	P3	Crabhole plains	
<i>Eragrostis lanicaulis</i>	P3	Red sandy clay. Flats	Mar-May/Aug-Oct
<i>Eragrostis surreyana</i>	P3		May-Sep
<i>Gomphrena cucullata</i>	P2	Red sandy loam, clayey sand. Open floodplains	Feb, May
<i>Gomphrena leptophylla</i>	P3	Sand, sandy to clayey loam, granite, quartzite. Open flats, sandy creek beds, edges salt pans & marshes, stony hillsides.	Mar-Sep
<i>Gomphrena pusilla</i>	P2	Fine beach sand. Behind foredune, on limestone	Mar-Apr, Jun
<i>Goodenia pallida</i>	P1	Red soils.	Aug
<i>Gymnanthera cunninghamii</i>	P3	Sandy soils.	Apr, Dec
<i>Nicotiana heterantha</i>	P1	Black clay. Seasonally wet flats	May-Jun
<i>Phragmites karka</i>	P3		
<i>Polymeria distigma</i>	P3	Sandy soils.	Jul-Sep
<i>Pterocaulon intermedium</i>	P3		Aug-Oct
<i>Rhynchosia bungarensis</i>	P4	Pebbly, shingly coarse sand amongst boulders. Banks of flow line in the mouth of a gully in a valley wall.	May-Dec
<i>Stackhousia clementii</i>	P3	Skeletal soils. Sandstone hills	
<i>Terminalia supranitifolia</i>	P3	Among basalt rocks	May, July, Dec
<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	P3	Red clay. Clay pan, grass plain	Aug
<i>Vigna</i> sp. rockpiles (R. Butcher et al. RB 1400)	P3		May

4.5.9 Introduced Species

Eight weeds are considered to potentially occur within the study area and are listed in Table 11.

Table 11 Invasive flora species that may occur within the Project Area

Species	Description	Habitat	Flowering period	Declared
<i>Cenchrus ciliaris</i> (Buffel Grass)	A tufted or sometimes stoloniferous perennial, grass-like or herb and grows to a height of between 0.2-1.5 m with purple flowers.	This species occurs in white, red or brown sand, stony red loam or black cracking clay	Feb-Oct	No
<i>Jatropha gossypifolia</i> (Bellyache)	An erect, viscid shrub. Grows to between 0.7-1.5 (sometimes 4) m high. Flowers are red-brown coloured	Occupies disturbed areas and often near rivers	Jan-May	Yes
<i>Opuntia</i> spp. (Prickly Pear)	A spreading to erect shrub and grows to 2 m high with yellow flowers	Sandy soils.		Yes
<i>Parkinsonia aculeata</i>	A spiny shrub or tree. Grows to 8 m high. Has yellow flowers.	Occurs in sandy or clayey soils and often found along watercourses	Mar, May-Dec	Yes
<i>Prosopis</i> spp. (Mesquite)	A spiny tree or shrub, grows to 10 m high. Has green-white-cream-yellow coloured flowers.	Alluvial red silty soils and semi-saline clay plains or coastal plains	Jul-Oct	Yes
<i>Passiflora foetida</i>	A woody climber (vine with unpleasant smell) that grows to 9 m high.	Occurs in coastal areas, rivers and creek banks	Feb-Nov	No
<i>Portulaca oleracea</i>	A succulent, prostrate to decumbent annual, herb that grows to 0.2 m high	Clay loam, sand and often in disturbed sites	Apr-May	No
<i>Setaria italica</i>	A tufted annual, grass-like or herb that grows to between 0.3 – 1.5 m high.	Generally recorded in sand.		No

4.5.10 Field Investigation

A field investigation was undertaken by an experienced botanist on 22 August 2013. The site was traversed by vehicle and the ecological values of the area were investigated by assessing the vegetation communities and their extent, and developing a fauna species list. The current land use of the study area is pasture and this has led to the degradation of original environmental values. There were three vegetation communities identified in the study area (as shown in Figure 5).

The dominant vegetation type was Paddock, considered as degraded in condition. This vegetation community consisted of aggressive weed species including Buffel Grass (**Cenchrus ciliaris*) and Kapok Bush (**Aerva javanica*) with mixed native grasses and herbs. A large creekline bisects the study area, characterised by clay soils with hummock grassland and open shrubland. In addition there were several smaller areas of *Triodia* species, lacking any mid- or upper-storey strata.

4.5.11 Clearing of Native Vegetation

Very little native vegetation was evident in areas outside the Maitland River tributary. Given this and the degraded condition of the site it is unlikely that a clearing permit would be required, unless fauna surveys reveal that the area is important habitat for threatened fauna.

4.5.12 Environmentally Sensitive Areas

There are no Environmentally Sensitive Areas (ESAs) as declared under section 51B of the EP Act, within the study area. The closest ESAs to the study area are the associated islands of the Dampier Archipelago located approximately 16km north.

4.5.13 Threatened and Priority Ecological Communities

The Protected matter search did not list any Threatened Ecological Communities, however the DPaW search listed two possible Priority Ecological Communities (PEC). It was considered that the “paddock grasses” might be part of the Priority Ecological community (PEC) Roebourne Plains coastal grasslands with gilgai microrelief on deep cracking clays (Roebourne Plains gilgai grasslands) (Priority 1), but discussions with DPaW (Stephen van Leeuwen) suggest it is unlikely. It is described as:

The Roebourne Plains coastal grasslands with gilgai micro-relief occur on deep cracking clays that are self-mulching and emerge on depositional surfaces. The Roebourne Plains gilgai grasslands occur on microrelief of deep cracking clays, surrounded by clay plains/flats and sandy coastal and alluvial plains. The gilgai depressions supports ephemeral and perennial tussock grasslands dominated by *Sorghum* sp. and *Eragrostis xerophila* (Roebourne Plains grass) along with other native species including *Astrelba pectinata* (barley mitchell grass), *Eriachne benthamii* (swamp wanderie grass), *Chrysopogon fallax* (golden beard grass) and *Panicum decompositum* (native millet). Restricted to the Karratha area, this community differs from the surrounding clay flats of the Horseflat land system which are dominated by *Eragrostis xerophila* and other perennial tussock grass species (*Eragrostis* mostly). Threats: Grazing, clearing for mining and infrastructure and urban development, weed invasion, basic raw material extraction.

Or

Horseflat land system of the Roebourne Plains (Priority 3) (Does not include priority ecological communities “Roebourne Plains gilgai grasslands” and the “Chenopod association of the Roebourne Plains area”). The Horseflat Land System of the Roebourne Plains are extensive, weakly gilgaied clay plains dominated by tussock grasslands on mostly alluvial non-gilgaied, red clay loams or heavy clay loams. Perennial tussock grasses include *Eragrostis xerophila* (Roebourne Plains grass) and other *Eragrostis* spp., *Eriachne* spp. and *Dichanthium* spp. The community also supports a suite of annual grasses including *Sorghum* spp. and rare *Astrelba* spp. The community extends from Cape Preston to Balla Balla surrounding the towns of Karratha and Roebourne. This community incorporates Unit 3 (Gilgai plains), Unit 5 (Alluvial Plains) with some Unit 7 (Drainage Depressions) described in Van Vreeswyk et al. 2004. Threats: grazing, weed invasion, fragmentation.

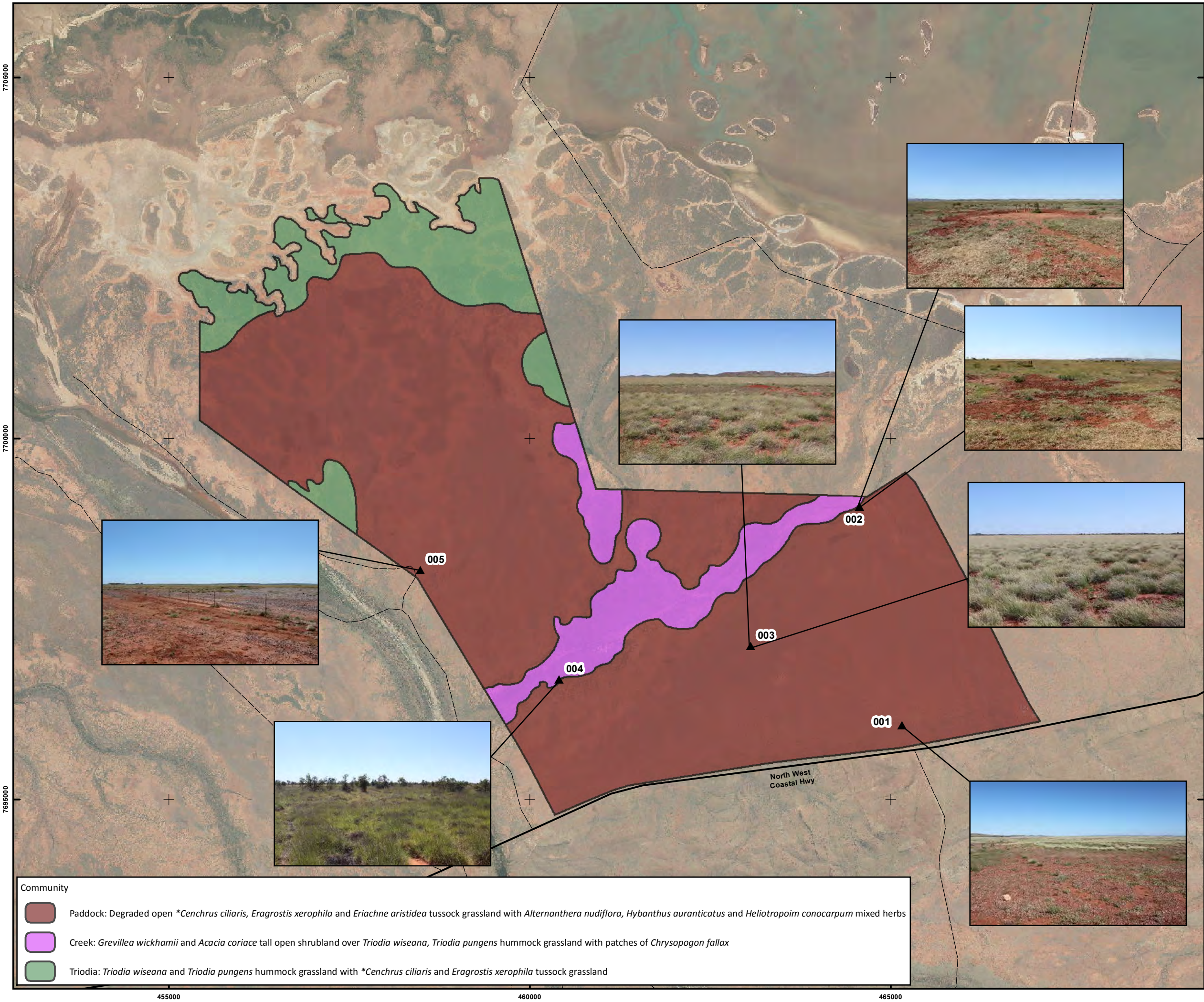
4.5.14 Data Gaps

The Survey undertaken by Mattiske (1994) was not completed under any specific guidance and is unlikely to conform to Level 2 survey requirements under Guidance Statement 51. Data regarding listed species and communities is well out of date and requires updating.

The site itself is a large paddock of buffel grass, heavily degraded by cattle grazing and has very little original environmental features that if disturbed would constitute a significant environmental impact. Endemic species remaining were essentially confined to the creekline tributary which would potentially be retained as a drainage channel. This area also was heavily grazed by cattle and highly degraded. The desktop survey presented above could be used to demonstrate that development of the site will not constitute a significant impact on native flora and vegetation.

4.5.15 Recommendations

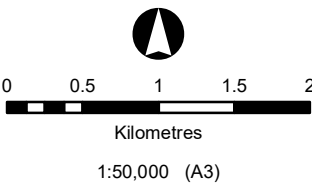
DPW was consulted with respect to the possibility that the PEC may occur in this area. Advice from S. van Leeuwin (Pers comm.) was that this was unlikely given the proximity of the area to the coast. It would seem unnecessary that further studies are required given the degraded condition of the site and its long history of cattle grazing. Confirmation from DER/DPaW is always useful and can provide more certainty whether to undertake further studies.



Vegetation Mapping

Maitland

Figure 5






Coordinate System: GDA 1994 MGA Zone 50

LEGEND

▲ Waypoints

Community

-  Paddock: Degraded open **Cenchrus ciliaris*, *Eragrostis xerophila* and *Eriachne aristidea* tussock grassland with *Alternanthera nudiflora*, *Hybanthus auranticatus* and *Heliotropium conocarpum* mixed herbs
-  Creek: *Grevillea wickhamii* and *Acacia coriacea* tall open shrubland over *Triodia wiseana*, *Triodia pungens* hummock grassland with patches of *Chrysopogon fallax*
-  Triodia: *Triodia wiseana* and *Triodia pungens* hummock grassland with **Cenchrus ciliaris* and *Eragrostis xerophila* tussock grassland

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4.6 Terrestrial Fauna

4.6.1 Introduction

All fauna species in Western Australia are protected under the *Wildlife Conservation Act 1950*, making it an offence to remove or harm native fauna species without approval. If a project has the potential to disturb habitat or threaten a population of native fauna, this disturbance may require assessment under the EP Act. Where Matters of National Environmental Significance are present within the proposed disturbance area, referral under the EPBC Act should be considered.

EPA Objectives and Guidance for Fauna

To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystems levels through the avoidance or management of adverse impacts and improvement of knowledge.

Guidance for surveys of fauna for environmental impact assessment in Western Australia is available through Position Statement No 3. "Terrestrial Biological Surveys as an Element of Biodiversity Protection" (EPA, 2002) and Guidance Statement No 56 "Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia" (EPA, 2004), Significant impact guidelines 1.1, Matters of National Environmental Significance (DEWHA 1999) and EPBC Act Policy Statement 3.25, EPBC Act referral guidelines for the endangered northern quoll, *Dasyurus hallucatus*.

4.6.2 Data Available

Reports reviewed and referred to in this section are listed in Table 12.

Table 12 Fauna data available

Report/Search	Summary
AGC Woodward-Clyde Pty Ltd. 1994. <i>Maitland Heavy Industry Estate Public Environmental Review</i> . Prepared for LandCorp and Department of Resources Development.	This report is a technical review of the proposed estate development, incorporating input from the public consultation process. The report outlines both key issues and potential impacts.
Mattiske Consulting Pty Ltd. 1994. <i>Karratha Heavy Industry Site Study – Flora, Vegetation and Vertebrate Fauna</i> . Prepared for AGC Woodward-Clyde Pty Ltd.	Field survey where 24 species of bird, three mammal species and 10 reptile and frog species recorded.
Astron Environmental. 1994. <i>Proposed Maitland Heavy Industry Estate. Marine Survey of Intertidal and Shallow Marine Habitats</i> . Prepared for LandCorp and Department of Resources Development.	Relates to marine habitat and not relevant to the MIE.
Department of Environment and Conservation, 2013. <i>Threatened and Priority Fauna Database</i> . The search was conducted within the vicinity of Maitland with a 15 km buffer	26 listed species were recorded as potentially occurring within the study area, but 3 are marine species and 16 are migratory birds.
Department of Environment and Conservation. 2013. <i>Naturemap – Mapping Western Australia's Biodiversity Search</i> . Search created on 31 July 2013	This is a search using DPaW's Naturemap service, providing records of not just Threatened and Rare Fauna but all species recorded in a given area.
Environmental Protection Authority, 2004. <i>Guidance for the Assessment of Environmental Factors. Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia</i> . Guidance Statement No. 56, June, 2004.	This is a guidance statement by the EPA on assessment for fauna surveys in Western Australia for Environmental Impact Assessment.

Report/Search	Summary
EPBC Act Protected Matters Search Report. Report created: 18/02/13	16 EPBC species listed as potentially occurring at MIE. Ten are marine species and are not likely to occur at MIE. The two species most likely to occur are the Northern Quoll and the Pilbara Olive Python although there are no rocky creeklines which are the main habitat for these species. 33 migratory species have the potential to occur at MIE.
Birddata. Search undertaken on 31 July 2013	An online repository of bird records within Australia. Search was conducted for the Karratha Postcode

4.6.3 Desktop Assessment

Fauna Habitat

Five main terrestrial faunal habitats were identified in the study area by Matiske Consulting (1994).

These habitats were:

- tussock grassland of *Eragrostis xerophila* on weakly gilgaied alluvial plains. Considered badly degraded in some areas
- hummock grasslands of *Triodia* spp. on reddish sand. Some areas of scattered *Acacia inaequilatera*. Considered badly degraded in some areas
- wooded creek lines of *Acacia coriacea* over grasses over tussock grasses of *Eragrostis xerophila* (and others) and/or hummock grasses of *Triodia pungens* on reddish-brown loamy-clay. Condition varied from light disturbance to badly degraded. Some creeklines were expected to contain pools for some time following good rains
- low open shrubland of *Acacia coriacea* over a sparse understorey (Not on the Mainland site)
- grasses with minor occurrences of *Eucalyptus* spp. on rocky substrata (Not on Mainland Site).

Matiske (1994) considered the MIE to have been subject to significant disturbance by human activities such as grazing, roads and fire.

A field survey undertaken in August 2013 found the current fauna habitat to be mostly consistent with the Matiske 1994 results. The site is still heavily degraded and subject to invasion by weeds and grazing animals such as cattle. Fauna habitat as recorded in the field investigation includes:

- Paddock grassland consisting of *Cenchrus ciliaris*, *Eragrostis xerophila* and *Eriachne aristidea* tussock grassland with *Alternanthera nudiflora*, *Hybanthus auranticatus* and *Heliotropium conocarpum* mixed herbs.
- Creekline community of *Grevillea wickhamii* and *Acacia coriacea* tall open shrubland over *Triodia wiseana*, *Triodia pungens* hummock grassland with patches of *Chrysopogon fallax*.
- Hummock grassland of *Triodia wiseana* and *Triodia pungens* with *Cenchrus ciliaris* and *Eragrostis xerophila* tussock grassland.

Fauna as per Matiske (1994)

Twenty-four (24) species of bird were recorded at the mainland sites during a two day survey conducted by Matiske and Associates in April 1994. With intense seasonal surveys, a further 166 species were expected to occur, including a number of wading and waterbird species (Matiske 1994) in the coastal areas.

Three mammal species were recorded, and a further 31 would be expected to occur including three introduced species. Ten (10) species of reptile and frog were recorded and a further 116 were expected to occur at this site (Matiske 1994).

A desktop review of current databases is outlined in Table 14.

Threatened and Priority Fauna

Seven species of vertebrate fauna that was, at the time of Mattiske (1994) survey, gazetted on the Wildlife Conservation (Specially Protected Fauna) Notice were expected to occur at the MIE. Note that the areas considered included the coastal and offshore sections of the larger proposed industrial estate so some results will not be relevant to the MIE area.

Protected species that were expected to occur in 1994 are listed in Table 13. The Dugong, Loggerhead Turtle, Leatherback Turtle and Saltwater Crocodile are not expected to occur at the Maitland site.

Table 13 Threatened and Priority fauna species expected to occur in the Maitland industrial area from Mattiske (1994)

Species	Status (as at time of Study)	Status (Current)	Habitat	Comments	Likelihood of Occurrence
Dugong (<i>Dugong dugon</i>)	Schedule 4 (WC Act)		Shallow tropical seas with sandy bottoms and growth of sea grasses	Many of the shallow bays and areas between the islands of the Dampier Archipelago are used by the dugongs for feeding on sea grasses	Unlikely
Peregrine Falcon (<i>Falco peregrinus macropus</i>)	Schedule 4 (WC Act)		Most Pilbara records are from hilly country, particularly the Hamersley Range	Major reason for decline of this species is due to birth defects and egg shell thinning due to pesticide ingestion, falconry, illegal trade and shot as a pest in some areas	May fly over the area
Grey Falcon (<i>Falco hypoleucos</i>)	Schedule 1 (WC Act)		Most Pilbara records are from coastal areas	The main threats to this species include over grazing of arid rangelands and vegetation clearance in the semi-arid zone for farming.	May fly over the area
Loggerhead Turtle (<i>Caretta caretta</i>)	Schedule 1 (WC Act)		Mangroves, open ocean and beaches when laying eggs	The Australian breeding population of southern Queensland has declined by 50-80% in the 15 years pre-dating 1994.	Unlikely
Leatherback Turtle (<i>Dermochelys coriacea</i>)	Schedule 1 (WC Act)		Open Ocean	No significant nesting had been recorded in Australia at the time of the study	Unlikely
Pilbara Olive Python (<i>Morelia olivacea barroni</i>)	Schedule 1 (WC Act)		Rocky areas and river pools	The Pilbara Olive Python is a subspecies of the widespread tropical Olive Python. It would be most likely found inhabiting the rockpile areas on West Intercourse Island	Possible that this species may pass through the area.
Saltwater Crocodile (<i>Crocodylus porosus</i>)	Schedule 4		Mangroves and open ocean	Sightings at Port Hedland and offshore from Onslow indicate the species may be present	Unlikely

Table 14 Threatened and priority species as per the 2013 DPaW search

Species	DEC Priority Rank	EPBC status	Habitat	Records	Likelihood of Occurrence
Dugong <i>Dugong dugon</i>	s	Migratory	Marine		Unlikely
Ghost Bat <i>Macroderma gigas</i>	4	-	Cave	Two - 1 West Intercourse Island 1 near Yanyare River West, Karratha Station	Unlikely
Northern Quoll <i>Dasyurus hallucatus</i>	T	Endangered		Six - 3 in the Karratha area, 2 along Hamersley Iron Rail and 1 unspecified	Possible
Short-tailed Mouse, Karekanga <i>Leggadina lakedownensis</i>	4	-		Two both in the Dampier Area	Possible
Little North-western Mastiff Bat <i>Mormopterus loriae subsp. cobourgiana</i>	1		Cave	One on West Intercourse Island	Unlikely
Australian Peregrine Falcon <i>Falco peregrinus subsp. macropus</i>	S	-		One on West Intercourse Island	Possible
Bar-tailed Godwit <i>Limosa lapponica</i>	IA	Migratory	marine	One at Dampier Salt Works	Possible species or species habitat known to occur in the area
Bridled Tern <i>Onychoprion anaethetus</i>	IA	Migratory	marine	Two, both at Haycock	Likely – breeding known to occur in the area
Bush Stone-curlew <i>Burhinus grallarius</i>	4	-	Terrestrial bird	One at West Intercourse Island	Possible
Common Greenshank <i>Tringa nebularia</i>	IA	Migratory	Marine	Two -One at Dampier Salt Works and one unspecified	Possible species or species habitat known to occur in the area

Species	DEC Priority Rank	EPBC status	Habitat	Records	Likelihood of Occurrence
Curlew Sandpiper <i>Calidris ferruginea</i>	T	Migratory	Marine	3 records all at Dampier Salt Works	Possible species or species habitat known to occur in the area
Eastern Great Egret <i>Ardea modesta</i>	IA	Migratory	Wetland	8 Records all at Mairee Pool, Maitland River	Possible
Eastern Reef Egret, Eastern Reef Heron <i>Egretta sacra</i>	IA	Migratory	Marine	Two both at Dampier Salt Works	Unlikely
Great Knot <i>Calidris tenuirostris</i>	T	Migratory	Marine	One at Dampier Salt Works	Unlikely
Grey Plover <i>Pluvialis squatarola</i>	IA	Migratory	Marine	One at Dampier Salt Works	Unlikely
Pin-tailed Snipe <i>Gallinago stenura</i>	IA	-	Wetland	Mairee Pool, Maitland River	Possible
Rainbow Bee-eater <i>Merops ornatus</i>	IA	Migratory	Wetland/Terr estrial	29 records, 25 from Mairee Pool, Maitland River and four unspecified	Possible
Red Knot <i>Calidris canutus</i>	IA	Migratory	Wetland	One at Dampier Salt works	Unlikely
Red-necked Stint <i>Calidris ruficollis</i>	IA	Migratory	Wetland	Two at Dampier Salt Works	Unlikely
Ruddy Turnstone <i>Arenaria interpres</i>	IA	Migratory	Wetland	Three at Dampier Salt Works	Unlikely
Sanderling <i>Calidris alba</i>	IA	Migratory	Wetland	One at Dampier Salt works	Unlikely
Whimbrel <i>Numenius phaeopus</i>	IA	Migratory	Wetland	One unspecified location	Unlikely
White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i>	IA	Migratory	Marine/Terre strial	Five – one at Mairee Pool, three at Dampier Salt works and one unspecified	Possible, breeding known to occur within area
Wood Sandpiper <i>Tringa glareola</i>	IA	-	Marine	Two both at Mairee Pool	Unlikely
Flatback Turtle	T	Vulnerable	Marine	No record	Unlikely
Green Turtle	T	Vulnerable	Marine	No record	Unlikely

Species	DEC Priority Rank	EPBC status	Habitat	Records	Likelihood of Occurrence
Lined Soil-crevice Skink	4		Terrestrial	9 records within 5km of MIE and 4 on WI island	Likely

Reserve Species

At the time of the Mattiske survey, the Threatened Fauna Scientific Advisory Committee prepared a “Reserve List” which included animals:

- that had recently been removed from the list of threatened fauna
- that had a restricted distribution, were uncommon or declining in range and/or abundance, but which did not meet the criteria for listing as threatened fauna, and
- for which there was insufficient information for the committee to make an assessment of their status.

Currently, the DPaW Priority rankings include species that come under one or a combination of the three categories as listed above.

Those species that were on the Reserve List at the time of study and were expected to occur within the Maitland Industrial site were:

- Square-tailed Kite (*Lophoictinia isura*)
- Black-breasted Buzzard (*Hamirostra melanosternon*)
- Painted Snipe (*Rostratula benghalensis australis*)
- Eastern Curlew (*Numenius madagascariensis*)
- Long-toed Stint (*Calidris subminuta*)
- Roseate Tern (*Sterna dougallii gracilis*)
- Little Tern (*Sterna sinensis*)
- Fairy Tern (*Sterna nereis nereis*)
- Mangrove Kingfisher (*Halcyon chloris pilbara*)

The main impact on the above species was considered to be from the loss of coastal habitat and mangrove areas, reducing food resources. Coastal habitat does not form part of this project, therefore impacts to these species are unlikely.

4.6.4 Data Gaps

Guidance Statement 56 recommends that for Level 2 Surveys several surveys are to be undertaken over different seasons until a high percentage of the faunal assemblage has been recorded. In practice the survey effort required to achieve this is extensive and usually beyond the time and resources of the project. In reality surveys are required to be undertaken at a minimum over two different seasons with sufficient/comprehensive sampling intensity for the species expected to occur.

The surveys at Maitland consisted of broad scale fauna observations undertaken 20 years ago. DER/DPaW would consider this survey to be out of date, particularly with regards to current listed species. Given that the site is a weedy paddock it could be argued that the habitat value to fauna is not high and that development of the area would not constitute a significant impact, but surveys may still be required, particularly with regards to matters of National Environmental Significance (MNES) (Section 4.7).

4.6.5 Recommendations

It is recommended that DER/DPaW is consulted with respect to fauna studies in that the mapped habitat is unlikely to support a diverse range of native fauna other than those species that thrive in a disturbed habitat. It may be that a targeted search for species on the current threatened species list, coupled with the desktop survey undertaken for this report, could be used to provide sufficient information for such a degraded site. If any MNES species are found further studies may be required. MNES species are discussed in more detail in Section 4.7.

4.7 Matters of National Environmental Significance (MNES)

4.7.1 Introduction

The Australian Government EPBC Act protects MNES across Australia. Species protected are listed under Schedule 1 of this Act. In 1974, Australia signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora. As a result, an official list of endangered species was prepared and is regularly updated. This listing is administered through the EPBC Act and reports of the species likely to occur in an area can be obtained from the Department of the (DOTE) website.

4.7.2 Data Available

A report on matters protected under the EPBC Act was produced using the Protected Matters Search Tool (Appendix A). The results of the report indicate that there are:

- No World Heritage Properties occur within the study area. The nearest World Heritage Properties is the Ningaloo Coast, 850km to the south west.
- There will be no direct or indirect impact upon World Heritage Properties.
- There is one National Heritage Place within the buffered search. The Dampier Archipelago (including Burrup Peninsula) National Heritage Place is located approximately 2.5km west of the study area and in the islands to the north of the study area.
- There is the possibility direct or indirect impact upon National Heritage Places could occur.
- There are no Wetlands of International Significance (Ramsar) within the study area. The closest Ramsar wetland is Eighty Mile Beach which is located 350km north east of the study area.
- There will be no impact upon the Great Barrier Reef Marine Park.
- There are no known EPBC listed TECs occurring within the study area.
- The action is not being taken within a Commonwealth marine area.
- The action is not a nuclear action.

In the EPBC Act Protected Matters Search 16 MNES species were recorded as potentially occurring within the study area. Of the species listed only six have the potential to occur in the study area as marine species have been omitted because the study area is restricted to land (Table 15). All the species listed in Table 15 have been found in fauna surveys within 100km of the study area. Therefore there is a high likelihood of one or more EPBC listed threatened species occurring within the study area.

Table 15 EPBC listed threatened species that potentially occur within the study area

Name	EPBC Status	Likelihood of Presence
Mammals		
Northern Quoll <i>Dasyurus hallucatus</i>	Endangered	Unlikely to occur. Northern Quoll has not been recorded since 1990 and suitable habitat does not exist within the project area.
Greater Bilby <i>Macrotis lagotis</i>	Vulnerable	Unlikely occur. It is unlikely that any suitable habitat exists within the project area for the species.
Northern Marsupial Mole <i>Notorcytes caurinus</i>	Endangered	Unlikely to occur. It is unlikely suitable habitat for the species occurs within the project area.
Pilbara Leaf-nosed bat <i>Rhinonicteris aurantia</i> (Pilbara form)	Vulnerable	Unlikely to occur. There are no suitable caves and fissures for the species.
Birds		
Southern Giant-Petrel <i>Macronectes giganteus</i>	Endangered	Unlikely to occur. This species may fly over the area.

Name	EPBC Status	Likelihood of Presence
Reptiles		
Olive Python (Pilbara subspecies) <i>Liasis olivaceus barroni</i>	Vulnerable	Unlikely. The Pilbara Olive Python may use habitat in the Maitland River, but suitable habitat does not occur within the project area.

Birds Protected Under International Agreements

Thirty nine (39) species of migratory wading birds were expected to occur in or use the mudflat, beach and mangrove habitats of the Mattiske study area. The current list in the EPBC protected matters search is in Table 16. The August 2013 field investigation found none of this habitat within the MIE so impacts to these species are considered unlikely. Three species of non-waterbirds protected under these agreements were expected to occur in coastal areas and were considered unlikely to be affected by any disturbance.

Forty seven listed migratory species were recorded as potentially occurring within the study area in the 2013 EPBC Act Protected Matters Search. Of the species listed, 33 have the potential to occur in the MIE. Marine mammal species have been omitted as the MIE is a land based project unlikely to impact on marine areas (Table 16).

Table 16 EPBC listed migratory and marine species potentially occurring within the study area

Name	EPBC Status	International Treaties	Likelihood of Presence
Fork-tailed Swift <i>Apus pacificus</i>	Migratory, Marine	JAMBA/CAMBA/ROKAMBA	Species may overfly the study area, but is unlikely to utilise habits.
Wedge-tailed Shearwater <i>Puffinus pacificus</i>	Migratory, Marine	JAMBA	Breeding known to occur within the study area
Bridled Tern <i>Sterna anaethetus</i>	Migratory, Marine	JAMBA/CAMBA	Breeding known to occur within the study area
Caspian Tern <i>Sterna caspia</i>	Migratory, Marine	JAMBA/CAMBA	Breeding known to occur within the study area
Roseate Tern <i>Sterna dougallii</i>	Migratory, Marine	JAMBA	Breeding likely to occur within the study area
White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i>	Migratory, Terrestrial	CAMBA	Breeding known to occur within the study area
Barn Swallow <i>Hirundo rustica</i>	Migratory, Terrestrial	JAMBA/CAMBA/ROKAMBA	Species or species habitat may occur within the study area
Rainbow Bee-eater <i>Merops ornatus</i>	Migratory, Terrestrial	JAMBA	Species or species habitat may occur within the study area
Common Sandpiper <i>Actitis hypoleucos</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Great Egret, <i>Ardea alba</i>	Migratory, Wetlands	JAMBA/CAMBA	Species or species habitat known to occur within the study area
Cattle Egret <i>Ardea ibis</i>	Migratory, Wetlands	JAMBA/CAMBA	Species or species habitat may occur within the study area
Ruddy Turnstone <i>Arenaria interpres</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Sharp-tailed Sandpiper <i>Calidris acuminata</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Sanderling <i>Calidris alba</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Red Knot, Knot <i>Calidris canutus</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area

Name	EPBC Status	International Treaties	Likelihood of Presence
Curlew Sandpiper <i>Calidris ferruginea</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Red-necked Stint <i>Calidris ruficollis</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Great Knot <i>Calidris tenuirostris</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Greater Sand Plover, Large Sand Plover <i>Charadrius leschenaultii</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Lesser Sand Plover, Mongolian Plover <i>Charadrius mongolus</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Oriental Plover, Oriental Dotterel <i>Charadrius veredus</i>	Migratory, Wetlands	JAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Oriental Pratincole <i>Glareola maldivarum</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Grey-tailed Tattler <i>Heteroscelus brevipes</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Broad-billed Sandpipe <i>Limicola falcinellus</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Bar-tailed Godwit <i>Limosa lapponica</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Black-tailed Godwit <i>Limosa limosa</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Eastern Curlew <i>Numenius madagascariensis</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Whimbrel <i>Numenius phaeopus</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Pacific Golden Plover <i>Pluvialis fulva</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Grey Plover <i>Pluvialis squatarola</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Common Greenshank, Greenshank <i>Tringa nebularia</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Marsh Sandpiper, Little Greenshank <i>Tringa stagnatilis</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area
Terek Sandpiper <i>Xenus cinereus</i>	Migratory, Wetlands	JAMBA/CAMBA/ROKAMBA	Species or species habitat known to occur within the study area

The one Commonwealth Land area within the buffer of the MIE is the Karratha Training Depot (Defence). There are no Commonwealth Heritage Places or Commonwealth Reserves within the MIE.

No whales or other cetaceans will occur within the MIE as it is not a marine area.

No critical habitats occur within the MIE.

Register of the National Estate

Seven places listed on the Register of the National Estate occur in close proximity to the MIE. The Register of the National Estate was closed in 2007 and is no longer a statutory list. All references to the Register of the National Estate were removed from EPBC Act on 19 February 2012 (DSEWPaC 2012).

Invasive Species

The database of species of national environmental significance also lists invasive species that are a threat to biodiversity. The EPBC Protected Matters Search Report (Appendix A) listed sixteen invasive species that potentially occur within the project area (Table 17).

Table 17 Invasive species of national significance that potentially occur within the study area

Name	Likelihood of occurrence
Mammals	
Horse <i>Equus caballus</i>	Possible due to pastoral lease operations.
Cat <i>Felis catus</i>	Likely. Has been recorded in several nearby surveys
House Mouse <i>Mus musculus</i>	Likely.
Rabbit <i>Oryctolagus cuniculus</i>	Possible. Has been recorded in one nearby survey
Black Rat, Ship Rat <i>Rattus rattus</i>	Not recorded.
Fox <i>Vulpes vulpes</i>	Possible. Has been recorded in one nearby survey.
Birds	
Rock Pigeon, Rock Dove, Domestic Pigeon <i>Columba livia</i>	Possible.
House Sparrow <i>Passer domesticus</i>	Possible.
Eurasian Tree Sparrow <i>Passer montanus</i>	Possible.
Plants	
Buffel-grass, Black Buffel-grass <i>Cenchrus ciliaris</i>	Confirmed.
Cotton-leaved Physic-Nut <i>Jatropha gossypifolia</i>	Not recorded.
Prickly Pears <i>Opuntia spp.</i>	Not recorded.
Parkinsonia <i>Parkinsonia aculeate</i>	May occur. Some outliers occur in the Pilbara and are a high priority for control if discovered.
Mesquite, Algaroba <i>Prosopis spp.</i>	Not recorded.
Reptiles	
Asian House Gecko <i>Hemidactylus frenatus</i>	Not recorded.
Flowerpot Blind Snake <i>Ramphotyphlops braminus</i>	Not recorded.

4.7.3 Data Gaps

NOTE is likely to consider that the site is potential habitat for Northern Quoll and Pilbara Olive Python and will assess requirement for studies as per the recommended methodologies listed in the Guidelines. Given that the site is a weedy paddock it could be argued that the habitat value to fauna is not high and that development of the area would not constitute a significant impact. It is unlikely that surveys would be required at this stage of the project, but this should be reviewed when a development footprint is finalised, particularly with regards to matters of National Environmental Significance, including Northern quoll, Pilbara olive python and the Greater Bilby.

4.7.4 Recommendations

The need for referral under the EPBC Act should be reviewed once a footprint is defined, based on species listed as MNES at the time.

4.8 Contaminated Sites

4.8.1 Introduction

4.8.2 Guidance for Contaminated sites

The general legislative framework relating to contaminated sites in Western Australia (WA) is based on the following four Acts:

- *Environmental Protection Act* (EP Act) 1986
- *Contaminated Sites Act* (CSA) 2003
- *Swan River Trust Act* (SRT) 1988
- *Health Act* (HA) 1911

The Contaminated Sites Act 2003 operates in conjunction with the other Acts creating an effective framework that enables the identification, classification, management and remediation of contaminated sites (considerate of soil and groundwater) across Western Australia.

The assessment and investigation of potentially contaminated and contaminated Sites is regulated by the Department of Environment Regulation (DER) (formerly the Department of Environment and Conservation DEC). Under the CSA, contaminated sites must be reported to DER, investigated and, if necessary, cleaned up.

Investigations are undertaken in accordance with the DEC's Contaminated Sites Guidelines Series (2001-2010) in a phased approach and generally involve four main stages, commencing with a Preliminary Site Investigation (PSI).

A PSI involves a desktop assessment and site inspection to ascertain whether contamination is present or likely to be present as well as to determine whether a Detailed Site Investigation (DSI) should be conducted. The DSI then confirms potential or actual contamination identified during the PSI, through a comprehensive sampling program. The third stage is the preparation of a Site Management Plan (SMP) which documents the type and extent of remediation required to ensure the site is suitable for its current or intended future use. Remediation, Validation and ongoing management is the final stage and is the process of demonstrating that a contaminated site has been successfully remediated and that the objectives of the SMP have been achieved.

4.8.3 Data Available/Previous Investigations

A number of reports have been previously prepared for the MIE. Review of these reports has indicated that there is no information pertaining to the contamination status of the Site. AECOM understands that no specific investigations relating to the contamination status of the Site have been undertaken at the site.

4.8.4 Desktop Assessment

4.8.4.1 DEC Contaminated Site Information

A DEC Basic Summary of Records (BSR) search has not been undertaken for the Site due to its size and unknown Lot details. An online search of the DEC Contaminated Sites Database (CSD) (DEC, 2010) was undertaken on 19 July 2013. The Site is not registered as being a registered, classified site, nor were there any registered sites located within 1 km of the Site.

4.8.4.2 Surrounding Areas

The online CSD identified one registered, classified site approximately 15 km from the Site, located in Gap Ridge. The BSR for the site indicated that the northern half of this site has operated as a rail yard used for the maintenance of a locomotive fleet and rolling stock since the 1960s. Facilities at the site include: a maintenance workshop, oil and fuel (diesel) facilities and refuelling facilities. In addition, there was a large scale loss of fuel in late 1992, estimated to be a few 100,000 litres, through a ruptured pipeline between the fuel farm and the north east corner of the main workshop.

Investigations found hydrocarbons (such as from diesel) were present in soils at concentrations exceeding Ecological Investigation Levels.

Groundwater investigations identified a plume of dissolved phase and free phase hydrocarbons (diesel) in groundwater beneath the site, with free phase hydrocarbons extending over an area of approximately 10,000m². Regular monitoring suggested that the free phase hydrocarbons may have been present for over a decade, with a maximum thickness of up to 3.5 metres. Dissolved phase hydrocarbons were detected at concentrations exceeding groundwater guidelines. The BSR is included in Appendix B.

Considering that the site is approximately 15 km away from the Maitland Industrial Site, it is considered that the groundwater plume would not have migrated to impact the groundwater beneath the Site.

4.8.5 Hazardous and Dangerous Goods Storage and Licences

Based on the Site's current use and information obtained through a review of historical aerial photographs which indicated that the Site has remained undeveloped since the earliest available photograph from 1957, AECOM did not submit a Freedom of Information (FOI) search for the Site through the DMP database for documents relating to Dangerous Goods Storage (DGS).

It should be noted that the Bunbury to Dampier gas pipeline crosses through the central portion of the Site in an east - west direction. The pipeline is clearly sign-posted and is buried within the area it traverses at the Site.

It was also noted that during an inspection of the Site on 22 August, 2013, that a mini LNG gas plant is located along the eastern boundary of the Site.

Operations undertaken at the Gas plant potentially include the storage of dangerous goods such as hydrocarbons and other chemicals. The gas plant was unable to be accessed during the site visit, however several large above-ground storage tanks (ASTs) were observed at the Plant from outside the boundary fence. It is not known what is stored in the ASTs or what processes (if any) take place at the site.

Historical Aerial Photograph Review

The table below provides a summary of a review of historical aerial photographs viewed on the Landgate webpage or provided by Landgate. Copies of selected historical aerals obtained from Landgate are presented as Figure 6. Review of the aerals indicated that the site has remained undeveloped since the earliest available photograph (1957). The large size of the Site resulted in a high number of frames being photographed in order to provide entire site coverage. As a result of the large number of frames available, selected aerals were chosen to show anthropogenic activities, where able to be identified, Table 18 provides a summary of the review of the historical aerals.

Table 18 Summary of historical aerals review

1957		
Frame	Run	Description
5118	8	<ul style="list-style-type: none">- Area within site boundary is clear of any anthropogenic activities.- Dense vegetation is present along Maitland River- Mangroves are observed to be present along northern boundary (coastline)- Shrubbery observed throughout the Site
5120	8	
5122	8	
5145	9	
5147	9	
5149	9	
1968		
Frame	Run	Description
3566	7	<ul style="list-style-type: none">- Unidentified track running north-east towards the north eastern coast- Unidentified track running north towards the northern coast- Dense vegetation present along Maitland River. No significant changes of the density of the vegetation observed since the previous photograph- Mangroves evident along northern boundary (coastline)- No significant changes to the observed vegetation throughout the Site since the previous aerial.
3568	7	
1971		
Frame	Run	Description
5013	9	<ul style="list-style-type: none">- North Coastal Highway is evident along the southern boundary of the Site.- The road leading to Dampier is evident.- Dense vegetation present along Maitland River. No significant change in the density of the vegetation observed in the previous aerial.- Mangroves are still evident along northern boundary (coastline)- No significant changes to the observed vegetation throughout the Site since the previous aerial.
5014	9	
5015	9	
5016	9	
5017	9	
5183	7	
5184	7	
5186	7	
5187	7	
5210	8	
5211	8	
5212	8	
5213	8	
5214	8	
5215	8	

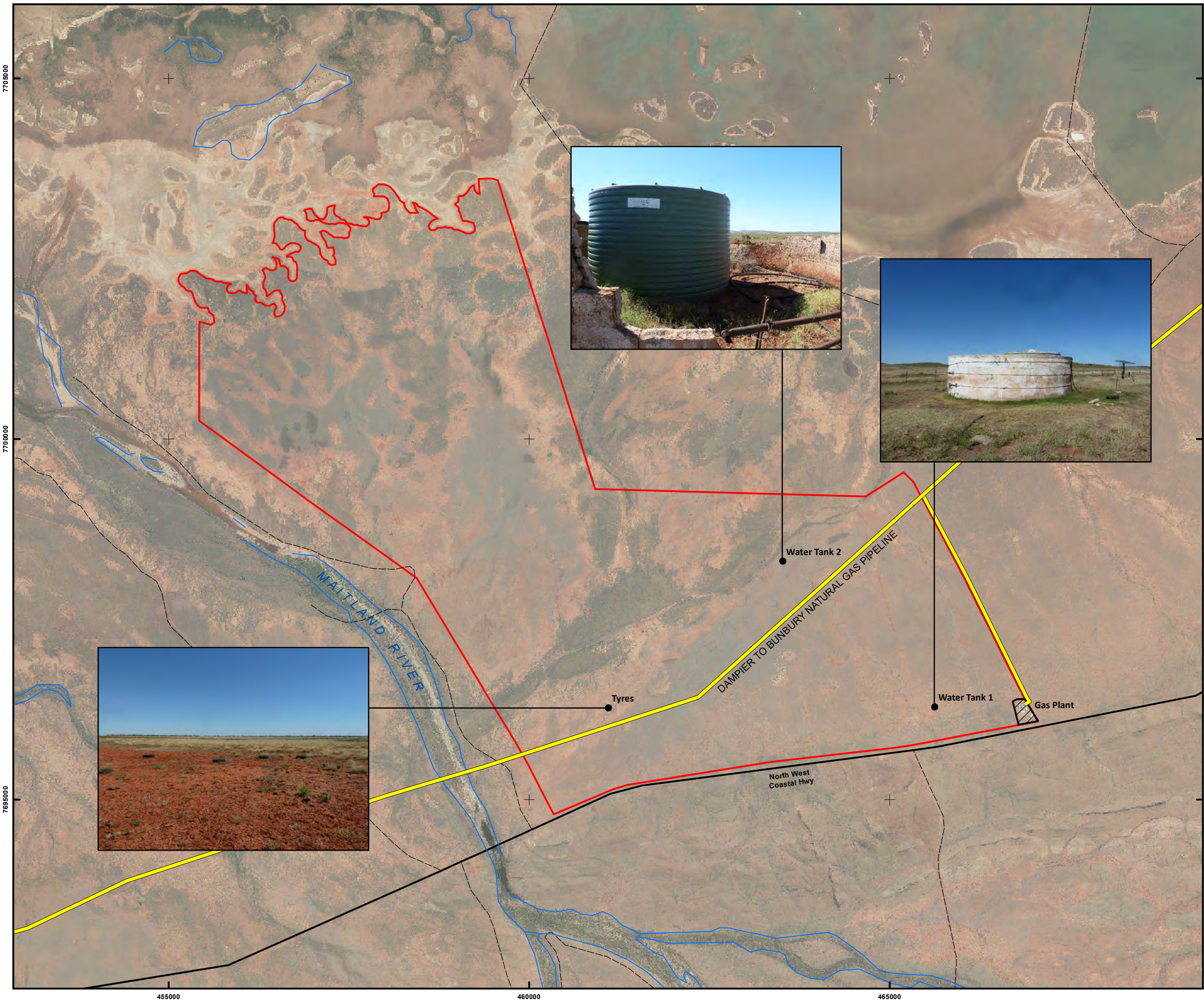
1983		
Frame	Run	Description
5059	10	- No significant changes observed since the previous aerial.
5062	10	
5085	9	
5089	9	
1993		
Frame	Run	Description
5046	11	- No significant changes observed since the previous aerial.
5048	11	
5068	12	
5070	12	
2004 Dampier 2256		
3/08/2004 viewed online		- No significant change since previous aerial.
2008 Dampier 2256		
7/11/2008 viewed online		- The gas plant is evident along the eastern boundary. - No other changes to the Site since the previous aerial.
2012 Dampier 2256		
24/08/2012 viewed online		- No significant change since previous aerial.

4.8.6 Site Inspection

An inspection of the site was undertaken by AECOM's Senior Environmental Scientists Sarah Horgan and Floor de Wit on the 22 August 2013. The site was traversed by vehicle on station access tracks only. Site observations are summarised below. The site features are provided in Figure 7. Photographs taken during the inspection are provided as Appendix C.

- The site is relatively flat and is currently used for the grazing of cattle.
- The Maitland River is located to the west of the Site boundary and North West Coastal Highway is located along the southern boundary of the site.
- A river drainage channel runs in an east west direction across the central portion of the site.
- The majority of the site is undeveloped and vegetated primarily with Buffel grass. Larger more dense vegetation was observed along the drainage channel in the central portion of the Site as well as along the western boundary of the site in proximity to the Maitland River (Section 4.5.10 and Figure 5).
- A small gas plant is located on approximately 9ha in the south eastern portion of the site. The gas plant was not accessed during the site visit however several above ground tanks were observed from outside the fence. It is understood that Energy Development Limited's (EDL) operates the mini-Liquefied Natural Gas (LNG) plant which supplies bottled LNG to the North-Kimberley Power Plant. It is not currently known what processes occur at this site.
- Two water tanks were observed during the site inspection. The actual tanks were observed to be fibreglass and appeared to be in good condition. They were positioned inside larger original concrete tanks which were constructed from concrete with aggregates and had degraded. The tanks had plastic poly piping connected to the water trough for use by the cattle. The water in the tanks is sourced from the groundwater beneath the Site.

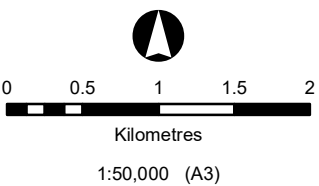
- Several dumped tyres were observed in the central western portion of the Site.
- The Dampier to Bunbury Gas pipeline runs from east to west across the central portion of the site. The pipeline is clearly sign-posted and is buried.
- No other infrastructure was observed at the site, including fuel or chemical storage.
- No fly tipped material or unauthorised stockpiles of materials were observed.
- No surface staining or odours were observed at the site.



Site Features





Maitland

Figure 7



Coordinate System: GDA 1994 MGA Zone 50

LEGEND

-  Site Boundary
-  Gas Plant
-  Dampier to Bunbury Natural Gas Pipeline
-  Site Features

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4.8.7 Interviews with People with Historical Knowledge of the Site

Prior to undertaking the site inspection, the Manager of Karratha Station, Ion Heseltine was interviewed to gain information on the activities historically occurring at the Site; Ion has been manager of the Station for the past 18 months and provided the following information:

- a) The site is used for the grazing of cattle and is under a pastoral lease.
- b) To the best of his knowledge there has been no other infrastructure on the site, apart from the original concrete water tanks. He understands that the tanks were constructed using local sand and aggregate which is very salty and the reason behind the degradation of the tanks.
- c) Water for the tanks is sourced from onsite bores and used to water the cattle. Solar panels power the pumps that pump the water to the tanks. Water is piped to the tanks from the main bore in the south eastern portion of the site via an underground polypipe.
- d) No asbestos containing material has ever been used in the construction of the water tanks, nor has he seen any evidence of fly tipping during his travels around the site.
- e) No fuel storage has occurred at the site to the best of his knowledge, with the exception of the mini LNG plant located in the south eastern corner of the site. Mr Heseltine informed that there may have been temporary generators used at times for pumping water if the solar panels malfunctioned and these would likely have had small quantities of fuel associated with the powering of the generators.

4.8.8 Acid Sulfate Soils/Potentially Acid Forming Material

The EPA objective relevant to the management of soil quality is:

To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

Potentially acid forming material (PAF) is the common name for material that contains iron sulfide or sulfide oxidation products. When PAF is exposed to air and water, the iron sulfides can oxidise to produce sulfuric acid, iron precipitates and water of runoff with elevated concentrations of dissolved metals such as aluminium, iron and arsenic. Although these materials are typically benign when undisturbed in their natural environment, dewatering, excavation and/or stockpiling of PAF that lies below the naturally occurring watertable may promote the occurrence of these adverse environmental impacts. The disturbance of PAF and its exposure to oxygen has the potential to cause significant environmental impact including loss of habitat and biodiversity, degradation of wetlands and wetland-dependent ecosystems, reduction of soil stability and acidification of surface water bodies.

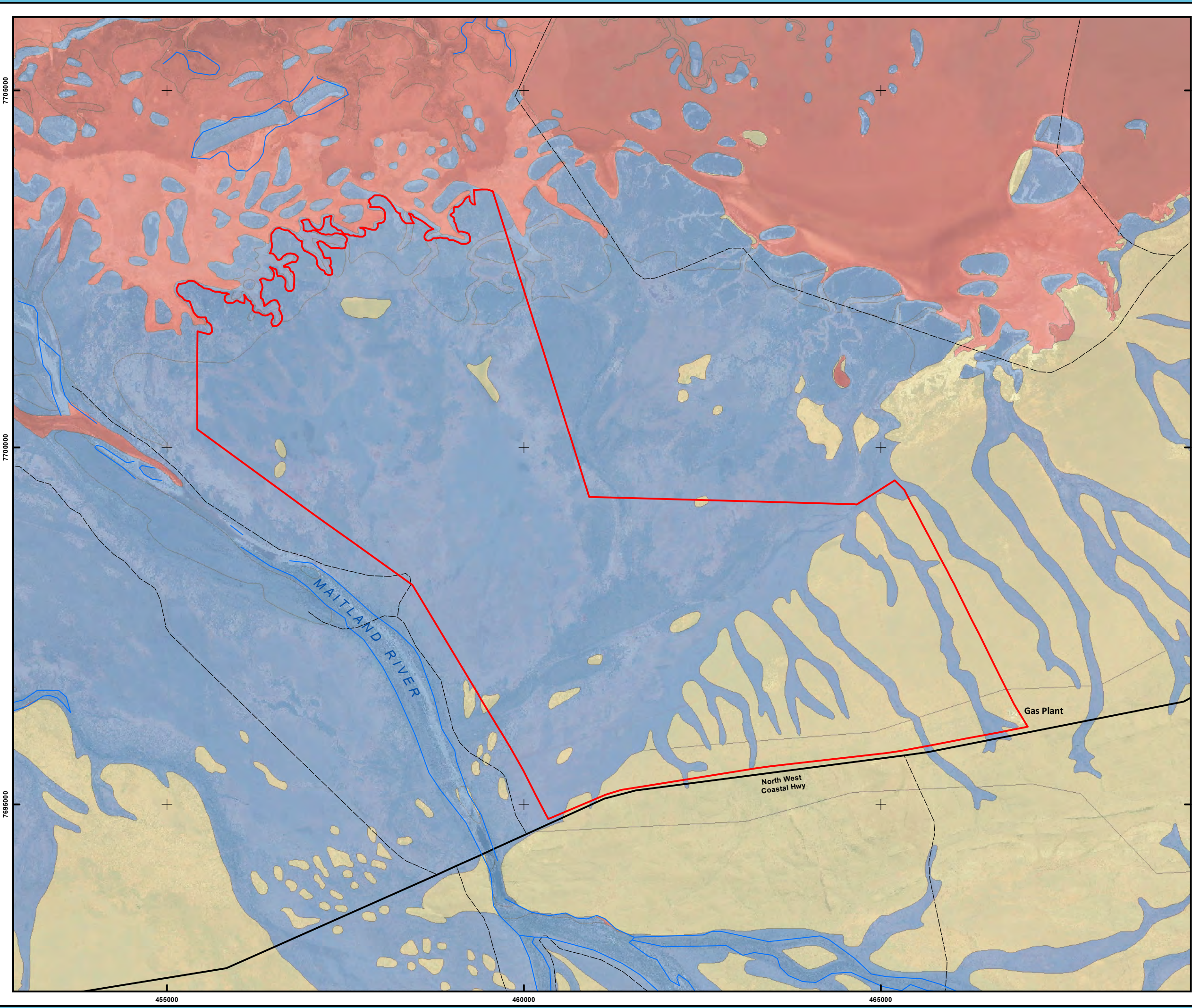
The soils within the Pilbara generally have low acid-forming potential. However, no surveys of PAF material have been conducted and this cannot be assumed for this Project. There is a low risk of PAF materials occurring, though testing of the materials at this site will be required to confirm this.

The CSIRO Acid Sulfate Soils (ASS) Risk Mapping (CSIRO 2006) indicates that the majority of the Site is mapped as having a low probability of occurrence (6% -70 % chance). This area is the northern portion of the Site in proximity to the coastal flood plains and channels.

The southern eastern portion of the Site is mapped as having an extremely low probability of ASS occurring (1-5% chance occurrence in small, localised areas) (CSIRO 2006).

It should be noted that the area immediately to the north of the Site is mapped as having a High Probability of Occurrence (>70% chance) which is associated with the floodplain area.

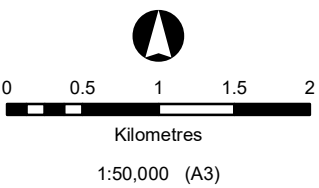
The ASS risk mapping is provided in Figure 8.



Acid Sulphate Soils

Maitland

Figure 8



Coordinate System: GDA 1994 MGA Zone 50

LEGEND



Site Boundary

Acid Sulphate Soils



High Probability of Occurrence,
>70% chance



Low Probability of Occurrence,
6-70% chance



Extremely Low Probability of Occurrence,
1-5% chance in small localised areas

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4.8.9 Conceptual Site Model

A Conceptual Site Model (CSM) describes the potential environmental and human health risks of identified areas of possible soil, groundwater and surface water contamination. The CSM outlines the potential links between known or potential areas of contamination (or sources) and potential receptors (ecological) via pathways for potential contamination migration.

The CSM content is based upon information obtained from the desktop investigation and the site inspection as detailed above.

The CSM follows a source/pathway/receptor framework. Sources are considered to be occurrences of contaminants. Receptors are entities that may come into contact with contaminants from sources. Pathways between a source and receptor are considered to be ways that source contaminants could interact with and expose receptors.

The CSM developed for this site has been considered based on information provided by LandCorp, the results of the desktop assessment and the site inspection. At this time, LandCorp anticipates that the end use for the site will be commercial/industrial land use. The CSM has been developed in consideration of the potential for site workers to be present at the site.

4.8.9.1 Potential Sources

During the site inspection limited potentially contaminating activities were observed to be being undertaken at the Site.

It is considered that the mini LNG plant located along the south eastern boundary of the site has the potential to contaminate the soil and/ or groundwater dependant on the site's operations which are currently unknown. For the purposes of this assessment it has been assumed that there is the potential that storage of hydrocarbons and chemicals occur at the site. Such chemicals may have leaked or been spilt over time resulting in soil and/or groundwater contamination. While the site may be a potential source for contamination, the EPA has strict statutory requirements companies such as EDL must comply with and as the site is quite new it is unlikely that contamination due to this site will be present.

Contaminants of concern associated with the gas plant, which have the potential to impact soil and groundwater beneath the Site may include the following:

- Metals (arsenic, cadmium, chromium, copper, iron, nickel, lead, mercury and zinc)
- Chlorinated compounds (VOCs)
- Total petroleum hydrocarbon (TPH)
- Monocyclic aromatic hydrocarbons (benzene, toluene, ethylbenzene and total xylenes (BTEX))
- Polycyclic aromatic hydrocarbon (PAHs) compounds
- Organophosphate pesticides (OPs)
- Organochlorine pesticides (OCs)
- Phenols

Apart from the mini LNG plant, the site history review has identified that the historical and current land use of the site has been for pastoral purposes with no development having occurred on the Site. As such AECOM considers that there are limited potential sources of contamination across the remainder of the Site.

4.8.9.2 Pathways

Pathways by which potential contamination from the identified sources, primarily the mini LNG Plant may impact the Site include:

- Infiltration & leaching into soil – contaminants that mobilise through the soil via infiltration of surface water and leaching of soils, which could impact deeper soil horizons and groundwater.
- Surface water runoff migrating from the Gas Plant– mobilisation of residual contamination arising from spills and leakages on soil.

- Abstraction and subsequent ingestion of potentially contaminated groundwater– groundwater contact/ingestion after abstraction via a production / monitoring bore by commercial workers (on and off site).
- Dermal absorption - possible irrigation use by impacted bore water and subsequent dermal absorption by commercial workers (on and off site).
- Inhalation of vapours – inhalation of vapours from groundwater impacts in indoor air space by commercial workers (on and off site).

4.8.9.3 Receptors

Receptors associated with potential soil and groundwater contamination from the Site include:

- Groundwater - Groundwater beneath the site and within the hydrogeological influence of the site (with particular reference to the Maitland River located to the west of the site).
- Human health –potential future construction workers and commercial/industrial workers. Includes ingestion and direct dermal contact with potentially impacted groundwater abstracted from wells.
- Ecological values - Terrestrial ecology at the site.

Table 19 below presents the conceptual site model prepared for the site based on the source, pathway and receptor linkages considered for the mini LNG plant, which is the only identified potential source at the site. Note that the absence of any detailed information on the nature of the mini LNG plant has resulted in some uncertainty as to the potential risk category. As such, a range has been given to reflect this uncertainty.

Table 19 Conceptual site model

Primary Source	Secondary Source	Pathway	Receptors	Potential Risk Category
Onsite sources (i.e. the mini LNG plant in the south eastern corner of the Site and potential spills from generators or passing traffic).	Potentially impacted unsaturated soils	Infiltration & leaching	Groundwater beneath the site	Low to Medium – It is difficult to ascertain the LNG gas plant operations and housekeeping practices which may or may not have resulted in volumes of chemicals to have been lost to ground.
		Ingestion and Dermal contact	Terrestrial wildlife and human receptors (future construction workers and site occupants (industrial))	Low to Medium – Limited primarily to the area of the mini LNG plant as no surface staining was observed throughout the rest of the Site. It is difficult to ascertain whether there is any obvious staining or impacts to soils within the LNG plant area or assess the operations and housekeeping practices which may or may not have resulted in volumes of chemicals to have been lost to ground.
		Surface water runoff and subsequent direct contact/ dermal absorption	Terrestrial wildlife and human receptors (future construction workers and site occupants (industrial))	Low – Limited primarily to the area of the mini LNG plant as no surface staining was observed throughout the rest of the Site. Limited vegetation and low opportunity for ecological values to be present. However, surface water would eventually flow towards the Maitland River to the west which is considered to be a sensitive receptor.

Primary Source	Secondary Source	Pathway	Receptors	Potential Risk Category
		Plant uptake	Terrestrial ecology	Low – Limited primarily to the area of the mini LNG plant as no surface staining was observed throughout the rest of the Site. The site currently has limited native vegetation; however is densely vegetated in proximity to the drainage channels.
	Potentially impacted groundwater	Groundwater migration	Surface water and aquatic environment	Low to Medium – Potential risks associated with the mini LNG plant. The nearby Maitland River would likely be the end receiver of any surface water runoff as well as the drainage channel in the central portion of the Site.
		Plant uptake	Terrestrial ecology	Low to Medium - Groundwater at the Site is anticipated to be shallow (3-6 mbgl) which may be within the uptake zone of vegetation along the drainage channels.
		Abstraction / Ingestion and or direct contact	On and off site Human receptors and fauna (cattle)	Low to Medium –groundwater abstraction currently occurs on-Site for the watering of cattle. There is also the potential that off-Site groundwater bores may be used for potable or irrigation purposes.
		Inhalation of vapours	Human receptors (construction workers and future site occupants (industrial))	Low to Medium – given the localised area currently developed and the fact that the primary sources would be the spillage of oil/diesel. It is considered that the risk associated with volatilisation of certain CoPC is considered to be limited. However it is noted that a groundwater assessment has not been undertaken in the vicinity of the mini LNG plant.

4.8.10 Conclusions and Recommendations

The primary objective of this site history assessment was to assess the potential contamination status of the site based on a review of current and historical land use, data base searches and a site inspection. The site history assessment and associated reporting has been prepared in general accordance with the DEC Contaminated Sites Management Series Guidelines (2001 – 2010), however is not a fully DEC compliant PSI.

The site is largely undeveloped and has historically and is currently used for the grazing of cattle. There is a mini LNG gas plant located in the south eastern portion of the Site which is operational. Review of historical arials indicates that the LNG plant was constructed between 2004 and 2008. It is considered that the ongoing operations at the LNG plant may be a potential source of contamination at the site depending on the nature of the site operations. It is considered that current statutory requirements and compliance would make it unlikely that contamination would be present due to activities undertaken on the plant site, however, it is recommended that baseline water quality data is undertaken on the MIE near the LNG plant to provide a baseline to provide evidence for future proponents.

Individual proponents may be required to undertake Acid Sulfate soil testing in areas where it is likely to occur.

In addition, the presence of the Dampier to Bunbury Gas Pipeline should be considered when designing the development site to ensure that construction does not intersect the pipeline.

4.9 Aboriginal Heritage

4.9.1 Data Available

The following reports and databases have been referenced to gain data for this section of the report:

Report	Summary
Murphy A, Edwards K, Campbell-Smith S 1994. Desk Top Review and Preliminary Filed Investigations of Aboriginal Heritage Issues associated with the proposed Karratha and Port Hedland Heavy Industry Estates	This report is a Desk Top Review and Preliminary Field Investigations of Aboriginal Heritage Issues associated with the proposed Karratha and Port Hedland Heavy Industry Estates.
Vinnicombe PJ 1997. Maitland Heavy Industry Estate - Aboriginal Heritage Survey. Prepared for the Department of Resources Development/Landcorp	This report is a detailed Aboriginal Heritage Survey of the Burrup Peninsula and associated islands of the Dampier Archipelago. Maitland is considered in this report.
Department of Aboriginal Affairs 2013, Aboriginal Sites search, Government of Western Australia	Database search of Aboriginal Heritage Sites in Western Australia

The Project falls within the Native Title area of the Ngarluma / Yindjibarndi people (WC99/14) who have a determination of Native Title claim over the area as of 25 March 2013. Under the *Native Title Act 1993*, determination of native title relates to an area for which there is no approved determination of Native Title. This area may be in the process of being approved as a Registered Native Title claim. To the west of the Project lies the Native Title area of the Yaburara and Mardudhunera people who have a register of Native Title claim over the area.

Murphy et al 1994, was the first Aboriginal Heritage investigation that took place within the study area. The investigations determined that three sites were located within the study area, Site P04398 (quarry and artefact scatter) adjacent to the north-east corner, Site P04617 (artefact scatter) along the northern boundary and Site P01471 (artefact scatter and 'tree') at the north-west corner of the study area (Murphy et al 1994). The investigations identified a further 17 Sites within close proximity of the study area. The report recommended further detailed surveys were required to determine the extent of Aboriginal Heritage within the study area (Murphy et al 1994).

Further Aboriginal Heritage surveys were carried out in 1997 by the Land Council and the Department of Resources Development (DRD). The survey of the study area involved vehicular and pedestrian transects that covered 32.8% of the proposed 38.3km² industrial estate. 37 Aboriginal Heritage Sites with defined boundaries were identified and 198 artefact scatters (Vinnicombe 1997). At the conclusion of this survey a recommendation that a joint Land Council-Government committee should be established to negotiate the Maitland Estate concept in the light of the heritage survey results (Vinnicombe 1997). The main role of the committee was to explore alternative locations for the site and recognise that there are native title issues that needed attention.

A search of the Department of Aboriginal Affairs (DAA) database identified that there are 13 Registered Aboriginal Heritage Sites within the study area (Table 20) (Figure 9). As seen in Table 20, the 13 Registered Sites became official after the 1997 surveys conducted by the Land Council and the DRD. Since the surveys of the study area were conducted, it is evident that more detailed investigations have taken place.

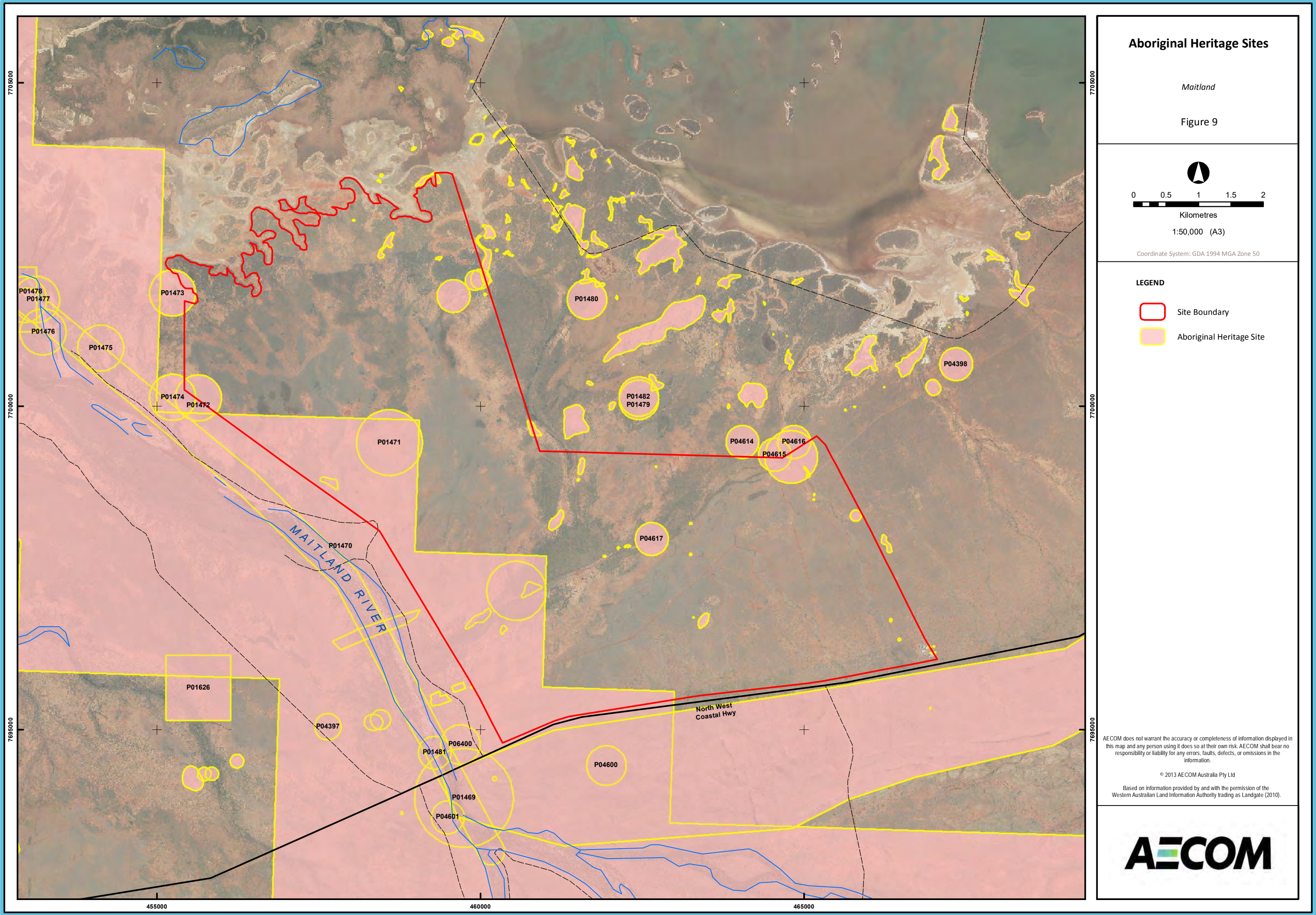


Table 20 Registered Aboriginal Heritage Sites within the study area

Site ID	Site Name	Type	Status	Date became a Registered Site
16257	Mainland (Maitland River) Site 20	Quarry, Artefacts / Scatter	Registered	29/01/2000
10683	WESTERN LEASE 03	Modified Tree, Artefacts / Scatter	Registered	20/09/1999
10684	WESTERN LEASE 04	Artefacts / Scatter	Registered	20/09/1999
10686	WESTERN LEASE 06	Artefacts / Scatter	Registered	20/09/1999
10685	WESTERN LEASE 05	Artefacts / Scatter, Midden / Scatter	Registered	20/09/1999
16260	Mainland (Maitland River) Site 13	Artefacts / Scatter, Midden / Scatter, Grinding patches / grooves	Registered	29/01/2000
16258	Mainland (Maitland River) Site 15	Artefacts / Scatter, Midden / Scatter, Grinding patches / grooves	Registered	29/01/2000
8069	BORROW PIT 5	Artefacts / Scatter	Registered	22/12/1998
8066	BORROW PIT 4	Artefacts / Scatter	Registered	22/12/1998
8067	CHEEDY WELL NORTH	Artefacts / Scatter	Registered	22/12/1998
8068	CHEEDY WELL NORTH-EAST	Grinding patches / grooves	Registered	22/12/1998
16259	Mainland (Maitland River) Site 30	Quarry, Artefacts / Scatter, Grinding patches / grooves	Registered	29/01/2000
16261	Mainland (Maitland River) Site 14	Artefacts / Scatter, Midden / Scatter	Registered	29/01/2000

4.9.2 EPA requirements for Factor

All Aboriginal sites within Western Australia are protected under the AHA (LAS 2011). An Aboriginal site is defined under Section 5 of the Act as follows.

- Any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present.
- Any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent.
- Any place which, in the opinion of the Committee, is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the State.
- Any place where objects to which the Act applies are traditionally stored, or to which, under the provisions of the Act, such objects have been taken or removed.

The most relevant part of the AHA for developments is Section 17 which makes it an offence to disturb an Aboriginal site without the consent of the Minister for Indigenous Affairs pursuant to Section 18 of the AHA.

The AHA does not stipulate that heritage surveys must be conducted and does not claim that the Register of Aboriginal Sites is an exhaustive list of all sites.

4.9.3 Data Gaps

While Aboriginal Heritage is not necessarily an environmental factor it is addressed in Environmental Impact Assessment and there are precedents where it has created issues for developments (Red Hill Quarry in the Perth Hills, Roe Hwy Extension) as part of the EPA assessment. Surveys usually include an ethnographic survey and archaeological survey.

4.9.4 Recommendations

It is recommended that existing comprehensive archaeological surveys (Vinnicombe 1997) are reviewed as they are more than 10 years old. This will confirm locations of heritage sites and an understanding of their importance so that appropriate permissions (Section 18 under the Aboriginal Heritage Act 1978) for disturbance can be sought.

4.10 Reserves and Conservation Areas

There are no DPaW managed Reserves or Conservation Areas within or in close proximity of the study area.

4.11 Emissions

4.11.1 Air Quality

The EPA environmental objective for air quality is:

To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

Dust is generally characterised by three size ranges: less than 50 µm, less than 10 µm and less than 2.5 µm with the particulate matter (PM) in each range abbreviated as PM₅₀, PM₁₀ and PM_{2.5} respectively. PM₅₀ is also referred to as Total Suspended Particulates (TSP).

Activities or aspects of construction operations that may result in dust emissions include:

- physical disturbance on the land surface during construction of infrastructure (removal of vegetation, blasting, earthmoving, cutting and filling)
- haulage and light traffic on unsealed roads
- dust lift-off from dry, cleared areas and stockpiles.
- These dust emissions have the potential to create a dust nuisance for workers and adjacent land users.
- Most airborne particles likely to originate from the proposed construction and operation are larger than PM₁₀ and are more associated with nuisance than public health problems. The larger particles tend to settle back to the ground within a short range (<300 m) from the source.

Recommendations

As the Project is situated at some distance from any sensitive receptors it is unlikely that dust will be an issue. Impacts on traffic and any environmentally significant habitat will require management.

4.11.2 Noise and Vibration

The EPA environmental objective for noise impacts is:

To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.

Applicable legislation includes:

- *Environmental Protection Act 1986*
- *Environmental Protection (Noise) Regulations 1997.*

Noise would be generated as a result of blasting and excavation, construction activities and vehicle movements. The main source of ground vibration would be associated with blasting which is unlikely to occur given the clayey nature of the site geology.

4.11.3 Greenhouse Gases

The environmental objective for Greenhouse Gas emissions is:

To minimise emissions to levels as low as practicable on an ongoing basis and consider offsets to further reduce cumulative emissions.

Increasing global greenhouse gas (GHG) emissions and the implications for climate change is a significant issue at the national and international level. The Australian Government has proposed national schemes to reduce overall emission rates. The current Climate Change Plan incorporates a range of mechanisms and initiatives:

- a Carbon Pricing Mechanism (CPM)
- substantial funding for renewable and clean energy development
- energy efficiency initiatives
- assistance packages for certain entities that will be affected by the CPM.

The Australian Government has announced that the CPM will commence on 1 July 2012, using the broad framework of the previously proposed Carbon Pollution Reduction Scheme (CPRS) and the existing *National Greenhouse Gas Emissions Reporting Act 2007* (NGER Act) as a base.

The *National Greenhouse Gas Emissions Reporting Act 2007* (NGER Act) establishes the National Greenhouse Gas Emissions Reporting Scheme (NGERS) as a national framework for Australian corporations to report GHG emissions, reductions, removals and offsets, and energy consumption and production.

Reporting thresholds have been progressively lowered since 2008 and from 1 July 2011, corporations are required to register and report if they control facilities that emit 25 kt or more of GHG (CO₂-e), or produce/consume 100 TJ or more of energy; or their corporate group emits 50 kt or more GHG (CO₂-e), or produces/consumes 200 TJ or more of energy.

The proposed development of the Proposal would produce the following GHGs:

- carbon dioxide
- methane
- nitrous oxide.

Recommendations

If annual GHG emissions from the Project are expected to exceed the reporting threshold for a corporation (50 kt CO₂-e) under NGERS they would subsequently be required to report GHG emissions.

4.12 Social Environment

4.12.1 Visual Amenity

There is the potential for short term impacts to visual amenity during construction of the Project, such as dust temporary modifications to the North West Coastal Highway configuration, and construction vehicles, machinery and equipment associated with the ground disturbing activities. If night works are conducted, the flashing lights from the beacons on construction vehicles and equipment may be visible from the North West Coastal Highway.

4.12.2 Local Government

The Project is located in the Shire of Roebourne.

5.0 Environmental Approvals Process

5.1 Key Approvals

5.2 Environmental Protection Act

5.2.1 Part IV – Impact Assessment Process

5.2.1.1 Section 38 of the EP Act

Under the State environmental approvals process, a project considered likely to have a significant environmental impact may be referred by any person or a decision making authority to the EPA. The EPA will determine whether or not a referred proposal requires assessment and, in the case that it does, will set the level of assessment. Under the existing environmental approvals process, there are two levels of assessment (excluding Public Inquiry which is available under the EP Act but has never been used) for which Environmental Impact Assessment Administrative Procedures have been gazetted (EPA, 2010a). These levels of assessment are:

- 1) Assessment on Proponent Information (API) - no public review, proposals where the environmental acceptability or unacceptability of the proposal is apparent at the referral stage.
- 2) Public Environmental Review (PER) – proposals that potentially have environmental consequences that warrant detailed assessment and a public review.

In general, referrals under the EP Act should contain information on the potential environmental impacts of the Proposal, the proposed management mechanisms to be implemented to minimise and mitigate these impacts, and how the principles of the EP Act have been addressed. A referral form needs to be completed with any additional relevant information attached that would assist the EPA in determining whether a Proposal should be assessed and, if it is to be assessed, the level of assessment required. Information the EPA would expect includes:

- a definition of the proposal as per the new Environmental Assessment Guideline (EAG), *Defining the Key Characteristics of a Proposal* (May 2012)
- environmental setting
- relevant environmental aspects
- potential environmental impacts and environmental risks that may arise from relevant environmental aspects
- controls that are proposed to address identified environmental risks with particular reference to the mitigation hierarchy (avoidance, minimisation, rectification and reduction).

The EPA intend to assess only key factors that are likely to have: a significant impact on the environment, where it is uncertain whether there will be an impact or where offsets may be required (*EAG 9 Application of a significance Framework in the environmental impact assessment process* – 2013).

The EPA is required to make a decision within 28 days of receipt of a referral on whether the referred proposal requires assessment and, if so, the level of assessment. If the EPA considers that the referral does not contain adequate information, it may request the required information about the Proposal before proceeding further – effectively ‘stopping the clock’ on the statutory timeframe. The EPA will aim to issue a notice requesting additional information within 14 days of receipt of referral and the EPA expects the proponent to respond with additional information within 28 days from receipt of notice; however, these timeframes will be administrative and not statutory.

If the EPA considers that the referral contains adequate information, but that the proposal is unlikely to be environmentally acceptable, it will advise that the proponent may withdraw the proposal, or provide additional information to indicate why the environmental impact of the proposal is not unacceptable, within a timeframe specified by the EPA.

The 28 day decision period shall not be regarded as having begun in relation to the referral until all requests for required information have been met to the EPA’s satisfaction. That is, if the EPA requests additional information, the EPA will ‘stop the clock’ and the 28 day period will be reset.

In addition, all referrals received by the EPA undergo a seven day public review period (after any further information is requested, if applicable) and comments are directed towards helping the EPA make its decision whether or not to assess the proposal. It is important to not include commercially confidential information in the referral.

5.2.2 Part V – Clearing Permit and/or Works Approval

If a project has been assessed under Part IV of the EP Act it does not require a clearing permit. If the project is considered to not have a significant impact by the EPA, then it will require a clearing permit under Part V of the EP Act. The clearing permit process requires submission of a form with sufficient supporting information and scientific studies to quantify the impact in relation to the 10 Clearing Principles. Discussions with the Department of Environment Regulation (DER) are recommended to determine the level of studies and investigations required and to discuss the level and type of assessment required.

5.2.2.1 Works Approval

Some projects may be classified as “prescribed premises” under Schedule 1 of the Environmental Protection Regulations 1987, such that a Works Approval may be required. Depending on the expected industries expected at the site it will likely be classified under, but may not be limited to, the following prescribed premises:

- Category 5 Processing or beneficiation of metallic or non-metallic ore
- Category 12 Screening, etc. of material
- Category 52 Electric power generation
- Category 73 Bulk storage of chemicals.

It is likely that works approval will be required when individual development approval is sought.

The granting of a Works Approval for construction of facilities i.e. office areas under Part V of the EP Act cannot occur until after the Part IV assessment is complete and construction cannot proceed without such approval. However, an application for the approval can be submitted prior to the decision on environmental approval, and DER can grant the approval following the Ministerial decision. When the approval is granted, it is advertised and is subject to third party appeal. The Works Approval may take several months to finalise, depending on any appeals received. Construction may commence once the approval has been granted, and the appeals can be resolved following commencement of construction. However, the proponent runs the risk of portions of the construction requiring modification as a result of the appeals, and possible reconstruction of parts of the facility.

5.2.2.2 Licence (operating)

A Works Approval is effectively an authorisation to construct the project, but does not permit it to operate if there are any associated emissions of waste, noise, odour or electromagnetic radiation to the environment. If a Works Approval is required, then a Part V licence may be required to permit and control any associated emissions to the environment.

If the project is a prescribed premise and may cause an emission (waste, noise, odour or electromagnetic radiation) into the environment, a licence is required to permit that emission. The licences can carry conditions relating to the levels of the emissions, and requiring monitoring and reporting. Such licences are only required to enable operation of the facility, and are not a pre-requisite to commence construction.

The obtaining of a licence should be relatively straightforward, and would not be critical to the timing of commissioning, provided application was made reasonably soon after obtaining the Works Approval, if required.

If a Works Approval is not required, then a Part V licence is not required, however, the proponent would still fall under the general requirements of Part V of the EP Act, that prohibit anyone from causing pollution or causing environmental harm.

5.3 Environment Protection and Biodiversity Conservation Act

The Act that governs environmental protection at the Commonwealth level is the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act), which is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places – defined in the EPBC Act as Matters of National Environment Significance (MNES).

Under the environmental assessment provisions of the EPBC Act, 'actions' (proposals/projects) that are likely to have a significant impact on one or more MNES protected under the EPBC Act are subject to an assessment and approvals process by the Australian Government DOTE.

The eight broad MNES protected under the EPBC Act are:

- world heritage properties
- national heritage places
- wetlands of international importance (listed under the Ramsar convention)
- listed threatened species and ecological communities
- migratory species protected under international agreements
- Commonwealth marine areas
- the Great Barrier Reef Marine Park
- nuclear actions (including uranium mines).

The completion and submission of a referral form will be the principal basis for the Minister's decision as to whether approval is necessary and, if so, the type of assessment that will be taken. The referral form requires information on the following:

- location of the proposal
- description of the proposal (a detailed description outlining all activities and aspects of the proposed action and referencing figures and/or attachments, as appropriate)
- description of Aboriginal consultation undertaken
- description of MNES relevant to the Proposal and nature and extent of likely impact on MNES
- other features of the environment
- existing and proposed land uses in proximity to Proposal area
- measures proposed to avoid and/or reduce impacts on MNES.

Following referral of an action under the EPBC Act, the action is determined by the Minister to be either a 'controlled action' or 'not a controlled action' depending on whether the action is likely to have a significant impact on one or more MNES. The decision is made within 20 days of referral unless the Minister requires more information to make this decision. Alternatively, the Minister may decide (within 20 days of referral) that the action is clearly unacceptable and will inform the referring party of such.

If the project is deemed to be 'not a controlled action', it may be either considered 'not a controlled action' or 'not a controlled action under a particular manner'. If the decision is 'not a controlled action', approval is not required if the action is taken in accordance with the referral. If the decision is 'not a controlled action under a particular manner', approval is not required if the action is taken in accordance with the manner specified, i.e. according to management measures specified to mitigate potential impacts to ensure the impacts will not be significant. Examples of particular manner approaches may include timing of works to avoid critical periods for listed species, identification and avoidance of important habitat, and design measures or adoption of work practices to reduce or avoid impacts.

If the proposal is determined to be a 'controlled action', the Minister sets a level of assessment (similar to the State approval process) and outlines the information required from the Proponent. The levels of assessment (excluding Public Inquiry, which is not generally used) in increasing order of time and information required are:

- 1) Assessment on referral information: no further information is required to be provided by the referring party and the assessment is to be completed within 30 days of assessment decision.
- 2) Assessment on preliminary documentation: includes a public comment period and possibly provision of additional information by the proponent, followed by revision of referral information taking into account public comments. DOTE then prepares a Recommendation Report to the Minister and a decision is made within 40 days of receiving the final proponent documentation.
- 3) Assessment by Public Environment Report/Environmental Impact Statement: includes preparation of a formal impact assessment document, DOTE approval of the draft document for public release and public comment period, followed by finalisation of the impact assessment document taking into account public comments. DOTE then prepares a Recommendation Report to the Minister and a decision is made within 40 days of receiving the final proponent documentation.

If DOTE considers the proposal to be a 'Controlled Action' and the action is already subject to a PER under the EP Act, the Australian Government environmental assessment process used to be undertaken through the State assessment process under the Bilateral Agreement. In this instance, DOTE would set a level of assessment and the proponent would prepare the documentation to satisfy both the State and Commonwealth requirements, but using the State assessment procedure. The Commonwealth Minister for the Environment then makes a decision under the EPBC Act following a decision by the State Minister for the Environment under the EP Act.

The most recent version of the Bilateral Agreement between WA and the Commonwealth is yet to be signed.

5.4 Department of Water (DoW) process (Groundwater Licence)

The *Rights in Water and Irrigation Act 1914* (RIWI Act) requires people to hold a licence to construct or alter production bores and take water from any artesian underground water source throughout the state, and from non-artesian underground water sources located within proclaimed groundwater areas.

Licences to construct or alter wells are issued under Section 26D of the RIWI Act and licences to take water are issued under Section 5C of the RIWI Act. This provision is applicable to water supply and dewatering abstraction.

It is recommended that liaison with the DoW occur before submitting any applications and provide an outline of the development concept to the DoW. The DoW will be expecting a summary of water requirements, major water management issues and an indicative water balance in its development concept.

A licensee can apply to the DoW at any time for the amendment of a licence; for example, a licensee may apply for an increased annual water entitlement. In assessing such an application, the DoW is entitled to have regard to the same matters as it would when assessing an application for the grant of a new licence.

Groundwater Licence (GWL) applications (for grants, amendments, transfers or agreements) are submitted to the DoW on standard application forms. Upon receiving an acceptable application, the DoW will undertake a preliminary assessment to determine if it has sufficient information to make a decision on whether to grant the application.

The main factors that will be considered in determining whether a hydrogeological assessment is required are:

- volume and pumping regime requested
- level of use in groundwater management area (groundwater area or subarea)
- potential impacts upon other users
- potential impacts upon groundwater-dependent ecosystems
- existing salinity of the groundwater resource.

Based on consideration of these factors, the DoW may decide that it requires additional information to be supplied by the applicant in the form of a hydrogeological assessment. The DoW will determine the level of assessment that is required.

An Operating Strategy may be required dependent upon the volume of abstraction or dewatering that will be undertaken and this should be discussed with the DoW.

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6.0 Consultation

6.1 Stakeholder Consultation

A consultation program is an essential component of impact assessment to ensure that stakeholder concerns are addressed. Stakeholders may include government agencies, landowners, leaseholders, traditional owners and other interested parties.

The primary stakeholder engagement objectives would include:

- identifying key stakeholders
- identifying and verifying areas of stakeholder concern for social and environmental values
- establish a robust consultation approach to demonstrate that appropriate and effective consultation has been undertaken
- assessing stakeholder issues and areas of concerns so that proposed impacts are minimised to as low as reasonably practicable
- establishing collaborative relationships with stakeholders to assist with managing Proposal related expectations.
- The consultation program would include the following key activities:
- correspondence to potentially impacted parties to advise them regarding the Project and offer detailed briefings
- workshop meetings with representatives of decision making authorities to brief them on specific issues and concerns
- one-on-one briefings and feedback sessions with specific stakeholders.

Stakeholders are likely to include: Government agencies DOTE, DER/DPaW, DoW, DMP, DIA, Local Shires, pastoral holders, neighbouring mining companies, Aboriginal communities and non-government organisations.

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7.0 Conclusions and Recommendations

7.1 Gap Analysis

7.1.1 Flora and Vegetation

The Survey undertaken by Mattiske (1994) was not completed under any specific guidance and is unlikely to conform to Level 2 survey requirements under Guidance Statement 51. Data regarding listed species and communities is well out of date and requires updating.

The site itself is a large paddock of buffel grass, heavily degraded by cattle and has very little original environmental features that if disturbed would constitute a significant environmental impact. Endemic species remaining were essentially confined to the creekline tributary which, according to engineering advice is likely to be retained as a drainage channel. This area also was heavily grazed by cattle and highly degraded. The desktop survey presented above could be used to demonstrate that development of the site will not constitute a significant impact on native flora and vegetation.

While DPaW was briefly consulted with respect to whether the vegetation was likely to be a PEC, further consultation would assist with determining whether any further vegetation and flora studies are required. It would seem unnecessary given the degraded condition of the site and its long history of cattle grazing.

7.1.2 Fauna

Guidance Statement 56 recommends that for Level 2 Surveys several surveys are to be undertaken over different seasons until a high percentage of the faunal assemblage has been recorded. In practice the survey effort required to achieve this is extensive and usually beyond the time and resources of the project. In reality surveys are required to be undertaken at a minimum over two different seasons with sufficient/comprehensive sampling intensity for the species expected to occur.

The surveys at Maitland consisted of broad scale fauna observations undertaken 20 years ago. DER/DPaW would consider this survey to be out of date, particularly with regards to current listed species. However the fact that the site is a weedy paddock could be used to argue that the habitat value to fauna is not high and that development of the area would not constitute a significant impact.

It is unlikely that surveys would be required at this stage of the project, but this should be reviewed when a development footprint is finalised, particularly with regards to matters of National Environmental Significance, including Northern quoll, Pilbara olive python and the Greater Bilby.

7.1.3 Surface Water

In terms of environmental impact, the following needs to be taken into consideration:

- Flora and fauna are unlikely to be impacted due to changes in site hydrology.
- Impacts on surface water bodies are likely to be ephemeral if infrastructure is not placed within drainage and sub-drainage lines and banks are not damaged, because the drainage lines are only periodically flooded.
- Contamination may be an impact on surface and ultimately marine waters if contaminating materials are washed into drainage lines and out to sea. Appropriate management controls and monitoring will be required, particularly regarding spill response and cleanup.

General recommendations for surface water after discussion with BG&E are as follows:

- Development should be located out of natural drainage lines where possible to minimise alterations to natural water flows. This protects ecological flows and minimises modifications required to protect infrastructure.
- Stormwater and storm surge should be diverted around infrastructure areas. Modelling indicates that much of the site is underwater during a peak event so protection systems and fill will be required to bring infrastructure above flood levels to reduce damage.
- Stormwater run-off from potentially contaminated infrastructure areas (refuelling and maintenance areas) should be contained and treated prior to release into the environment.
- The detailed survey should be used to design the required water management structures such as channels and/or diversions.

- Monitoring will be difficult to undertake as the drainage lines are dry most of the time. Good housekeeping and audits of management practices may be the best way to track compliance in this regard.
- Individual industries will require works approvals and licencing which may also require surface water management and monitoring.
- Long term monitoring to assess water quality at the Maitland River Delta can be linked in with existing Dampier Port Monitoring programs.
- Discuss with the DER/DPW (formerly DEC) to determine the thresholds where the potential for contaminants entering the Maitland River Delta is likely to be considered significant. This has implications particularly with regards to threatened species (Section 4.4, 4.5 and 4.6).

7.1.4 Groundwater

A lack of borehole data and other investigative work means that the hydrogeological setting of the study area is not well known (Astron 2002). An original desktop study of the hydrogeological setting was undertaken by the Geological Survey in 1993 (Appleyard 1993), which prompted a drilling program in 1994 (Prangley 1994). It has been 20 years since groundwater testing has occurred within the study area, meaning data may be out-dated and invalid. The Public Environmental Review (PER) produced by AGC Woodward-Clyde Pty Ltd. 1994 contained the same information as the Appleyard, 1993 report.

Prangley 1994 indicates that there is the potential for contamination of groundwater within the site, and this combined with the minimal information on groundwater within the study area indicates further investigations are required to inform a groundwater management strategy and to establish a baseline against which to monitor for potential contamination and to bring the understanding of hydrogeology of the area up to the current expected standards.

Monthly water level monitoring may be necessary along with an initial round of water quality monitoring to establish baseline water quality parameters and to provide input into a local water management strategy.

If proponents are going to be using groundwater for their industrial needs then further studies at lot level will provide data on potential yields, water quality and recharge in response to drawdown, but this can be undertaken at a later stage of the development.

7.1.5 Contaminated Sites

The Site is largely undeveloped and has historically and is currently used for the grazing of cattle. There is a mini LNG gas plant located in the south eastern portion of the Site which is operational. Review of historical aerials indicates that the LNG plant was constructed between 2004 and 2008. It is considered that the ongoing operations at the LNG plant may be a potential source of contamination at the Site depending on the nature of the site operations. It is considered that current statutory requirements and compliance would make it unlikely that contamination would be present due to activities undertaken on the plant site, however, it is recommended that future proponents undertake baseline water quality monitoring near the LNG plant to provide a baseline.

Individual proponents may be required to undertake Acid Sulfate soil testing in areas where it is likely to occur.

In addition, the presence of the Dampier to Bunbury Gas Pipeline should be considered when designing the development site to ensure that construction does not intersect the pipeline.

7.1.6 Heritage

While Aboriginal Heritage is not necessarily an environmental factor it is addressed in Environmental Impact Assessment and there are precedents where it has created issues for developments (Red Hill Quarry in the Perth Hills, Roe Hwy Extension) as part of the EPA assessment. Surveys usually include an ethnographic survey and archaeological survey.

It is recommended that existing comprehensive archaeological surveys (Vinnicombe 1997) are reviewed as they are more than 10 years old. This will confirm locations of heritage sites and an understanding of their importance so that appropriate permissions (Section 18 under the Aboriginal Heritage Act 1978) for disturbance can be sought.

7.1.7 Other Relevant Factors

At this stage of the projects studies should not be necessary for Dust, Emissions, Noise and Vibration.

7.2 Approval Strategy

7.2.1 EPA

While there is a choice to refer the scheme under section 48 of the EP Act, early advice from the EPA based on current data recommends submitting the structure plan to the OEPA for informal feedback prior to lodgement with the WAPC.

Bulletin 855 16 (e) advice was requested when the original PER proposal was rejected on the grounds that the project didn't conform to the definition of a 'proposal' under section 38 of the Act.

While the 16 (e) advice lists 14 factors, these are relevant to the original proposal which included a port and links to marine areas and these no longer form part of this proposal. The new guidelines for defining a proposal (*EAG 1 Defining the key characteristics of a proposal*) and for determining significance of an impact (*EAG 9 Application of a significance framework in the environmental impact assessment process* and *EAG 8 Environmental factors and objectives*) now encourage proponents to only consider factors which are likely to have a significant impact on the environment after mitigation and management have been taken into account. Using this as a reference it would seem that the list of key factors could be reduced significantly.

If it can be shown that there will not be significant impacts on mangroves, marine fauna and threatened and priority fauna (including turtle nesting areas and any dredging), System 8 area (Dampier Archipelago, particularly offshore islands), terrestrial declared rare and priority flora and vegetation communities (including weed control and rehabilitation), terrestrial fauna (particularly protection of the olive python, not thought to occur at Maitland), air quality, greenhouse gases, dust and particulate emissions, noise and vibration, surface water, marine water and water quality, turbidity (marine), liquid and solid wastes, public health and safety (specifically buffer areas) then these may not be considered key factors.

The new guidelines for defining a proposal (*EAG 1 Defining the key characteristics of a proposal*) and for determining significance of an impact (*EAG 9 Application of a significance framework in the environmental impact assessment process* and *EAG 8 Environmental factors and objectives*) now encourage proponents to only consider factors which are likely to have a significant impact on the environment after mitigation and management have been taken into account. Using this as a reference it would seem that the list of key factors at this site could be reduced to the point that referral may not be necessary.

Studies recommended in the 16 (e) advice that are still relevant for project ready status:

- detailed surface water catchment study, completed
- further assessment of the mini LNG plant could be undertaken to ascertain what (if any) processes occur, the condition of the site and determine if any chemicals are used or stored at the site.
- Environmental Management System as a framework for the governance of the Environmental Management Plan (EMP) (could be simply the front end of the EMP) and EMP.

Studies required at subdivision stage include:

- baseline monitoring to establish baseline conditions at the site
- Archaeological and Ethnographic surveys
- sufficient flora and fauna mapping for clearing permit
- air quality investigations of individual developments including dispersion modelling
- potential impacts of dust on Dampier Salts' solar ponds (including baseline levels)
- noise and noise emission modelling
- ethnographic and archaeological studies and heritage management plan
- Section 18 approvals under the Aboriginal Heritage Act 1978 WA.

Early advice from the EPA based on current data recommends submitting the structure plan to the OEPA for informal feedback prior to lodgement with the WAPC.

7.2.2 EPBC

Potential referral of the MIE to DOTE under the EPBC Act is dependent on:

- The presence or likely presence of threatened species (most likely to be fauna).
- The potential for activities at the site to have a significant impact on the threatened species or its habitat.

While it appears that it is unlikely that threatened species do regularly inhabit the area, maps in the Northern Quoll survey guidelines (DSEWPac 2011) do show the area to be potential habitat. Baseline studies would help to confirm the lack of habitat and of populations of threatened species. It is recommended that these studies are undertaken prior to making a decision whether to refer the MIE under the EPBC Act. It may be premature to refer the project at this stage as the Department of the Environment will expect the project footprint to be well defined. Species on the listed Matters of National Environmental Significance do change and surveys become quickly out of date.

7.2.3 Studies

Studies/ investigations recommended by EPA Bulletin 855 are largely still relevant with respect to the MIE and exclude studies required for the port and other infrastructure. These studies included:

- Detailed flora and fauna surveys (although the mainland site was considered as have been devalued with regards to fauna habitat) –particularly relevant for the EPBC Act.
- Air quality investigations of individual developments including dispersion modelling.
- Potential impacts of dust on Dampier Salts' solar ponds (including baseline levels).
- Noise and noise emission modelling.
- Formation of the estate buffer zone.
- Undertake ethnographic and archaeological studies and heritage management plan.
- Baseline groundwater quality to monitor impacts of waste disposal.
- Establish baseline water quality.
- Map exclusion zones.
- Environmental Management System (Part of approval conditions).
- Environmental Management Plan (Part of approval conditions).

This list is comprehensive and it is understood that some work has been completed on some these studies. A detailed flora and habitat study would best be completed once the optimal development areas have been confirmed as part of the Two-Dimensional Flood Modelling and Storm Surge Investigation (BG&E 2013). A targeted fauna search may be useful to establish baseline populations of any threatened species. Baseline surface and groundwater studies should be undertaken. Heritage site locations and significance should be confirmed and consultation made to understand any Indigenous concerns with the proposed use of the land.

It would be difficult to undertake dust, emission and noise and vibration modelling at this stage although baseline studies could be undertaken.

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8.0 Report Limitations

8.1 Data

Data for this report was taken from various previous studies undertaken by others and the conclusions based on that data are assuming that the data is correct.

One field visit was undertaken by an experienced botanist and contaminated sites practitioner. Their conclusions cannot be taken as an exhaustive study of the site, but as a confirmation of desktop conclusions.

Data provided for this study referred to the Maitland Heavy Industrial area which included a port and other large infrastructure with impacts on the marine and intertidal environment. This study did not include those areas.

The contaminated sites preliminary site investigation did not include a direct site visit of the EDL gas plant and conclusions have not been made as to the management of this site with regards to contaminating activities.

8.2 Recommendations

The recommendations made in this report were based on the data supplied and extracted from public databases and on the experience of the current regulatory regime. Discussions were held with the EPA and a phone conversation with DPaW and DoW provided additional statutory perspective. DER and DOTE were not consulted at this stage of the project.

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Appendix A

EPBC Protected Matters Search Report

Appendix A EPBC Protected Matters Search Report



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

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[Summary](#)

[Details](#)

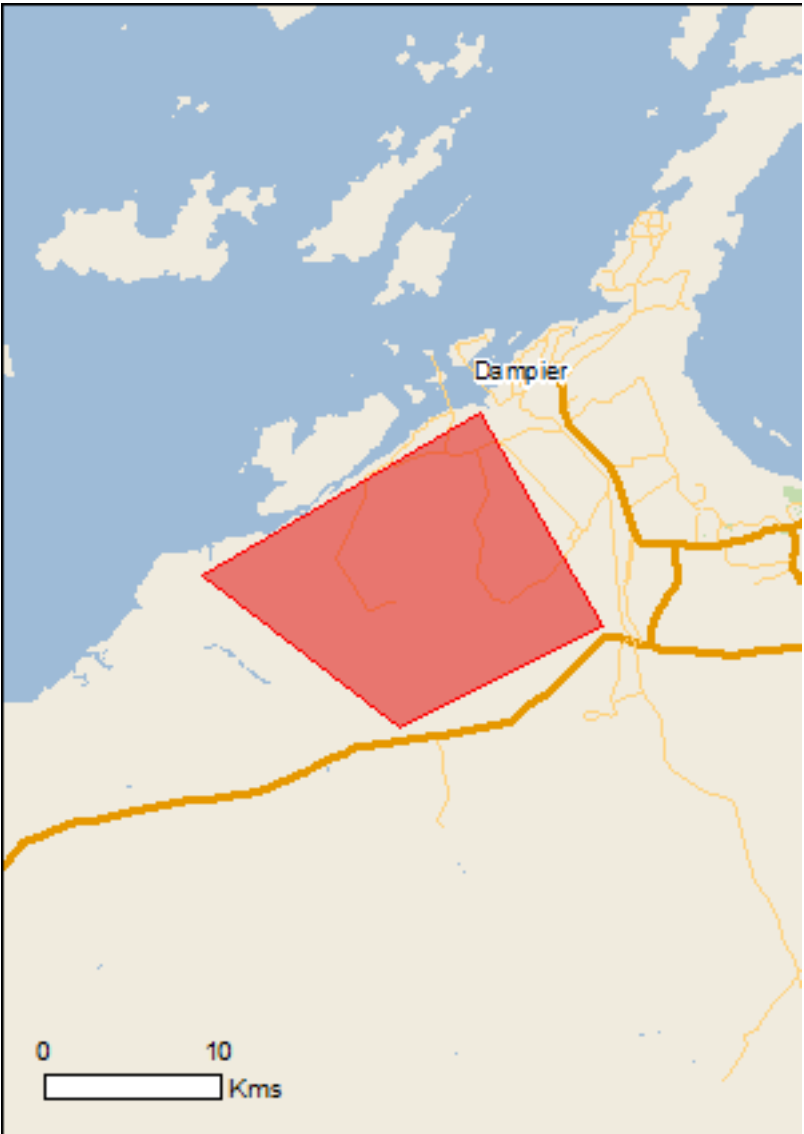
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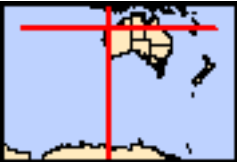
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Buffer: 15.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	16
Listed Migratory Species:	47

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As [heritage values](#) of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

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

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	2
Commonwealth Heritage Places:	None
Listed Marine Species:	91
Whales and Other Cetaceans:	12
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

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

Place on the RNE:	7
State and Territory Reserves:	5
Regional Forest Agreements:	None
Invasive Species:	16
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Dasyurus hallucatus Northern Quoll [331]	Endangered	Species or species habitat known to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Notoryctes caurinus Karkarratul, Northern Marsupial Mole [295]	Endangered	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat likely to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding likely to occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur

Name	Threatened	Type of Presence
Dugong dugon Dugong [28]		within area Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]		Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Species or species habitat known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew [847]		Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land

[Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Defence - KARRATHA TRAINING DEPOT

Listed Marine Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		

Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]		Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]		Species or species habitat known to occur

Name	Threatened	Type of Presence
Charadrius ruficapillus Red-capped Plover [881]	Endangered	within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew [847]		Species or species habitat known to occur within area
Numenius phaeopus Whimbrel [849]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]	Least Concern	Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]		Species or species habitat known to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area

Name	Threatened	Type of Presence
		within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding likely to occur within area
Stiltia isabella Australian Pratincole [818]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Species or species habitat known to occur within area
Fish		
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species

Name	Threatened	Type of Presence
Halicampus nitidus Glittering Pipefish [66224]		habitat may occur within area Species or species habitat may occur within area
Halicampus spirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Solenostomus paegnius Rough-snout Ghost Pipefish [68425]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Species or species habitat known to occur within area
Reptiles		

Name	Threatened	Type of Presence
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowellii null [25926]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hydrophis ornatus a seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Coastal Margin Cape Preston to Cape Keraudren	WA	Indicative Place
Dampier Archipelago Marine Areas	WA	Indicative Place
Dampier Archipelago	WA	Registered
Indigenous		
Dampier Art Site	WA	Registered
Dampier Climbing Men Area	WA	Registered
Historic		
Karratha Station Group	WA	Registered
West Lewis Island Pastoral Settlement	WA	Registered

State and Territory Reserves [Resource Information]

Name	State
Unnamed WA36907	WA
Unnamed WA36909	WA
Unnamed WA36913	WA
Unnamed WA36915	WA
Unnamed WA38287	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Mammals		
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat likely to occur within area

Coordinates

-20.683478 116.688853,-20.786225 116.752025,-20.835006 116.648341,-20.761829
116.547404,-20.761829 116.547404,-20.683478 116.688853

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

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

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

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

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

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

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

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

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

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

Acknowledgements

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

- [-Department of Environment, Climate Change and Water, New South Wales](#)
- [-Department of Sustainability and Environment, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment and Natural Resources, South Australia](#)
- [-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [-Environmental and Resource Management, Queensland](#)
- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- [-Geoscience Australia](#)
- [-CSIRO](#)
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The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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Appendix B

CSD Search

Appendix B CSD Search



Contaminated Sites Act 2003 Basic Summary of Records Search Response

Report Generated at: 1:56:42PM, 06/09/2013

Search Results

This response relates to a search request received for:

Lot 175 On Plan 26146

Gap Ridge WA 6714

This parcel belongs to a site that contains 1 parcel(s).

According to Department of Environment Regulation records, this land has been reported as a known or suspected contaminated site.

Address	Lot 175 On Plan 26146 Gap Ridge WA 6714
Lot on Plan Address	Lot 175 On Plan 26146
Parcel Status	<p>Classification: 08/08/2012 - Contaminated - remediation required</p> <p>Nature and Extent of Contamination:</p> <p>Total petroleum hydrocarbons are present in the soil over a large portion of the site. Additionally, dissolved and free phase hydrocarbons are present in the groundwater beneath the site.</p> <p>Restrictions on Use:</p> <p>Due to the nature and extent of groundwater contamination identified at the site, the abstraction of groundwater for any purpose other than remediation or monitoring is not permitted.</p> <p>Additionally, the land use of the site is restricted to the current industrial use and should not be developed without further contamination assessment and/or remediation.</p> <p>Reason for Classification:</p> <p>This site was reported to the Department of Environment and Conservation (DEC) prior to the commencement of the 'Contaminated Sites Act 2003' (the Act). The site classification is based on information compiled between 1992 and May 2004 and submitted to DEC's Contaminated Sites Branch by 17 May 2004.</p> <p>The northern half of this site (hereafter referred to as the site) has operated as a rail yard used for the maintenance of a locomotive fleet and rolling stock since the 1960s. Facilities at the site include: a maintenance workshop, oil and fuel (diesel) facilities, refueling facilities, locomotive washing facilities, locomotive standing areas, an oily-waste</p>

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Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report Generated at: 1:56:42PM, 06/09/2013

biotreatment facility and railway lines.

The site was the subject of an environmental investigation in 1992 which identified hydrocarbon impacts consistent with multiple sources, over a large area of the site, including the locomotive wash area, the fuel storage area and in the vicinity of the main workshop. In addition, there was a large scale loss of fuel in late 1992, estimated to be a few 100,000 litres, through a ruptured pipeline between the fuel farm and the north east corner of the main workshop.

Investigations found hydrocarbons (such as from diesel) were present in soils at concentrations exceeding Ecological Investigation Levels, as published in 'Assessment Levels for Soil, Sediment and Water' (November 2003), which was the relevant assessment criteria for the site at this time.

Groundwater investigations identified a plume of dissolved phase and free phase hydrocarbons (diesel) in groundwater beneath the site, in the vicinity of the workshop area, with free phase hydrocarbons extending over an area of approximately 10,000m². Regular monitoring suggested that the free phase hydrocarbons may have been present for over a decade, with a maximum thickness of up to 3.5 meters. Dissolved phase hydrocarbons were detected at concentrations exceeding Groundwater Intervention Values (Netherlands Ministry for Housing, Spatial Planning and Environment, 2000), which were the relevant assessment criteria for the site at the time of these investigations.

Solvents, metals and lubricants were also identified as potential contaminants in both soil and groundwater at the site, however, their presence had not been fully investigated. Furthermore, two other areas of potential contamination were also identified during investigations - the electrical substation and locomotive wash facility. Site investigations were limited, however, and potential impacts in these areas have not been fully investigated or delineated.

A Health Risk Assessment was undertaken using the ASTM Standard E1739-95, Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites (RBCA). The assessment report concluded that maximum hydrocarbon concentrations found at the site did not exceed site-specific response levels and therefore did not pose an unacceptable risk to human health under the current landuse. Although the contamination does not pose a health risk under its current landuse, it may pose a risk in the future, particularly as the groundwater plume appeared to be spreading at the time of these investigations.

At the time of reporting, natural attenuation as a remediation option at the site had proven to be inadequate to degrade the hydrocarbon groundwater plume within an acceptable time frame (one generation, 30 years). Subsequently, DEC's predecessor agency (the Department of Environmental Protection) recommended that more active remediation techniques be implemented at the site.

A site management plan, dated 17 May 2004, received by DEC on 15 June 2004, outlined

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Contaminated Sites Act 2003 Basic Summary of Records Search Response

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the two techniques for the recovery of free phase hydrocarbons. An active remediation system combining bioslurping and bioparging was to be implemented on site, with periodic monitoring and reporting. At the time of classification, however, DEC's Contaminated Sites Branch had not received any further reporting on soil or groundwater impacts, and the current quality of soil and groundwater at the site is unknown.

Based on a lack of recent information on the site, comment cannot be made on the suitability of the site as a whole for its current landuse. It is understood that potentially contaminating land uses have continued at the site since 2004, and as such, full staged investigations will be required at the site should the site be developed for any other purpose in the future.

As free-phase hydrocarbons are present in the groundwater and residual hydrocarbons are present in the soil, which have resulted in a significant dissolved-phase groundwater plume, which presents a risk to human health, the environment, or environmental values, the site is classified as 'contaminated - remediation required'.

Due to the nature and extent of groundwater contamination identified at the site, the abstraction of groundwater for any purpose other than remediation or monitoring is not permitted. Additionally, the land use of the site is restricted to the current industrial use and should not be developed without further contamination assessment and/or remediation.

DEC, in consultation with the Department of Health, has classified this site based on the information available to DEC at the time of classification. It is acknowledged that the contamination status of the site may have changed since the information was collated and/or submitted to DEC, and as such, the usefulness of this information may be limited.

Action Required

Any environmental site assessments or monitoring conducted at the site since 2002 should be reported to DEC's Contaminated Sites Branch for review. In particular a report on progress with the remedial works proposed in 2004 should be provided to DEC's Contaminated Sites Branch by 31 October 2012.

Full staged investigations will be required at the site should the site be developed for any purpose in the future.

Under the Contaminated Sites Act 2003, this site has been classified as "contaminated - remediation required". For further information on the contamination status of this site, please contact the Contaminated Sites Branch of the Department of Environment & Conservation.

Type of Regulatory Notice: Nil

Date Issued: Nil

Certificate of Title
Memorial

Current Regulatory
Notice Issued

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Government of **Western Australia**
Department of **Environment Regulation**

Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 1:56:42PM, 06/09/2013

General

No other information relating to this parcel.

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Appendix C

Site Photographs

Appendix C Site Photographs

Site Photographs



Plate 1 Exterior of Water Tank



Plate 2 Newer water tank inside of concrete exterior



Plate 3 Water trough and poly pipe visible in foreground



Plate 4 Signage for Dampier to Bunbury Gas Pipeline corridor traversing central portion of Site



Plate 5 Tyres observed in central portion of the Site.

Appendix B

Coastal hazard risk management adaptation plan

R998 Rev 0

April 2018

LandCorp

**Maitland Strategic Industrial Area
CHRMAP**

marinas

boat harbours

canals

breakwaters

jetties

seawalls

dredging

reclamation

climate change

waves

currents

tides

flood levels

water quality

siltation

erosion

rivers

beaches

estuaries

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K1440, Report R998 Rev 0

Record of Document Revisions

Rev	Purpose of Document	Prepared	Reviewed	Approved	Date
A	Draft for MRA Review	A Clapin	C Doak	C Doak	11/01/2018
0	Issued for Client Use	A Clapin	C Doak	C Doak	05/04/2018

Form 035 18/06/2013

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1. Introduction

In 1993, the Western Australian (WA) State Government identified the Maitland Strategic Industrial Area (MSIA) as a suitable location for major industrial development and subsequently established the MSIA.

Located 24 kms west of the Karratha townsite and 39 kms south of Dampier Port, the MSIA, as shown in Figure 1.1, is planned to potentially accommodate gas or petroleum processing power, production and other associated downstream processing industries including urea, ammonia and ammonium nitrate.



Figure 1.1 Location Plan

The MSIA comprises approximately 2,500 ha of crown land and freehold land owned by the Western Australian Land Authority (LandCorp). The area consists of land designated for strategic industry and industry protection. The Dampier-Bunbury Natural Gas Pipeline (DBNGP) traverses the estate, and the North-West Coastal Highway runs along the southern boundary.

The MSIA has a critical role to play in adding value to export commodities and generating employment opportunities and economic benefits. It is of strategic economic significance to the State, and the WA State Government has identified the need to provide a statutory planning framework that reflects the significance of the MSIA to the State's economy and, as far as practicable, provide improved project ready capacity.

Improvement Plan No. 44 - Maitland Strategic Industrial Area was prepared pursuant to the Planning and Development Act 2005 (P&D Act) and gazetted in June 2016. This provided the

head of power for the preparation of the MSIA Improvement Scheme. Once gazetted, the City of Karratha's (City) local planning scheme will cease to have affect of the Planning Scheme Area.

The purpose of the Improvement Scheme Report is to provide the context rationale and explanatory commentary outlining the origins of the planning framework; the key considerations in establishing the Improvement Scheme framework including the MSIA Guide Plan; the rationale for decisions made; and the direction taken during the preparation of the Improvement Scheme.

This Coastal Hazard Risk Management and Adaptation Plan (CHRMAP) has been prepared to inform the Scheme Report and forms an Appendix to this report.

It is important to note, that the Department of Jobs, Tourism, Science and Innovation (DJTSI) is the Lead Agency for the MSIA and LandCorp is the industrial estate manager, landowner and lessor. When considering Business Case submissions from future industrial proponents seeking to establish with the MSIA, DJTSI and LandCorp will consider the proposal in the context of existing developments in the MSIA. This is to ensure the MSIA is developed to its full potential. This process occurs well before the lodgement of a Development Application with the Western Australian Planning Commission (WAPC).

The MSIA is located in relatively close proximity to the coast which is significant, as the risks posed to the site from coastal hazards need to be considered both now and into the future. To inform the engineering and planning works, LandCorp engaged specialist coastal and port engineers, M P Rogers & Associates Pty Ltd (MRA), to complete a Coastal Hazard Assessment for the MSIA to quantify the potential for coastal erosion and inundation at the site.

The results of this assessment are outlined within *Maitland Industrial Estate – Coastal Hazard Study* (MRA 2017) as provided in Appendix A. The findings of this report highlight that coastal hazard impacts on the MSIA will generally only be experienced during the passage of severe cyclone events. The primary reasons for this are as follows.

- Approximately 4km of saltflats, interspersed with some higher land areas, separate the MSIA from the alignment of the shoreline that is subject to the action of coastal processes, as shown in Figure 1.2.
- The elevation of the seaward boundary of the site is typically above 5 mAHD, which is well above the height of the highest astronomical tide (2.44 mAHD).



Figure 1.2 Maitland Strategic Industrial Area Coastal Boundary

Within Western Australia, State Planning Policy 2.6: State Coastal Planning Policy (SPP2.6; WAPC, 2013) provides guidance on the assessment of coastal hazard risks for assets or infrastructure located in close proximity to the coast. The objectives of SPP2.6 are wide ranging, however a key component of the policy is to ensure the identification of appropriate areas for the sustainable use of the coast for housing, tourism, recreation, ocean access, maritime industry, commercial and other activities.

The guidance on the assessment of coastal hazard risk is provided within SPP2.6 in the form of a methodology to assess the potential extent of coastal hazard impacts, as well as for the development of a CHRMAP. Further details in this regard are also provided in the CHRMAP Guidelines (WAPC, 2014).

The key requirement of a CHRMAP is to develop a risk based adaptation framework for assets or infrastructure that could be at risk of impact by coastal hazards over the relevant planning timeframe. The risks within the MSIA will vary significantly from Lot to Lot, based on location and the industrial land use of each Lot. For this reason, the development of each Lot will be subject to the completion of a Coastal Risk Management Plan (CRMP) to outline how the future development of each industrial Lot fits into the risk assessment detailed in this CHRMAP document. These individual CRMP documents will be required when seeking Development Approval and are to detail and assess relevant land use, specific risks and to outline subsequent mitigation plans.

This CHRMAP report for the entire MSIA site will assess a subset of potential industrial land uses to determine whether the coastal hazard risks can be managed to an acceptable level by the

future industrial proponents. The risk assessment and proposed adaptation and mitigation strategies presented in this report is one factor that will guide site and land use selection by future industrial proponents. Importantly, this overall CHRMAP will include a guideline and framework for the individual CRMPs that are to be completed by industrial proponents of each Lot, as discussed in more detail in Section 7. This CHRMAP document covers the following key items.

- Establishment of the context.
- Summary of the completed coastal hazard assessment.
- Risk analysis and evaluation.
- Risk management and adaptation planning.
- Implementation plan.

Details regarding each of these items will be provided in this report.

2. Context

Even though the MSIA is not impacted by coastal hazards on a regular basis, the fact that severe cyclone events can impact the site necessitates further review with respect to risk quantification, management and adaptation planning.

2.1 Purpose

The potential vulnerability of the coastline and the subsequent risk to the community, economy and environment needs to be considered for any coastal development.

SPP2.6 requires that the responsible management authority prepares a CHRMAP where an existing or proposed development may be at risk from coastal hazards over the planning timeframe. The main purpose of the CHRMAP is to define areas of the coastline which could be vulnerable to coastal hazards and to outline the preferred approach for the assessment and management of these hazards where required.

Specifically, the purpose of this CHRMAP is as follows.

- Confirm the specific extent of coastal hazards.
- Outline the risks associated with the MSIA development site and how these risks may change over time.
- Establish the basis for present and future risk management and adaptation, which will be used to provide a framework for industrial proponents to complete their own CRMPs for each Lot.
- Provide guidance on appropriate management and adaptation planning for the future, including reviewing and updating relevant documents.

2.2 Objectives

The key objective of this plan is to assess the risks associated with the development of the MSIA. Once these risks have been assessed, adaptation strategies can be developed to help mitigate the risks where necessary.

2.3 Scope

The *CHRMAP Guidelines* (WAPC, 2014) provide a specific framework for the preparation of a CHRMAP. This is outlined in the flowchart presented in Figure 2.1 which highlights the steps required to be taken in the management and control of coastal hazard risks in order to ensure acceptable outcomes are achieved for all parties.

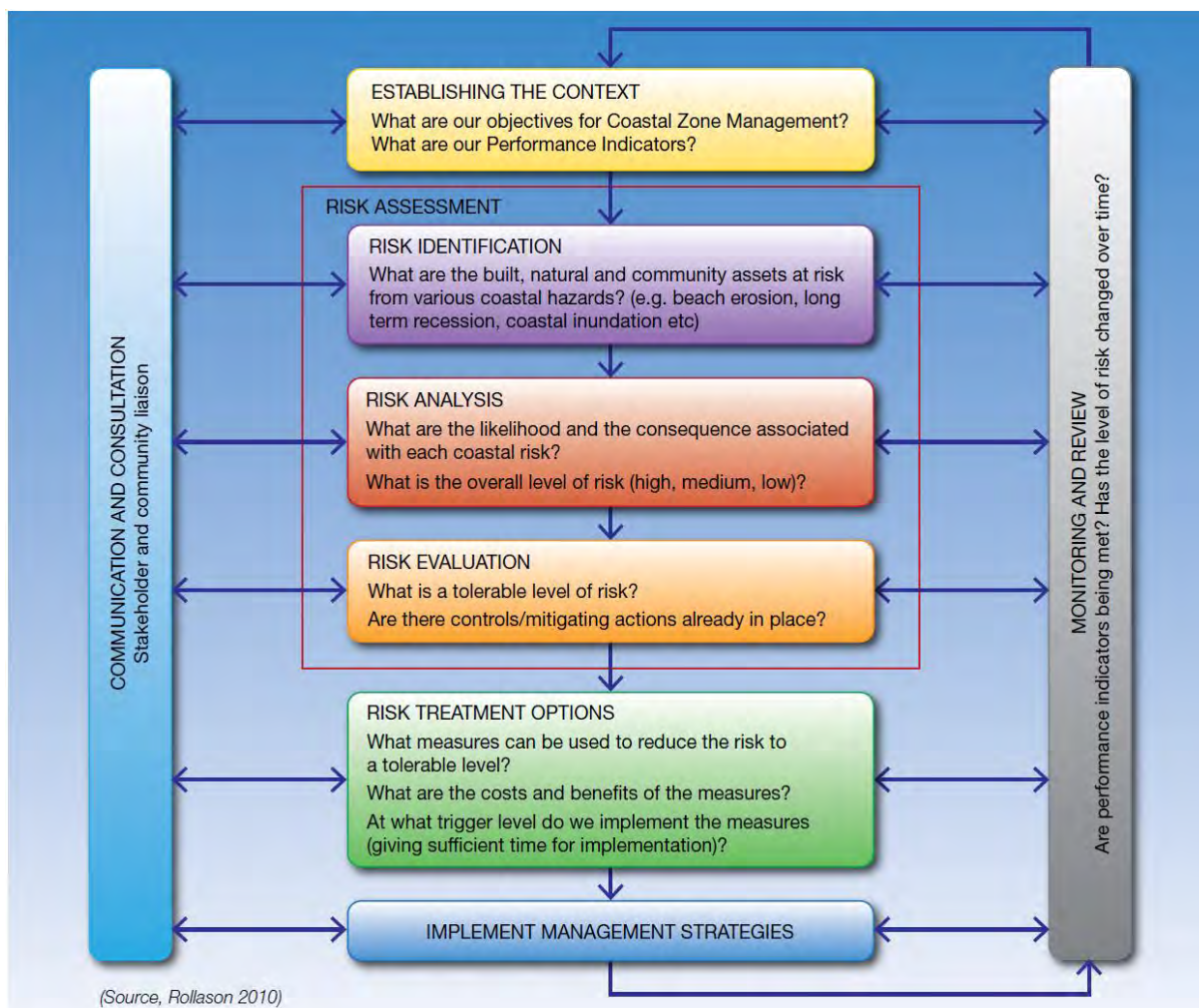


Figure 2.1 Risk Management & Adaptation Process Flowchart (WAPC 2014)

As presented in the flowchart, the process for the development of a meaningful CHRMAP requires a number of fundamental inputs. These inputs enable the assessment and analysis of risk, which should ultimately be informed by input received from key stakeholders, to help shape the subsequent adaptation strategies.

The management of coastal hazard risk associated with the MSIA will be required to present a proposed adaptation plan that is acceptable to the stakeholders. As a result, the approach that has been taken for this plan is to develop a management methodology that allows for flexibility into the future, with options available to the industrial proponents of individual Lots.

The development of the adaptation plan will be informed by the assessment of the coastal erosion and inundation hazards as identified in the *Coastal Hazards Study* by MRA (2017). The coastal erosion and inundation hazards are summarised in Section 3 and the full report is provided in Appendix A.

This CHRMAP will assess the potential risks posed by coastal hazards over a range of timeframes covering a 100 year planning horizon to the year 2118. This planning horizon is required by SPP2.6 for development on the coast. Intermediate planning horizons will also be considered in order to assess how risk profiles may change in the future and to inform the requirement for adaptation strategies. Intermediate planning horizons that will be considered are below.

- Present Day (2118).
- 25 years to 2043.
- 50 years to 2068.

Based on the results of the risk assessment, indicative risk mitigation strategies will be developed, where required, in order to provide a framework for future management. However, it is important to realise that the risk assessment will be based on the outcomes of the coastal vulnerability assessment, which, by their nature, are justifiably conservative. This is due to the uncertainty around coastal dynamics when predicting impacts over long timeframes. As a result, the framework for future risk management strategies should be considered to be a guide of future requirements.

As the land use for each Lot is not yet known, it is important that the risk assessment in this CHRMAP is wide ranging and covers a range of potential uses. Risks vary significantly depending on the land use and operations of each individual Lot. It is anticipated that the CRMPs completed by industrial proponents of individual Lots will detail the specific land uses and corresponding infrastructure and operations. This will enable land use and operation specific risks to be identified in relation to this overarching CHRMAP and for relevant management strategies to be developed for each individual Lot within the MSIA .

The actual requirement for implementation of these management actions would typically be informed by a coastal monitoring regime. As previously mentioned, the MSIA is located approximately 4 km behind the active shoreline that would typically be monitored. Changes to this shoreline would need to be especially dramatic to alter the impacts of the large recurrence interval events that are critical to the MSIA (as discussed in Section 3). This means that shorter term shoreline monitoring is unlikely to be beneficial when considering changes to coastal hazard risks at the site. Identification of changes in sea level and conditions that could alter, either positively or negatively, the risk exposure of the proposed infrastructure to coastal hazards should therefore be based on a regular data review, with document update recommended if any significant changes are identified. This is included within the implementation plan presented in Section 7 of this report.

2.4 Site

The MSIA is located south west of Dampier and the Burrup Peninsula, approximately 24 km west of Karratha. The Peninsula and surrounding islands directly offshore of the site provide protection against wave attack from the open ocean.

Northeast of the site, exists a series of salt ponds operated by Dampier Salt. Seaward of the site and the adjacent salt flats, the coastal frontage consists of mangroves behind sections of subtidal sandy beaches and shallow mud flats.

2.5 Stakeholder & Community Engagement

2.5.1 Stakeholder Identification

The stakeholder and community engagement process developed for the MSIA CHRMAP has been designed around the existing governance framework established for the preparation of the Maitland Improvement Scheme. A Stakeholder Reference Group (SRG) was established by the Western Australian Planning Commission (WAPC) as the key consultation body throughout the Improvement Plan/Improvement Scheme preparation process. The SRG members are outlined in Table 2.1.

Table 2.1 SRG Members

Agency/Stakeholder	Role
JTSI	<p>Responsible for implementing the State's Heavy Use Industrial Land Strategy to bring MSIA to a 'project ready' status by undertaking necessary land based assessments of the MSIA to inform future site-specific approvals requirements for proponent led development. Eg. Preparing the Maitland Improvement Scheme.</p> <p>Lead Agency for the facilitation of new proposals/expansion of existing proposals where the proposed investment is significant or of strategic importance.</p> <p>Is preparing the Maitland Improvement Scheme on behalf of the State.</p>
LandCorp	<p>Responsible for management the commercial arrangements between proponents and the State. LandCorp is to become the land owner within Maitland once transferred in freehold. LandCorp and JTSI work closely when assessing Proponent Business Cases that are seeking to establish in a Strategic Industrial Area such as Maitland.</p>
Department of Lands, Planning and Heritage (DPLH)	<p>The Western Australian Planning Commission will become the development control authority within the MSIA Improvement Scheme area and has responsibility for determining applications made for development in that area.</p>
City	<p>Relevant local government.</p>
Murujuga Aboriginal Corporation (MAC)	<p>The Corporate Body representing the three registered native title claimants party to the Burrup and Maitland Industrial Estates Agreement (BMIEA).</p>

Additional stakeholders relevant to the CHRMAP process have been identified based on the site specific values of MSIA including current and future land use.

The following stakeholders have been identified:

■ Government Agencies.

- Department of Water and Environmental Regulation (DWER).
- Department of Biodiversity, Conservation and Attractions (parks and wildlife services).
- Department of Transport (DoT, coastal infrastructure).

■ Industry.

- Dampier Salt.
- Energy Developments Pty Ltd (outside of area impacted by inundation over the 100 year planning timeframe).
- Broader community.

The Project team in consultation with DPHL determined that direct engagement with the broader community was not required to inform the preparation of the MSIA CHRMAP. It was agreed that public review of the draft CHRMAP during advertising of the Improvement Scheme was the appropriate engagement approach.

2.5.2 Engagement Strategy

The engagement approach has been tailored to support an efficient approval process of the CHRMAP as part of the overall Improvement Scheme documentation. The following Table 2.2 outlines the additional consultation points for the CHRMAP together with existing obligations to engage with the SRG and key stakeholders through the Improvement Scheme process.

Table 2.2 Stakeholder Consultation Summary

Stakeholder	Existing Stakeholder Consultation	Additional CHRMAP Consultation
DPLH (SRG member)	Improvement Scheme Page Turn Session. Statutory Planning Committee (SPC) and WAPC approval to advertise. Public advertising including Government agencies briefing. SRG meeting prior to final approval. SPC and WAPC recommendation for final Approval.	Agreement regarding CHRMAP structure.
City (SRG member)	Improvement Scheme Page Turn session (will include CHRMAP). Public advertising (draft CHRMAP available for review). SRG meeting prior to final approval.	Targeted email – notify the preparation of a CHRMAP as part of Improvement Scheme Planning process. Offer a Meeting/Teleconference to discuss community social, environmental and cultural values relevant to the Maitland SIA Improvement Scheme Area (preliminary discussion with CoK indicate that future road/infrastructure assets that become the responsibility of the City are of interest). Outline the process for CHRMAP preparation and advertising through Improvement Scheme process.
MAC (SRG member)	Improvement Scheme Briefing. Public advertising (draft CHRMAP available for review). SRG meeting prior to final approval.	
DBCA (parks and wildlife services)	Public advertising (draft CHRMAP available for review), including Government agencies briefing.	Targeted email – notify the preparation of a CHRMAP as part of Improvement Scheme Planning process.
DWER	Pre referral of the Environmental Assessment Report (will include aspects of the coastal environment/CHRMAP). 28 day Referral prior to Public Advertising. Public advertising (draft CHRMAP available for review) including Government agencies briefing.	Targeted email – notify the preparation of a CHRMAP as part of Improvement Scheme planning process.
DoT (coastal infrastructure)	Public advertising (draft CHRMAP available for review) including Government agencies briefing.	Targeted email – notify the preparation of a CHRMAP as part of Improvement Scheme Planning process, offer review of the Coastal Hazard Study.
Dampier Salt	Draft Improvement Scheme Briefing. Public advertising (draft CHRMAP available for review).	Targeted email – notify the preparation of a CHRMAP as part of Improvement Scheme Planning process. Offer Meeting to discuss existing operations in relation to Improvement Scheme provisions and requirement for no impact on operations under Sate Agreement.

2.6 Existing Planning Controls

The gazettal of Improvement Plan No. 44 for the MSIA (refer section 2.6.1 of this report) removes the MSIA from the City Local Planning Scheme, and places the responsibility for decision making with the WAPC. Notwithstanding, it is relevant to note the City Framework relating to the MSIA as follows:

City of Karratha Local Planning Strategy (June 2015)

A key outcome of the City Local Planning Strategy is identified as:

'Support the State Government actions that are aiming to enable the provision of land to facilitate 'Strategic Industry' and/or industry of state importance ie. Improvement Plans and Improvement Schemes for ... Maitland'.

The MSIA is identified within the approved City Local Planning Strategy, along with an associated 2 km industrial buffer. The MSIA provides for the long term future supply of strategic industrial land for downstream processing activities such as urea, methanol, gas to liquids, renewable LNG, ammonia and domestic gas processing. The area will be a significant employment generator, also driving housing demand. The City expects that the MSIA will accommodate industries that cannot be accommodated within the Karratha Industrial Estate or Gap Ridge.

Other key outcomes of the Local Planning Strategy relate to the recognition and implementation of buffers for industry and infrastructure uses; addressing coastal hazard risk and bush fire risk management.

City Local Planning Scheme No. 8

The MSIA is identified within Town Planning Scheme No.8 (TPS8) as 'Strategic Industry' Zone with a 2 km 'Industry Buffer SCA' (Special Control Area). A State and Regional Road reserve traverses the southern boundary of the site, and 'Conservation, Recreation and Natural Landscape Reserve' abuts the northern and south western boundaries of the site. To the east and west is an Infrastructure Corridor.

The Zoning Table sets out the permissibility of land uses within the Strategic Industry Zone and allows a range of uses to be considered. The table is not replicated here.

Clause 5.10 of the Scheme sets out the following objectives for Maitland:

(b) Facilitate the development of the Maitland Precinct as a strategic industry estate which:

- *allows the efficient and effective processing of primary resources,*
- *allows for the development of land uses compatible with and not restrictive to future development of strategic industry,*
- *does not compromise the lifestyle and tourist assets of the Shire, and*
- *has due regard to the environmental and heritage values of the area.*

Clauses 6.7.3 to 6.7.5 include provisions relating to the Strategic Industry Zone:

6.7.3 In considering applications for planning approval in the Strategic Industry zone Council shall ensure that the proposal:

- a) optimises the effectiveness of the zone as a strategic industrial area and utilises major infrastructure, creates symbiosis with other industries or includes resource processing industry;*
- b) is significant to the regional and/or state economies; or*
- c) provides goods and services which directly support or complement industries described in a) and b) of this subclause; and*
- d) minimises or offsets impacts on local infrastructure, economic and community development.*

6.7.4 The purpose of the Strategic Industry zone is to accommodate strategic industries and, notwithstanding the provisions of any other part of the Scheme, development which may impede the operation of such industries shall not be permitted within the Strategic Industry zone or Industrial Buffers Special Control Areas.

6.7.5 Council shall consult with the relevant State government or other relevant organisations, when assessing planning applications in the Strategic Industry zone, to ensure the proposal does not conflict with the strategic intentions for industry and infrastructure development in the zone.

Clause 7.3A relates to Industry Buffers as follows:

7.3A.1 Within the Industry Buffers:

- a) no dwelling is permitted; and*
- b) no development is permitted which would attract persons, other than those working in the adjacent strategic industrial area.*

7.3A.2 When considering applications for planning approval within the Industry Buffers Council shall have regard to:

- a) the existing, proposed or likely risks, hazards and nuisance (odour, noise, and light) associated with the adjoining Strategic Industrial Area;*
- b) compatibility of uses; and*
- c) the impact of the proposal on the efficient development of the strategic industrial area.*

Summary

The MSIA is recognised and supported by the City Local Planning Strategy and LPS8 for long term and large scale strategic industrial uses. Development of the area in a manner which will not adversely affect local infrastructure or environmental values, and will contribute to the economic development of the State is recognised by the Strategy and Scheme and will be further addressed in the Improvement Scheme and Report (below). As noted, the gazettal of Improvement Plan No. 44 (refer 2.6.1 below) effectively removes the MSIA from the Scheme and places the responsibility for decision making with the WAPC.

Local Planning Policies

The City of Kalgoorlie has prepared the following Local Planning Policy to guide industrial development:

DP05 Industrial Zones and Industrial Development Requirements

The Policy provides direction on preparing planning applications, establishing what type of development require a planning application; the process for applying; information required to accompany an application; establishes assessment criteria; statutory development standards (including setting out the objectives of the Maitland Precinct as per the Scheme) and associated policy provisions. Requirements for the preparation of a number of Environmental Management Plans are also included along with car parking and traffic management and environmental health requirements.

2.6.1 Improvement Plan and Scheme

In May 2014, the WAPC resolved to prepare Improvement Plans to facilitate the delivery of project ready strategic industrial land over the Maitland (and other) Strategic Industrial Areas. Following the gazettal of Improvement Plans, Improvement Schemes for each area will be prepared to guide the WAPC in making decisions on land use and development in the Improvement Plan area.

Improvement Plan No. 44 for the MSIA was approved by the Minister for Planning and WAPC in June 2016. The Improvement Plan spatially defines the areas subject to future key industrial and infrastructure developments and establishes the framework for land use coordination and infrastructure delivery.

An Improvement Scheme and Guide Plan is being prepared for the MSIA. The Improvement Scheme will zone the MSIA land for the purposes defined in the scheme, and therefore control and guide land use and development. It will be the principal statutory tool for implementing the strategic planning objectives for the project. The Improvement Scheme Report provides an outline of the planning arrangements as they apply to the area, the strategic intentions for the industrial area and an overview of the statutory provisions of the Improvement Scheme.

The WAPC is the “Responsible Authority” for implementing the MSIA Improvement Scheme, and is also responsible for the Guide Plan and any Planning Policies that are prepared under the terms of the scheme. This takes the responsibility for decision making out of the City’s jurisdiction and places the responsibility with the WAPC.

The Guide Plan provides the spatial guide for the preparation, assessment and determination of applications for subdivision, leasehold and planning approval of site-specific development plans.

Under the Improvement Scheme, a primary role of the WAPC is to receive, assess and determine applications for planning approval within the MSIA. Applications will be determined having regard for compliance with statutory requirements including the Improvement Scheme provisions and Guide Plan.

2.6.2 Land Tenure and Ongoing Management

The MSIA comprises approximately 2,500 hectares of Crown land and freehold land owned by the Western Australian Land Authority (LandCorp).

The DJTSI is the Lead Agency for the MSIA and LandCorp is the industrial estate manager, landowner and lessor. When considering Business Case submissions from future industry proponents seeking to establish within the MSIA, DJTSI and LandCorp will consider the proposal in the context of existing developments in the MSIA, the Improvement Scheme, and the supporting technical reports and operational requirements of the MSIA. This is to ensure the MSIA is developed to its full potential. This process occurs well before the lodgement of a Development Application with the Western Australian Planning Commission (WAPC).

2.6.3 Environmental Requirements

RPS has prepared an Environmental Assessment Report (EAR) for the Maitland Strategic Industrial Improvement Scheme Area, dated xxxxxxxx. The key outcomes of the EAR form Appendix B of this document.

The purpose of the EAR is to:

- Define the key environmental characteristics and issues of the MSIA Improvement Scheme area based on desktop assessments, existing site surveys, formal reports and EPA advice.
- Identify the relevant policy and guideline documents that have been considered and which are relevant to the site.
- Define the EPA's objectives relevant to environmental characteristics identified, potential impacts and mitigation measures proposed through the Improvement Scheme and Guide Plan for assessment by the EPA under section 48 of the EP Act.
- Ensure future industrial developments in the MSIA are managed by proposed statutory mechanisms which will be administered by the WAPC as the Responsible Authority (in consultation with the EPA and other relevant authorities).
- Describe proposed approvals framework and governance.

Summary

A key conclusion of this environmental assessment report is that, based on RPS' experience in the region, none of the identified key environmental risk factors alone present as being a "fatal flaw" to the MSIA. Based on a high-level review, the key environmental factors (or risks) identified include:

- Flora and vegetation.
- Terrestrial fauna.
- Hydrological process.
- Terrestrial environmental quality – acid sulfate soil.
- Aboriginal heritage.

2.6.4 Bushfire Management Plan

Strategen has prepared a Bush Fire Management Plan (BMP), dated xxxxxxxx to inform the Improvement Plan. The Bush Fire Management Plan forms Appendix C of this document.

The purpose of the BMP is to:

- ...
- ...

Summary

The BMP concluded ...

2.7 Key Assets

As previously mentioned, the land use of each individual Lot within the MSIA is not yet known and will likely be informed by the outcomes of this CHRMAP assessment. To provide a broad ranging assessment, the following land uses in Table 2.3 were selected as examples that could be developed within the MSIA.

Table 2.3 The MSIA Example Industries & Description

Industry	Description
Strategic Industrial Landuse (80-220 ha)	Strategic industry. May comprise of ammonia/urea and/or domestic gas. Assets including processing infrastructure, pipeline access, roads and utilities.
Salt Ponds/Algae Farms (10 ha)	Salt ponds using sea water and natural evaporation to produce and harvest salt, similar to the adjacent Dampier Salt operations. Algae production and farming to cultivate and harvest microalgae for a number of uses. Assets including roads, ponds, pumps, trucks, harvesters, operational machinery and buildings.
Solar Farms (25 ha)	Solar panels used to generate and supply power in the order of 10 MW. Assets including solar panels, power lines, power storage facilities, roads and buildings.
Storage (20-100 ha)	Industrial layout storage. Assets including hard stand laydown, administration buildings, roads, dry chemical and hazardous storage items.
Power Station (50 ha)	Electricity Generation Assets including an electricity generating power station, power storage, gas pipelines, roads and pipelines.
Desalination Plant (65 ha)	A seawater desalination plant. Assets including water processing and storage, roads and buildings.

The risk assessment in Section 5 will consider each of the example industry land uses and the subsequent risks from coastal impacts.

There are also a number of proposed and existing assets within the MSIA that are shared and not owned by specific Lots, including services and roadways. These are outlined in Table 2.4.

Table 2.4 The MSIA Shared Assets

Assets	Description
Dampier to Bunbury Natural Gas Pipeline (DBNGP)	An existing 660 mm diameter pipeline that runs underground through a southern section of the MSIA site.
Water Pipeline	Proposed lateral pipeline to desalination plant.
Powerlines	Proposed powerlines from power plant.
Shared Infrastructure Corridor	Proposed utilities including gas.
Roadways	Proposed roadways for access to each industrial Lot.

Similarly, these assets will be assessed for coastal risks in Section 5.

2.8 Success Criteria

The success criteria for the CHRMAP will ultimately be as follows.

- To understand the potential extent of impact of coastal hazards on a range of industrial land uses and the existing and proposed shared assets within the MSIA.
- To understand the potential/likelihood of industrial land uses and shared assets within the MSIA being impacted by coastal hazards over each planning horizon.
- To understand the consequences of industrial land uses and shared assets within the MSIA being exposed to the different coastal hazards.
- To determine total risk ratings for the potential example industrial land uses and shared assets within the MSIA.
- Development of an acceptable risk management and adaptation strategy for the potential example land uses and share assets at the MSIA.
- To provide a framework for individual Lots to undertake their own detailed and land use specific CRMP.
- Development of an implementation plan to outline the requirements and responsibilities over time.

The outcomes of the success criteria listed above are presented in the following Sections of the report.

3. Coastal Hazard Identification

The *Coastal Hazard Study* (MRA 2017) completed for the MSIA and provided in Appendix A, explains in detail the extensive investigation and modelling methodology used to determine the 100 and 500 year ARI cyclone event conditions.

3.1 Inundation

The SPP2.6 requires that the risk of storm surge inundation is assessed based on the 500 year ARI event, however it is also important to consider the 100 year ARI event to appropriately assess risk. While the 500 year ARI event is more severe, the 100 year ARI event is more likely to occur within the planning timeframe and may actually result in greater risk at the MSIA. The modelling of both 100 and 500 year ARI events at the MSIA showed impacts from inundation within the site. Further analysis identified that, due to the flat and complex topography at the MSIA, inundation appeared to be a combination of both:

- Typical coastal inundation (consists of inundation flow with high water depths) over lower elevations; and
- “Diffusive” type inundation of depths less than 0.5 m (consists of a wide spread “sheet like” flow with small water depths) over higher elevations.

The distinction between typical inundation and shallow “sheet like” flow is important and is considered by the coastal inundation likelihoods and consequences discussed in Section 4.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) Standing Committee on Agriculture and Resource Management (SCARM 2000) Report 73 provides guidance on potential hazard categories associated with different depths of inundation. Review of this report suggests that at low flow velocities, such as those associated with the shallow “sheet like” flow areas, inundation depths of less than around 0.5 m should not present a significant hazard. However, depths of greater than 0.6 m, as described in MRA (2017) as typical coastal inundation, present greater (High and Extreme) hazards for the same flow velocities. This is shown in Figure 3.1.

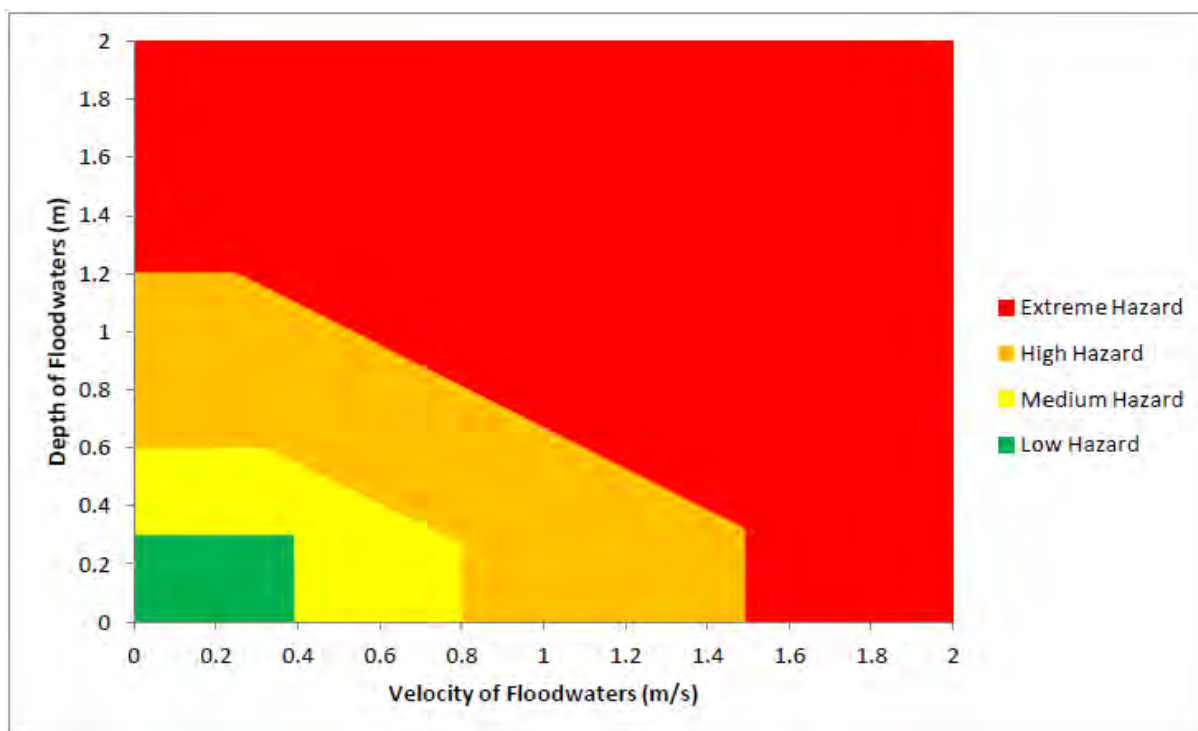


Figure 3.1 SCARM Report 73 Inundation Hazard Categories

It is to be noted that the hazards presented in Figure 3.1 relate to personal safety, specifically pedestrians being swept away by flood waters, and not to industrial assets or infrastructure. It will however be used as a guide for the MSIA risk assessment detailed in Section 4.

Analysis of the modelling completed by MRA (2017) identifies that coastal inundation at the MSIA, both typical and shallow “sheet like” inundation, isn’t likely to result in significant flow velocities. The flat nature of the site and absence of substantial channels or constrained flow paths means that flow velocities are expected to be less than around 0.3 m/s during inundation events. This will be considered in determining the inundation consequences presented in Section 4.

The allowances for sea level rise used in the *Coastal Hazard Study* (MRA 2017) for the 25, 50 and 100 year planning timeframes, will be considered in determining the likelihoods and consequences of inundation. Based on DoT (2010) assessment, and subsequently adopted by the SPP2.6 (WAPC 2013) for use in planning along the Western Australian coast, these sea level allowances are shown in Table 3.1.

Table 3.1 Sea Level Rise Allowances (S3)

Planning Timeframe	SLR Allowance (m)
Present day (2018)	0.00
25 years (2043)	0.15
50 years (2068)	0.37
100 years (2118)	0.90

3.2 Erosion

For the calculation of coastal erosion hazard risk, the SPP2.6 requires that consideration is given to the potential impacts of each of the following:

- Acute storm erosion associated with the 100 year ARI event (termed the S1 Allowance).
- Long term shoreline movement (termed the S2 Allowance).
- Sea level rise (termed the S3 Allowance).
- Appropriate allowances for uncertainty.

The *Coastal Hazard Study* (MRA 2017) completed for the MSIA identified inundation hazards as being critical for the site, compared with erosion hazards which are limited to a relatively small section along the northern boundary of the site. As previously mentioned, this is largely due to the approximately 4 km width that separates the MSIA from the shoreline and the elevation of the seaward boundary being located substantially above the highest astronomical tide. As inundation impacts are expected to be far more severe at the MSIA site during a severe event, this will be the focus of the following risk assessment.

4. Risk Analysis

In accordance with WAPC (2014), a risk based approach has been used to assess the hazards and required mitigation and adaptation options for the MSIA. As coastal hazards are the focus of this assessment, it is the likelihood and consequences of these coastal hazards that need to be considered. These are determined in following Sections for the example industrial land uses and shared assets within the MSIA to produce the risk assessment shown in Section 5.

4.1 Likelihood

Likelihood is defined as the chance of something happening (AS/NZS ISO 31000:2009). WAPC (2014) defines the likelihood as the chance of erosion or storm surge inundation occurring or how often they impact on existing and future assets and values. This requires consideration of the frequency and probability of the event occurring over a given planning timeframe.

The probability of an event occurring is often related to the Annual Exceedance Probability (AEP) or the ARI. The use of the AEP to define impacts of coastal hazards over the planning timeframe assumes that events have the same probability of occurring each year. In the case of climate change and sea level rise, which has a large influence on the assessed coastal hazard risk, this is not true. In addition, there is insufficient data available to properly quantify the probability of occurrence. A scale of likelihood has therefore been developed, which follows the Australian Standard Risk Management Principles and Guidelines (AS/NZS ISO 31000:2009). This is presented in Table 4.1.

Table 4.1 Scale of Likelihood

Rating	Description / Frequency
Almost certain	There is a high possibility the event will occur as there is a history of frequent occurrence 90-100% probability of occurring over the timeframe.
Likely	It is likely the event will occur as there is a history of casual occurrence 60-90% probability of occurring over the timeframe.
Possible	The event may occur 40-60% probability of occurring over the timeframe.
Unlikely	There is a low possibility that the event will occur 10-40% probability of occurring over the timeframe.
Rare	It is highly unlikely that the event will occur, except in extreme / exceptional circumstances. 0-10% probability of occurring over the timeframe.

The potential impacts associated with both the 500 year ARI event, as required by SPP2.6, and the 100 year ARI event were assessed based on the *Coastal Hazard Study* (MRA 2017). The results indicate that the southern portion of the MSIA would not be inundated by either the 100 or 500 year ARI events, including appropriate allowances for sea level rise over the 100 year planning horizon. This southern portion of the site therefore **avoids** the risks associated with

coastal hazards to the extent required by SPP2.6 and is therefore able to be developed with no further consideration of coastal hazards. However, the northern portion of the site that could be impacted by the 100 and 500 year ARI events over the 100 year planning horizon requires further consideration of coastal hazards. These areas are shown below in Figure 4.1. The risk assessment discussed in the following Sections considers only this northern portion of the site.

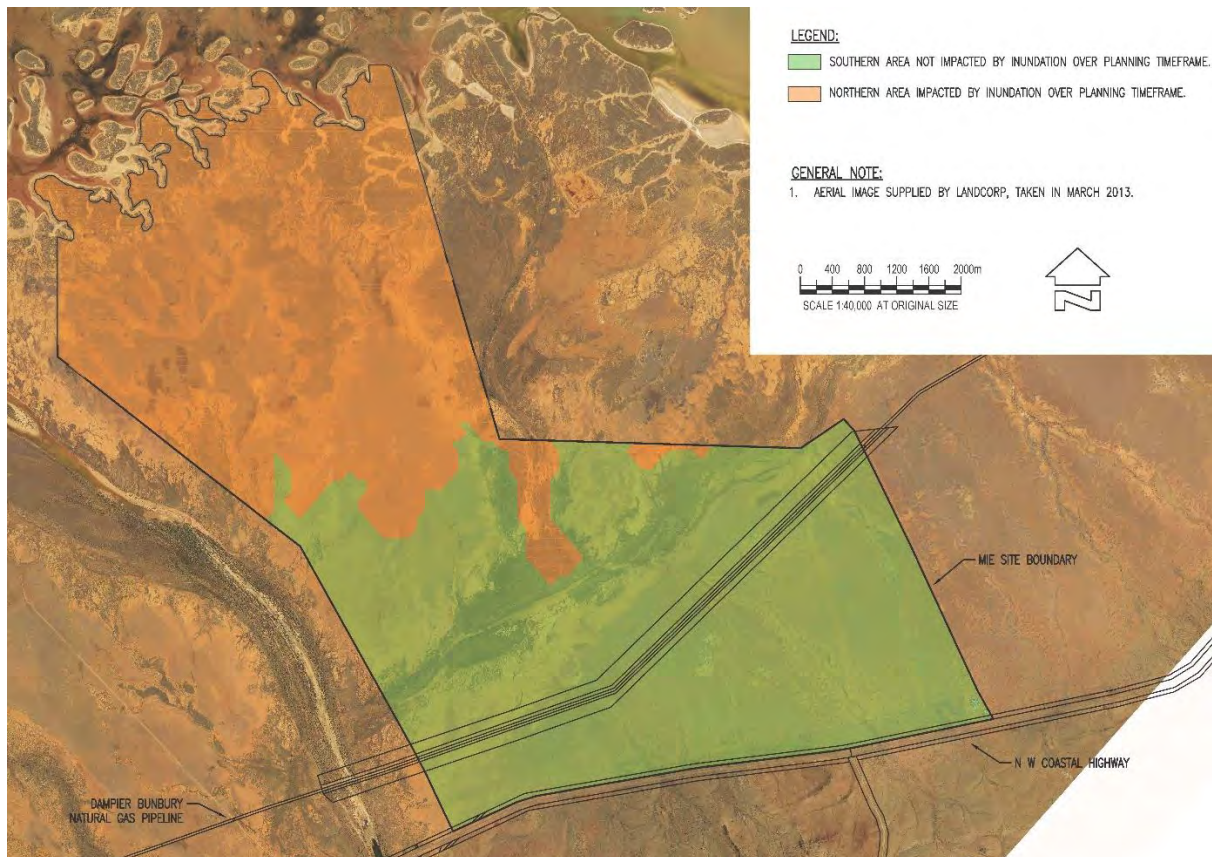


Figure 4.1 MSIA Inundation Area Considered in Risk Assessment

The likelihood of coastal inundation varies over time based on projected changes in mean sea level over the planning timeframe. An area that would only be inundated during a very severe event in the present day could potentially be inundated by a less severe event in the future. Assessment of the probability of an area being inundated within a given planning horizon therefore needs to consider the changing probability of event occurrence throughout that planning timeframe.

Interrogation of the modelling completed for the *Coastal Hazard Study* (MRA 2017) suggests that the chances of experiencing significant inundation within the northern portion of the site would be as follows.

- Approximately 20-25% chance over a 25 year period to 2043.
- Approximately 35-40% chance over a 50 year period to 2068.
- Approximately 60-65% chance over a 100 year period to 2118.

Whilst these cumulative probabilities may seem high, it is important to realise that, given the relatively large tidal range at Maitland, the duration of peak coastal inundation impact associated

with tropical cyclones would typically be limited to 12 hours or less. In other words, it is estimated that there is a 60-65% chance that a portion of the MSIA may be significantly inundated for a period of 12 hours or less over a 100 year planning horizon. Outside of this time, there may be periods of low level inundation (less than 0.5 m depth), however such inundation events are less likely to be critical to development. This is taken into account by the consequence ratings presented in following Sections.

The likelihoods of being impacted by inundation vary across the assessed northern portion of the site based on surface elevation and consequent inundation depths during severe events. The likelihood ratings and subsequent risk assessment has been completed for example land uses assuming that development occurs at the northernmost boundary of the site. Furthermore, as the location of the services and roadways to and within each Lot is not yet known, it is assumed in the following risk assessment that these northernmost developed locations are fully serviced and accessible by shared roadways. The likelihoods and subsequent risks are based on this critical location for development. Risks calculated are therefore likely to be less for Lots developed and shared assets located landward of these northernmost Lots.

The existing DBNGP is outside the northern portion of the MSIA likely to be impacted by inundation over the 100 year planning timeframe and has therefore been omitted from this risk assessment.

The results of the assessment of likelihood of coastal inundation for each of the industrial land uses and shared assets is presented in Table 4.2.

Table 4.2 Assessment of Likelihood of Coastal Inundation Impact

Land Use or Shared Asset	Planning Timeframe			
	Present Day (2018)	2043	2068	2118
Strategic Industrial Landuse	Rare	Unlikely	Possible	Likely
Salt Ponds/Algae Farms	Rare	Unlikely	Possible	Likely
Solar Farms	Rare	Unlikely	Possible	Likely
Storage	Rare	Unlikely	Possible	Likely
Power Station	Rare	Unlikely	Possible	Likely
Desalination Plant	Rare	Unlikely	Possible	Likely
Water Pipeline	Rare	Unlikely	Possible	Likely
Powerlines	Rare	Unlikely	Possible	Likely
Shared Infrastructure Corridor	Rare	Unlikely	Possible	Likely
Roadways	Rare	Unlikely	Possible	Likely

Notes: Based on most exposed location for land use or shared asset group.

4.2 Consequence

The second part of the risk assessment is determining the consequence of the coastal hazards within the MSIA. A scale of consequence has been developed which provides a range of impacts and is generally consistent with the Australian Standard Risk Management Principles and Guidelines (ISO 31000:2009).

Table 4.3 Scale of Consequence

Rating	Social	Economic	Environment
Catastrophic	Loss of life and serious injury. Large long term or permanent loss of services, employment wellbeing, finances or culture (75% of community affected), international loss, no suitable alternative sites exist	Damage to property, infrastructure or local economy > \$20M	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage
Major	Serious injury. Medium term disruption to services, employment wellbeing, finances or culture (<50% of community affected), national loss, limited alternative sites exist	Damage to property, infrastructure or local economy > \$5M to \$20M	Severe loss of environmental amenity and a danger of continuing environmental damage
Moderate	Minor injury. Major short or minor long term disruption to services, employment wellbeing, finances or culture (<25% of community affected), regional loss, many alternative sites exist	Damage to property, infrastructure or local economy > \$500,000 to \$5M	Isolated but significant instances of environmental damage that might be reversed with intensive efforts. Recovery may take several years.
Minor	Small to medium disruption to services, employment wellbeing, finances or culture (<10% of community affected), local loss, many alternative sites exist	Damage to property, infrastructure or local economy > \$50,000 to \$500,000	Minor instances of environmental damage that could be reversed. Consistent with seasonal variability, recovery may take one year.
Insignificant	Minimal short-term inconveniences to services, employment, wellbeing, finances or culture (<5% of community affected), neighbourhood loss, many alternative sites exist	Damage to property, infrastructure or local economy < \$50,000	Minimal environmental damage, recovery may take less than 6 months.

The consequence ratings are outlined and discussed below. These consequence ratings have been reviewed by key stakeholders,

The assessed consequences of coastal inundation for each of the industrial land uses and shared assets within the MSIA are presented in Table 4.4. Importantly, the assessment of the consequences of coastal inundation has been completed on the basis that the personal safety of employees and people at MSIA is managed during inundation events. Given that the major inundation events are likely to be associated with the passage of cyclone events, management of personal safety is something that will occur through the emergency management plan recommended in Section 6 and the emergency management procedures of the Department of Fire and Emergency Services (DFES).

The consequences of being impacted by inundation vary across the assessed northern portion of the site, based on surface elevation and subsequent inundation depths in severe events. The inundation consequence rating for each of the industrial land uses and shared assets within the MSIA has been determined based on the following assumptions:

- That infrastructure and assets within the northern portion of the MSIA site that could be impacted by the 100 and 500 year events, over the 100 year planning timeframe, are appropriately designed to withstand the 500 year event conditions with appropriate allowances for sea level rise. This includes for example; solar panels being anchored down sufficiently, power being turned off during severe events and buildings designed appropriately for expected flow velocities and inundation depths.
- That development occurs at the northernmost boundary of the MSIA site where the greatest inundation depths are expected during the 100 and 500 year ARI events. The consequence ratings will be based on this most critical location for development of both land uses and shared assets. As with likelihood, the servicing and access via roadways is assumed for Lots at this northernmost critical development location. Again, consequences and therefore risks calculated landward of this location are likely to be less.
- That the duration of significant inundation at the MSIA associated with the passage of a severe cyclone would be limited to around 12 hours or less, due to the high tidal range at Maitland and based on the modelling completed in the *Coastal Hazard Study* (MRA 2017).
- That projected sea level rise of 0.15 m to 2043 is unlikely to significantly increase the consequences of inundation at MSIA. However, that projected sea level rise of 0.37 m and 0.90 m to 2068 and 2118 respectively would likely increase the consequences of inundation at the MSIA.

There are also a number of scenarios to be considered in determining the consequence ratings for each of the example land uses assessed. For the relatively inert land uses, Salt ponds/Algae Farms and Solar Farms, the consequences are considered to be Minor at present day and to 2043 as short duration inundation would likely result in a small to medium disruption, relatively low (under \$500,000) damage and minor reversible environmental damage. Following this, within the 50 year planning horizon to 2068 and beyond, with projected sea level rise, the consequences are considered to be Moderate.

Conversely, considering Storage as a land use, the consequences are entirely based on the materials being stored and how they are stored. The consequence of inundation for well contained dry storage is far less than uncontained chemical or hazardous material storage. This has been considered and the consequence ratings for Storage, as presented for in Table 4.4, are based on the latter more critical scenario.

Similarly, considering the land uses Strategic Industrial Landuse, Power Station and Desalination Plant, the consequences of potential inundation outlined in Table 4.4 are based on the most critical scenarios considered.

The varying scenarios and subsequent consequences, as a result of inundation, inform the recommended risk adaptation and mitigation strategies presented and discussed in Section 6 of this report.

Table 4.4 Assessment of Consequence of Coastal Inundation Impact

Land Use or Shared Asset	Planning Timeframe			
	Present Day (2018)	2043	2068	2118
Strategic Industrial Landuse	Major	Major	Catastrophic	Catastrophic
Salt Ponds/Algae Farms	Minor	Minor	Moderate	Moderate
Solar Farms	Minor	Minor	Moderate	Moderate
Storage	Major	Major	Catastrophic	Catastrophic
Power Station	Major	Major	Catastrophic	Catastrophic
Desalination Plant	Moderate	Moderate	Major	Major
Water Pipeline	Minor	Minor	Moderate	Moderate
Powerlines	Minor	Minor	Moderate	Moderate
Shared Infrastructure Corridor	Minor	Minor	Moderate	Moderate
Roadways	Minor	Minor	Minor	Minor

Notes: Based on most critical consequence for each industrial land use or shared asset group.

5. Risk Evaluation

5.1 Risk Evaluation Matrix

The risk rating from a risk assessment is defined as “likelihood” x “consequence.” A risk matrix defining the levels of risk from combinations of likelihood and consequence has therefore been developed for the coastal hazards. This risk matrix is generally consistent with WAPC (2014).

Table 5.1 Risk Matrix

RISK LEVELS		CONSEQUENCE				
		Insignificant	Minor	Moderate	Major	Catastrophic
LIKELIHOOD	Almost Certain	Low	Medium	High	Extreme	Extreme
	Likely	Low	Medium	Medium	High	Extreme
	Possible	Low	Medium	Medium	Medium	High
	Unlikely	Low	Low	Medium	Medium	Medium
	Rare	Low	Low	Low	Low	Low

A risk tolerance scale assists in determining which risks are acceptable, tolerable and unacceptable. The risk tolerance scale used for the assessment is presented in Table 5.2.

Table 5.2 Risk Tolerance Scale

Risk Level	Action Required	Tolerance
Extreme	Immediate action required to eliminate or reduce the risk to acceptable levels	Intolerable
High	Immediate to short term action required to eliminate or reduce risk to acceptable levels	Intolerable
Medium	Reduce the risk or accept the risk provided residual risk level is understood	Tolerable
Low	Accept the risk	Acceptable

The risk tolerance scale shows that the extreme and high risks need to be managed.

5.2 Risk Assessment

The risk assessment for the study area has been completed in accordance with the recommendations of AS5334 (Standards Australia, 2013), which requires a detailed risk analysis to include a vulnerability analysis to thoroughly examine how coastal hazards and climate change may affect the assets. This includes consideration of the adaptive capacity and vulnerability of an asset.

Based on the results of the risk analysis completed previously, Table 5.3 presents the coastal inundation risk levels for each of the land uses and shared assets. The order of the assessed risks in the table has been used to show the priority risk areas for each planning timeframe at the start of the table, with decreasing risk down the table. Once again, this risk assessment is on the basis that personal safety is effectively managed as discussed in Section 6.

Table 5.3 Preliminary Assessment of Coastal Inundation Risk Level

Land Use or Shared Asset	Assessed Risk Level			
	Present Day (2018)	2043	2068	2118
Storage	Low	Medium	High	Extreme
Strategic Industrial Landuse	Low	Medium	High	Extreme
Power Station	Low	Medium	High	Extreme
Desalination Plant	Low	Medium	Medium	High
Water Pipeline	Low	Low	Medium	Medium
Powerlines	Low	Low	Medium	Medium
Shared Infrastructure Corridor	Low	Low	Medium	Medium
Salt Ponds/Algae Farms	Low	Low	Medium	Medium
Solar Farms	Low	Low	Medium	Medium
Roadways	Low	Low	Medium	Medium

The results of the assessment show that the relatively inert land uses, Salt ponds/Algae Farms and Solar Farms and shared assets, , have a Low risk of being impacted by inundation at present as well as over the 25 year planning horizon to 2043. These land uses and shared assets have a Medium risk of being impacted by inundation over the 50 and 100 year planning timeframes to 2068 and 2118 respectively. Based on Table 5.2, the Medium level risk is deemed to be tolerable, but steps should be taken to reduce these risks where possible.

The less inert land uses, Storage, Strategic Industrial Landuse and Power Station, have an assessed risk to the 25, 50 and 100 year planning horizons of Medium, High and Extreme respectively. The Desalination Plant land use has an assessed risk to the 50 and 100 year planning horizons of Medium and High respectively. These are based on the most critical scenarios and subsequent consequence ratings as previously discussed in Section 4.

Further consideration of the implications of these results are provided in the following Section with regard to risk management.

6. Risk Adaptation & Mitigation Strategies

SPP2.6 outlines a hierarchy of risk adaptation and mitigation options, where options that allow for a wide range of future strategies are considered more favourably. This hierarchy of options is reproduced in Figure 6.1.



Figure 6.1 Risk Management & Adaptation Hierarchy

These options are generally outlined below.

- Avoid – avoid new development within the area impacted by the coastal hazard.
- Retreat – the relocation or removal of assets within an area identified as likely to be subject to intolerable risk of damage from coastal hazards.
- Accommodation – measures which suitably address the identified risks.
- Protect – used to preserve the foreshore reserve, public access and public safety, property and infrastructure.

The assessment of options is generally done in a progressive manner, moving through the various options until an appropriate mitigation option is found.

6.1 Proposed Mitigation Strategies

As previously mentioned, each industrial proponent proposing to develop within the MSIA will be required to complete a CRMP. Once detailed plans for the land use and site operations are known for a specific Lot, the industrial proponent will be able to complete a CRMP detailing how their future land use fits into the risk assessment and proposed mitigation strategies outlined in this CHRMAP document.

The six example industry land uses considered by this report serve to demonstrate that the MSIA can be developed and that the risks from coastal impacts can be reduced to tolerable levels by implementing appropriate adaptation and mitigation strategies. The following Sections outline proposed mitigation strategies to reduce or minimise the risks identified by the risk assessment in Section 5.

It should be again noted that any development in the southern portion of the site behind the inundation extent of the 100 and 500 year ARI events, is essentially adopting an **avoid** strategy.

The following mitigation strategies proposed for the example industry land uses assessed are based on development at the most critical exposed location, the northernmost boundary. However, in the case that an industrial proponent identifies tolerable risks from inundation over the 50 year planning horizon and intolerable risks over the 100 year planning timeframe, a **managed retreat** strategy may be appropriate. With this strategy and provided that the industrial Lot is large enough to permit **managed retreat** within the Lot, assets could be replaced further landward at the end of their respective service lives (typically around 25 or 50 years) to tolerable risk levels.

6.1.1 Example Industry Land Uses

Strategic Industrial Landuse

The risk assessment for a Strategic Industrial Landuse, potentially consisting of ammonia/urea and/or natural gas related infrastructure and operations, showed risks of impact from coastal inundation over the 25, 50 and 100 year planning horizons as Medium, High and Extreme respectively. Strategies must therefore be implemented to reduce the intolerable High and Extreme risks to tolerable levels.

The most critical Strategic Industrial Landuse scenario governing the risk assessment values determined in Section 5, was for chemical and hazardous materials being processed by the facilities within the Lot. While the risks are tolerable over the 25 year planning horizon, it is recommended that any chemical or hazardous materials are either located and processed behind the northern portion of the MSIA impacted by inundation hazards adopting an **avoid** strategy or, if within the northern portion, **protected** from inundation risks. These strategies will reduce the longer term risks to planning horizons 2068 and 2118 to tolerable levels.

Protection from inundation risks may include filling or building up processing facility and storage areas to levels above potential inundation depths, with an appropriate additional safety factor allowance. This strategy would require further analysis of modelled water depths at the proposed location of various Lot facilities. Assessment of the impacts from **protection** on adjacent landholdings is also required to ensure that the exposure of other areas is not increased by the development. This will need to be completed by industrial proponents of individual Lots through their own CRMP process. Assessment of these impacts on adjacent landholdings would need to be completed in line with SPP2.6 and submitted by industrial proponents as part of seeking Development Approval.

The processing of inert, non-chemical and non-hazardous materials have lower consequences of impact from inundation. It is expected that these materials can be used and processed within the northern portion of the MSIA adopting an **accommodate** approach. The ALARP approach should be adopted however, to reduce the extent of impacts should a severe inundation event occur.

Permanent assets including roads, buildings and facility infrastructure should be designed to accommodate **inundation** risks. This includes designing these assets for expected inundation depths and flow velocities, with sufficient supports, anchors and tiedowns. If practical, moveable assets and operational equipment could be temporarily relocated offsite. These assets will need to be easily relocatable at short notice. Where assets require removal offsite for cyclone events expected to inundate the Lots within the MSIA, an appropriate plan detailing which assets, the threshold trigger values and duration for which they require relocation should be detailed within the CRMP and implemented prior to such events.

Salt Ponds/Algae Farms

The risk assessment for Salt Ponds/Algae Farms as a land use showed a Low risk of impact from coastal inundation over the 25 year planning horizon to 2043 and following that, a Medium risk over the 50 and 100 year planning timeframes to 2068 and 2118 respectively. The risk tolerance scale in Table 5.2 which is generally consistent with WAPC (2014) identifies these risks as tolerable. Furthermore, the service life of the assets required for this land use would typically only be 25 or 50 years.

Despite these risks being tolerable, the As Low As Reasonably Practical (ALARP) approach should be adopted for planning to reduce the extent of impacts should a severe inundation event occur.

Permanent assets including roads, pumps, various buildings and the ponds themselves should be designed to **accommodate** inundation risks. This includes designing these assets for expected inundation depths and flow velocities, with sufficient supports, anchors and tiedowns. As these assets are relatively inert, it is expected that this can be done to tolerable risks and with minimal impacts during severe events. This will need to be confirmed by the individual CRMP completed by industrial proponents of individual Lots.

Assets including trucks, harvesters and various operational machinery should be designed to **accommodate** inundation risks, or if that is not practical, temporarily moved offsite during the passage of severe cyclone events. These assets will need to be easily relocatable at short notice. Where assets require removal offsite for cyclone events expected to inundate the Lots within the MSIA, an appropriate plan detailing which assets, the threshold trigger values and duration for which they require relocation should be detailed within the CRMP and implemented prior to such events.

Solar Farms

The risk assessment for Solar Farms as a land use showed a Low risk of impact from coastal inundation over the 25 year planning horizon to 2043 and following that, a Medium risk over the 50 and 100 year planning timeframes to 2068 and 2118 respectively. Similar to the Salt Ponds/Algae Farms, these risks are considered tolerable and assets within a solar farm would typically have service life of 25 or 50 years.

The ALARP approach should also be adopted to reduce the extent of impacts should a severe inundation event occur.

Permanent assets including roads, power lines, power storage facilities, buildings and the solar panels themselves should be designed to **accommodate** inundation risks. This includes designing these assets for expected inundation depths and flow velocities, with sufficient supports, anchors and tiedowns. As these assets are relatively inert, it is expected that this can be done to tolerable risks and with minimal impacts during severe events. This will need to be confirmed by the individual CRMP completed by industrial proponents of individual Lots.

If it is impractical to design moveable assets within the Lot to **accommodate** the inundation risks, these assets should be temporarily relocated offsite. These assets will need to be easily relocatable at short notice. Where assets require removal offsite for cyclone events expected to inundate the Lots within the MSIA, an appropriate plan detailing which assets, the threshold trigger values and duration for which they require relocation should be detailed within the CRMP and implemented prior to such events.

Storage

The risk assessment for Storage as a land use showed risks of impact from coastal inundation over the 25, 50 and 100 year planning horizons as Medium, High and Extreme respectively. Strategies must therefore be implemented to reduce these intolerable risks to tolerable levels.

The most critical storage scenario governing the risk assessment values determined in Section 5, was for chemical and hazardous storage. While the risks are tolerable over the 25 year planning horizon, it is recommended that any chemical or hazardous storage is either located behind the northern portion of the MSIA impacted by inundation hazards adopting an **avoid** strategy or, if within the northern portion, **protected** from inundation risks. These strategies will reduce the longer term risks to planning horizons 2068 and 2118 to tolerable levels.

As mentioned above for Strategic Industrial Landuse mitigation strategies, **Protection** from inundation risks may include filling or building up storage areas to levels above potential inundation depths, with an appropriate additional safety factor allowance. This strategy would require further analysis of modelled water depths at the proposed storage Lot location. Assessment of the impacts from **protection** on adjacent landholdings is also required to ensure that the exposure of other areas is not increased by the development. This will need to be completed by industrial proponents of individual Lots through their own CRMP process. Assessment of these impacts on adjacent landholdings would need to be completed in line with SPP2.6 and submitted by industrial proponents as part of seeking Development Approval.

Dry storage, other non-chemical and non-hazardous assets have lower consequences of impact from inundation. It is expected that these can be developed within the northern portion of the MSIA adopting an **accommodate** approach. The ALARP approach should be adopted however, to reduce the extent of impacts should a severe inundation event occur.

Permanent assets including roads, buildings and shelving should be designed to accommodate **inundation** risks. This includes designing these assets for expected inundation depths and flow velocities, with sufficient supports, anchors and tiedowns. If practical, moveable assets including lifting and operational equipment and various storage items could be temporarily relocated offsite. These assets will need to be easily relocatable at short notice. Where assets require removal offsite for cyclone events expected to inundate the Lots within the MSIA, an appropriate plan detailing which assets, the threshold trigger values and duration for which they require relocation should be detailed within the CRMP and implemented prior to such events.

Power Station

The risk assessment for a Power Station as a land use showed risks of impact from coastal inundation over the 25, 50 and 100 year planning horizons as Medium, High and Extreme respectively. Strategies must therefore be implemented to reduce the intolerable risks to tolerable levels.

The most critical storage scenario governing the risk assessment values determined in Section 5, was for reactive and hazardous facilities and materials. While the risks are tolerable over the 25 year planning horizon, it is recommended that any reactive or hazardous facilities are either located behind the northern portion of the MSIA impacted by inundation hazards adopting an **avoid** strategy or, if within the northern portion, **protected** from inundation risks. These strategies will reduce the longer term risks to planning horizons 2068 and 2118 to tolerable levels.

Protection from inundation risks may include filling or building up storage areas to levels above potential inundation depths, with an appropriate additional safety factor allowance. This strategy would require further analysis of modelled water depths at the proposed location of various Lot

facilities. Assessment of the impacts from **protection** on adjacent landholdings is also required to ensure that the exposure of other areas is not increased by the development. This will need to be completed by industrial proponents of individual Lots through their own CRMP process.

Assessment of these impacts on adjacent landholdings would need to be completed in line with SPP2.6 and submitted by industrial proponents as part of seeking Development Approval.

Non-reactive, non-chemical and non-hazardous facilities and materials have lower consequences of impact from inundation. It is expected that these can be developed within the northern portion of the MSIA adopting an **accommodate** approach. The ALARP approach should be adopted however, to reduce the extent of impacts should a severe inundation event occur.

Permanent assets including roads, buildings and facility infrastructure should be designed to accommodate inundation risks. This includes designing these assets for expected inundation depths and flow velocities, with sufficient supports, anchors and tiedowns. If practical, moveable assets and operational equipment could be temporarily relocated offsite. These assets will need to be easily relocatable at short notice. Where assets require removal offsite for cyclone events expected to inundate the Lots within the MSIA, an appropriate plan detailing which assets, the threshold trigger values and duration for which they require relocation should be detailed within the CRMP and implemented prior to such events.

Desalination Plant

The risk assessment for a Desalination Plant as a land use showed risks of impact from coastal inundation over the 50 and 100 year planning horizons as Medium and High respectively. Strategies must therefore be implemented to reduce the intolerable High risk to a tolerable level.

The most critical storage scenario governing the risk assessment values determined in Section 5, was for reactive and hazardous facilities and materials. While the risks are tolerable over the 50 year planning horizon, it is recommended that any reactive or hazardous facilities are either located behind the northern portion of the MSIA impacted by inundation hazards adopting an **avoid** strategy or, if within the northern portion, **protected** from inundation risks. These strategies will reduce the longer term risks to planning horizons 2068 and 2118 to tolerable levels.

Protection from inundation risks may include filling or building up storage areas to levels above potential inundation depths, with an appropriate additional safety factor allowance. This strategy would require further analysis of modelled water depths at the proposed location of facilities within the Lot. Assessment of the impacts from **protection** on adjacent landholdings is also required to ensure that the exposure of other areas is not increased by the development. This will need to be completed by industrial proponents of individual Lots through their own CRMP process.

Assessment of these impacts on adjacent landholdings would need to be completed in line with SPP2.6 and submitted by industrial proponents as part of seeking Development Approval.

Non-reactive, non-chemical and non-hazardous facilities and materials have lower consequences of impact from inundation. It is expected that these can be developed within the northern portion of the MSIA adopting an **accommodate** approach. The ALARP approach should be adopted however, to reduce the extent of impacts should a severe inundation event occur.

Permanent assets including roads, buildings and facility infrastructure should be designed to accommodate **inundation** risks. This includes designing these assets for expected inundation depths and flow velocities, with sufficient supports, anchors and tiedowns. If practical, moveable assets and operational equipment could be temporarily relocated offsite. These assets will need to be easily relocatable at short notice. Where assets require removal offsite for cyclone events expected to inundate the Lots within the MSIA, an appropriate plan detailing which assets, the

threshold trigger values and duration for which they require relocation should be detailed within the CRMP and implemented prior to such events.

6.1.2 Shared Assets

The risk assessment for shared assets showed risks of impact from coastal inundation over the 25 year planning horizon to 2043 as Low and thereafter as Medium.

Despite the risks being tolerable over the 100 year planning timeframe, the ALARP approach should be adopted to reduce the extent of impacts should a severe inundation event occur.

The assessed consequences and subsequent risks for the shared assets are either the same or less than the example industries that they service or provide access to. Given this, it is expected that the strategies implemented for the shared assets will be consistent with the land uses on the Lots that they service. For example, if a Lot development deems that risks are intolerable and that the assets must be removed, then the services that connect to those assets and roadways that provide access should also be removed.

6.1.3 Personal Safety

As outlined previously, the risk ratings that were determined for inundation hazards, and consequently the risk mitigation strategies outlined above, are provided on the basis that personal safety will be managed by both the individual developed industries and DFES. DFES's management occurs along the entire coastline of Western Australia in response to cyclone events, which are the key contributor to inundation at the MSIA (refer Section 3).

Essentially, to manage risks associated with cyclone inundation, DFES communicate with the Bureau of Meteorology to receive updates on the potential cyclone tracks and associated storm surge and areas of inundation. Evacuations are then completed as required in order to manage personal safety prior to event impact.

It is also important to note that there would be some degree of self-management of these risks by employees and persons within the MSIA at the time of such events, as they would be aware of the risks and would likely leave the area before conditions became too severe. Nevertheless, despite the potential self-management by persons at the MSIA and the management by DFES, it is recommended that a specific inundation risk management plan is developed for the entire site and implemented by each individual developed industry. This plan should outline steps that should be taken as severe events approach, as well as evacuation pathways and routes to relevant evacuation centres. It is recommended that this plan be developed in consultation with DFES.

6.1.4 Summary of Coastal Adaptation Approach

The mitigation strategies recommended for the MSIA, based on the example industry land uses and shared assets discussed in Section 2 are summarised below for clarity.

- **Avoidance** of coastal hazard risks will be achieved by all development and shared assets located in the southern portion of the MSIA landward of the 100 and 500 year ARI inundation extent over the 100 year planning timeframe, including appropriate allowances for sea level rise.
- **Managed retreat** for the replacement of assets upon fulfilment of their design lives will be completed within Lots where space allows and when intolerable risks assets can be reduced to tolerable levels through the use of this strategy.

- **Accommodation** will be achieved through the use of appropriately designed infrastructure and systems that can withstand the impacts of coastal hazards, including inundation, over their service lives. An example of this is the design of solar panels, which are to designed to **accommodate** potential loads associated with severe events and inundation depths and flow velocities.
- **Protection** may be achieved through the building up or filling of a development area above the expected depths for significant inundation events. As mentioned, industrial proponents will be required to demonstrate further assessment of inundation and impacts on adjacent landholdings inline with SPP2.6 as part of seeking Development Approval.
- Risk mitigation will also be achieved through the temporary relocation of easily moveable assets during the passage of severe cyclone events likely to inundate individual Lots.
- Management of personal safety will be achieved through the proposed management plan for the entire MSIA site and DFES requirements that require evacuation of employees and people at the MSIA during cyclone or other coastal risk warnings.

7. Implementation Plan

7.1.1 Planning & Initial Construction

Coastal planning for this development, largely informed by the findings of this CHRMAP, have identified that coastal hazard risks, specifically inundation, exist within the northern portion of the MSIA site. A notification on title will therefore be required to ensure that the developer/landowner/lessee is fully cognisant of these risks and the requirements to prepare an appropriate CRMP report for the Lot, subject to approval from the relevant authorities, prior to development.

The other element that is key during the planning and construction phase is to ensure that the development designs for each Lot and for the shared assets are appropriate to withstand the short duration inundation expected during severe cyclone events.

The risk mitigation and adaptation strategies outlined in Section 6 present proposed coastal mitigation strategies for the example industrial land uses and shared assets assessed within this CHRMAP. While these strategies illustrate that the risks from coastal hazards for development within the MSIA can be reduced to tolerable levels, the specific land uses for each Lot are not yet known. This limits the level of detail that can be provided by the adaptation and mitigation strategies. Once the land uses are determined, likely based on the outcomes of this report, more in depth, detailed and applicable risk management plans can be completed for each individual Lot.

A broad framework of the CRMP assessment process that will need to be followed by industrial proponents for the development of each individual Lot within the MSIA is presented in Figure 7.1. This framework is reflective of the requirements of the SPP2.6 and WAPC (2014).

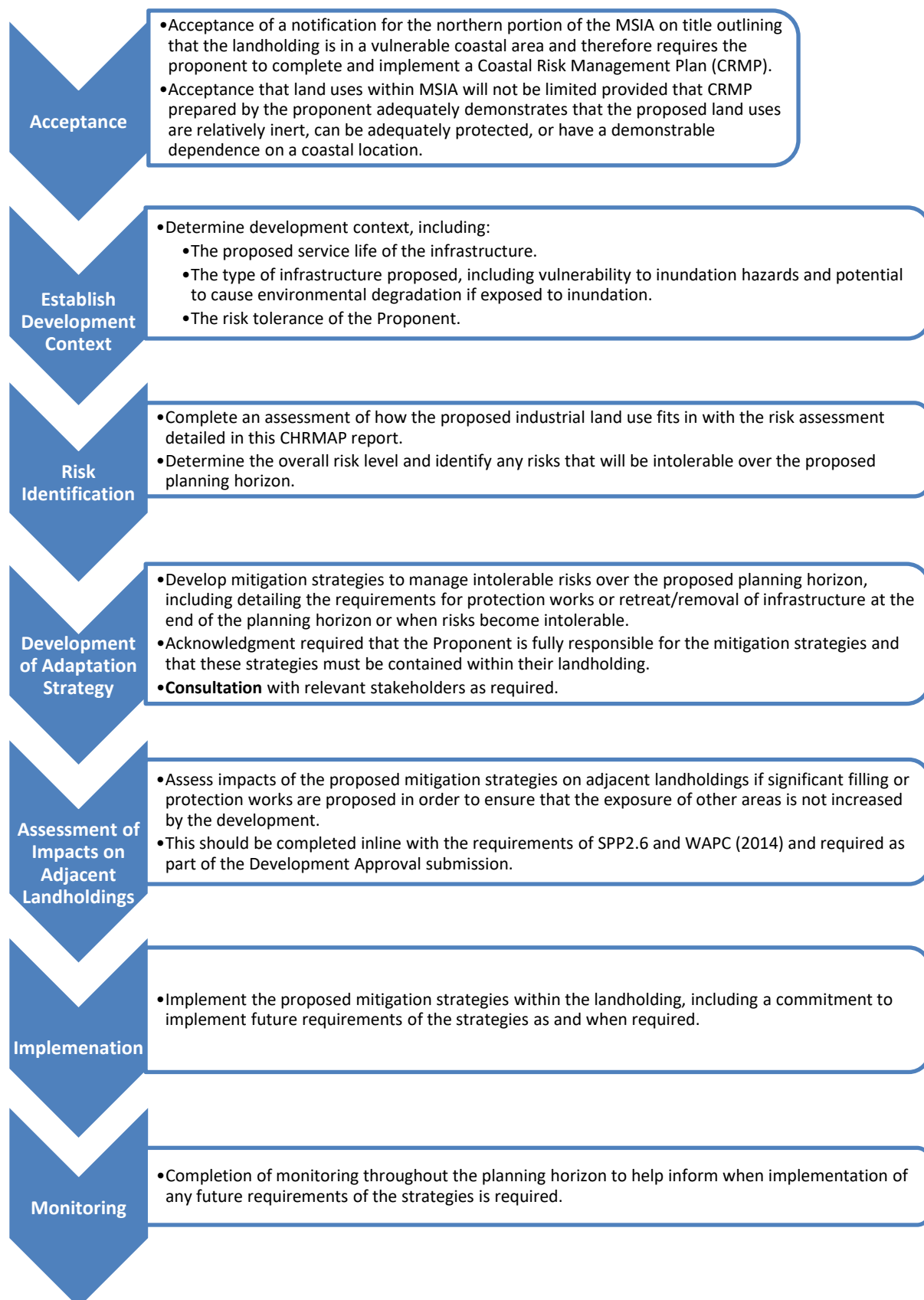


Figure 7.1 Proposed CRMP Framework for Lot Development within the MSIA

A summary of the requirements of the planning and construction stage is presented in Table 7.1.

Table 7.1 Implementation Plan Summary – Planning & Initial Construction Stage

Requirement	Timing	Responsibility
Acceptance of disclosed hazards/vulnerability and requirements to complete individual CRMP reports	Planning Stage	Industrial proponent of each Lot
Appropriate design of elements within each development Lot and of shared assets to ensure that risks are managed as best as possible	Planning & Construction Stage	Industrial proponent of each Lot and engaged design team for elements within each Lot development
Completion of individual CRMP report, specific to the land use of each Lot	Planning Stage	Industrial proponent of each Lot

7.2 Operation Over the Infrastructure Service Life

Over the service life of the assets within each industrial Lot development and the MSIA shared assets there will be a requirement to reassess and ascertain whether the risks to assets are increasing. Further details of these requirements are outlined in Section 7.4. This will be the responsibility of the industrial proponents for assets and infrastructure within each Lot and the responsibility of LandCorp for the MSIA shared assets.

If, at some stage during the service life of the infrastructure the risk from coastal hazards becomes untenable, the assets should be managed in accordance with the mitigation strategies proposed by each Lot's industrial proponent in their own CRMP documents. As previously mentioned, it is expected that the management of shared assets will be consistent with the individual Lot strategies as these risks are tolerable over the 100 year planning timeframe and likely equal or less than the assets of each Lot which use them.

The other item that needs to occur during the operation is to ensure that the evacuation and emergency management procedures are enacted during extreme events. This will be the responsibility of industrial proponents, but will ultimately be informed by advice from DFES prior to and during the passage of the events. This management will include both evacuation as well as management of the site, such as shut off of all services to ensure no spillage / leakage during the events.

A summary of the requirements during the operation of the assets over their service life is presented in Table 7.2.

Table 7.2 Implementation Plan Summary – Operation over the Infrastructure Service Life

Requirement	Timing	Responsibility
Reassess coastal hazard risk to assess if risk becomes untenable for assets and infrastructure within each Lot	Operation over service life	Industrial proponent of each Lot
<p>IF REQUIRED</p> <p>Asset management in accordance with the mitigation strategies proposed by each Lot developers individual CRMP document</p>	When risk level becomes untenable	Industrial proponent of each Lot
Evacuation and Emergency Management (including shut off of services etc to manage environmental risks as required)	During extreme events over service life	Industrial proponent of each Lot (will be informed by DFES advice prior to/during events)

7.3 Asset Replacement

Replacement of assets after their service life requires that they be relocated to an area where the risk to that asset over its service life is considered to be acceptable, provided this can be contained within the Lot. To do this will require a revised coastal hazard risk assessment to be completed in accordance with the requirements at that time. The appropriate location for the replacement assets can then be chosen based on the acceptable risk level. Alternatively, that particular asset could be removed and not replaced, which is essentially an “abandon” management approach. The responsibility for these actions would rest with the industrial proponent of each Lot.

A summary of the requirements during the replacement of assets is presented in Table 7.3.

Table 7.3 Implementation Plan Summary – Operation over the Service Life

Requirement	Timing	Responsibility
Complete a revised coastal hazard risk assessment to quantify the risk level at that time	Planning for asset replacement	Industrial proponent of each Lot
Determine appropriate location for replacement asset or infrastructure based on acceptable risk level OR Remove infrastructure and abandon for that particular asset	Planning for asset replacement	Industrial proponent of each Lot

7.4 Data Review & Document Updates

Data review and updating the relevant documents is essential in order to identify changes to coastal risks over the planning timeframe. Whilst the results of Section 3 provide an indication of potential sea level rise, the system is inherently complex and changes could be different to those presented. Monitoring of sea level rise should therefore be completed to track changes over time and to indicate whether the timing for risk mitigation should be adjusted. This can be done using DoT recorded data from the King Bay tidal gauge, the closest to the MSIA, which includes water levels since 1985.

If measured sea level rise is materially different from that allowed for in this risk assessment, it is also recommended that the Coastal Hazard Study (MRA 2017) and subsequent individual CRMPs completed by industrial proponents both be updated to quantify any changes to the risks posed by coastal hazards.

Likewise, should the State Government guidance on the required allowances for sea level rise change as a result of new information becoming available, the Coastal Hazard Study (MRA 2017) and subsequent individual CRMPs completed by industrial proponents should also be updated. The responsibility for both of these actions would rest with the industrial proponents of each Lot.

A summary of the requirements for the monitoring and review is presented in Table 7.4.

Table 7.4 Implementation Plan Summary – Monitoring & Review

Requirement	Timing	Responsibility
Monitoring of sea level rise	Ongoing throughout the development – to be assessed on a yearly basis or as required based on the triggers being met or exceeded	Industrial proponent of each Lot
Revision of Coastal Hazard Study and individual CRMP reports	<p>If sea level rise changes significantly from that identified within Coastal Hazard Study and individual CRMP reports completed by industrial proponents</p> <p>OR</p> <p>If guidance changes on potential future sea level rise</p>	Industrial proponent of each Lot

8. Conclusions

This CHRMAP has been completed to provide an understanding of the potential risks of coastal hazards on a range of potential industrial land uses and proposed shared assets at the MSIA. It has been completed in line with the requirements of SPP2.6 and WAPC (2014).

The *Coastal Hazard Study* completed by MRA (2017) identified a risk of coastal hazards impacting the site, namely inundation during the passage of severe cyclone events. The risk assessment in this report, completed for example industry land uses and proposed shared assets, determined a tolerable Low risk of impact from coastal inundation over the 25 year planning horizon to 2043.

For the relatively inert example land uses Salt Ponds/Algae Farms and Solar Farms, the assessed risks over the 50 and 100 year planning timeframes to 2068 and 2118 respectively are considered to be Medium. Despite this level of risk being acceptable, the ALARP approach has been adopted for the development and a number of risk mitigation strategies have been proposed.

For the example land uses Strategic Industrial Landuse, Power Plant and Storage, the assessed risks over the 50 and 100 year planning timeframes to 2068 and 2118 are High and Extreme respectively based on the critical materials and facilities considered. Similarly, the example land use Desalination Plant had an assessed risk of High over the 100 year planning timeframe to 2118. Mitigation strategies proposed for these land uses, including avoiding development within the northern portion of the site, protecting hazardous materials and facilities and accommodating risks for inert materials and facilities, illustrate that intolerable risks can be managed within the MSIA.

For the shared assets proposed within the MSIA, the risks from coastal hazards are tolerable over the 100 year planning timeframe to 2118. It is expected however, that the management of these assets will be consistent with the Lots that they service and provide access to.

This plan was developed on the basis that the risks to personal safety as a result of cyclone inundation will be managed within the MSIA by individual industrial proponents and DFES. It is recommended that a management plan is developed for the entire site and implemented by the industrial proponents of each Lot.

Finally, as the development within each individual Lot is not yet known, a framework for the completion of each individual industrial proponent's CRMP report has been provided. This is outlined to ensure that land use specific risks are identified and the appropriate mitigation strategies are proposed to ensure tolerable risks and minimal impacts to stakeholders.

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10.Appendices

Appendix A Maitland Industrial Estate Coastal Hazard Study

Appendix A Maitland Industrial Estate Coastal Hazard Study

R953 Rev 1

October 2017

LandCorp

**Maitland Industrial Estate
Coastal Hazard Study**

marinas

boat harbours

canals

breakwaters

jetties

seawalls

dredging

reclamation

climate change

waves

currents

tides

flood levels

water quality

siltation

erosion

rivers

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1. Introduction

1.1 Background

The Maitland Industrial Estate (MIE) is a valuable site for long-term industrial development. It is located approximately 1,500 km north of Perth, 24 km west of the Karratha Town site and 15 km south west of the Dampier Town site. The location of MIE is shown in Figure 1.1.

LandCorp is the proponent for the development of the MIE, and recognises that development within MIE would need to consider the requirements of State Planning Policy No.2.6: State Coastal Planning Policy (SPP2.6) (WAPC 2013). To inform the engineering and planning works, LandCorp engaged coastal specialist engineers M P Rogers & Associates Pty Ltd (MRA) to complete a coastal hazard study in line with the SPP2.6. The scope of work included the following:

- Completion of a coastal inundation hazard assessment to determine the potential extent of extreme inundation across the site.
- Completion of a coastal erosion hazard assessment to determine the potential extent of erosion hazards on the site.
- Prepare coastal inundation and erosion hazard plots showing the potential extent of inundation and erosion on the MIE.

The methodology and results of the coastal hazard study are provided within this report.

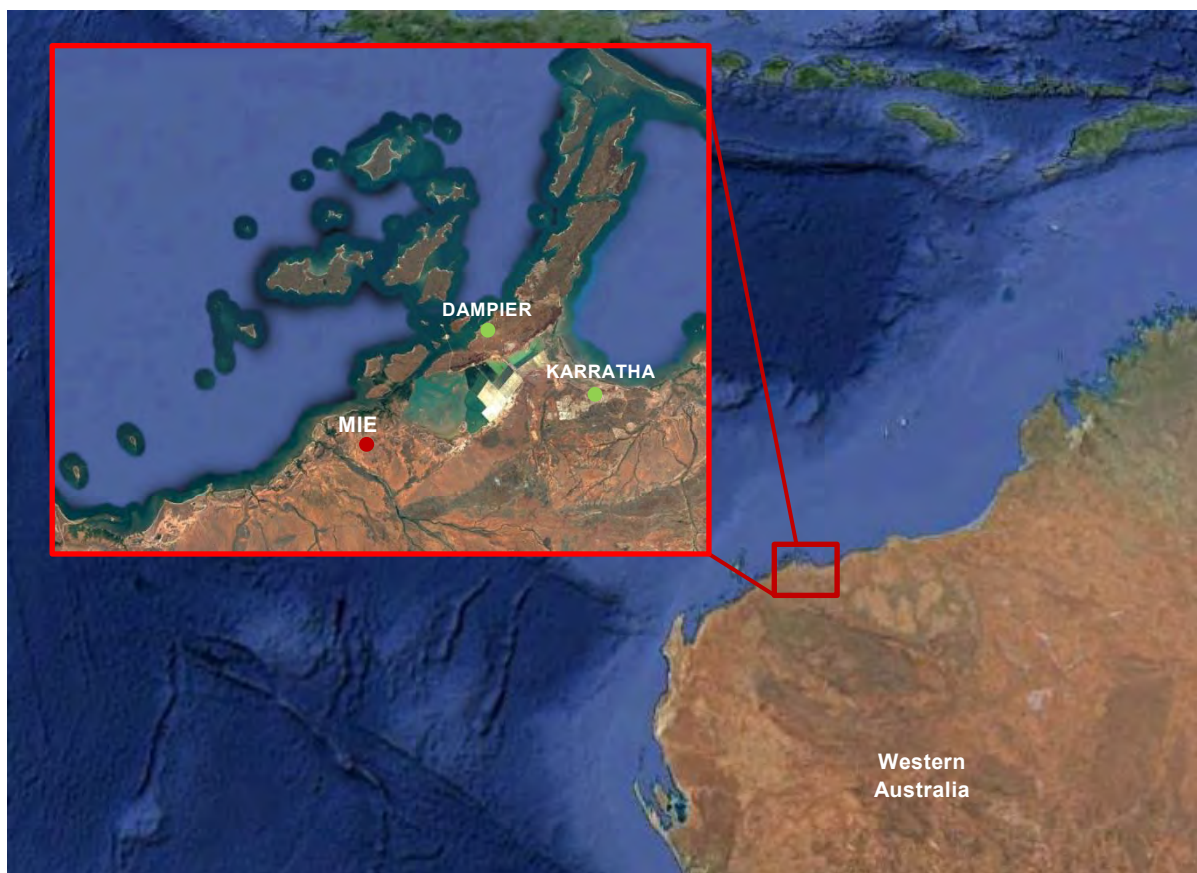


Figure 1.1 Location plan

1.2 SPP 2.6

Coastal development within Western Australia is guided by the requirements of SPP2.6. This policy outlines the general requirements for the assessment of risks posed by coastal hazards and advocates a considered and rational approach to the management of these risks over time. Decisions regarding the acceptance or management of these risks are typically made by the responsible management authority, but require input from relevant local stakeholders to ensure any such decisions reflect the wants and needs of the broader community, so far as practical. This is particularly relevant for industrial developments, where an increased level of risk tolerance may be possible compared to, say, freehold residential development.

SPP2.6 outlines that the appropriate parameters for development needs to be considered through a Coastal Hazard Risk Management and Adaptation Planning (CHRMAP) process. A CHRMAP must consider the potential impacts of coastal hazards, and the appropriate management and adaptation strategies, over a 100 year planning horizon. Therefore, the potential impact of coastal hazards on the MIE have been examined over a 100 year planning horizon within this report.

To ensure that planning for development adequately contemplates the impacts of coastal inundation over the 100 year planning horizon, SPP2.6 requires that development consider the impacts of storm surge inundation associated with an event with a 1 in 500, or 0.2%, chance of occurrence in any given year. This is equivalent to an event with a 500 year average recurrence interval (ARI). In addition to this event, the potential impacts of sea level rise over the 100 year planning horizon also need to be considered.

The challenge associated with this requirement of the Policy is that accurate and statistically relevant predictions of the 500 year ARI event cannot be made solely using the available historical water level measurements along the West Australian coastline. This is due to the fact that a continual water level record of about a third (167 years) of the recurrence interval in question (500 years) is required to ensure statistical relevance of the prediction. Even the longest reliable water level record within Western Australia (Fremantle) is limited to a little over 60 years (records extend before 1900 but are not reliable). Therefore, in the absence of sufficient water level data, other methodologies must be considered in order to provide meaningful predictions of the 500 year ARI event.

The most widely accepted methodology for the estimation of the 500 year water level event is to use available information on the frequency and characteristics of key meteorological events and, through modelling, generate a long term synthetic database of events and corresponding water levels. Though this process is still only based on a limited period of available data, the modelling seeks to capture the apparent randomness of the critical components of the meteorological effects through simulation of these events over extended periods of time. This methodology is particularly relevant in cyclone regions, where extremely localised effects on water levels can be observed. Modelling an extended time period therefore helps to ensure that the apparent randomness in cyclone track, severity and coincident tidal level is accounted for in any estimation of events with long recurrence intervals.

This methodology is also applicable to the assessment of coastal erosion hazards, which requires consideration of the potential impacts of an erosion event with a 1 in 100 or 1% chance of occurrence per year. This is equivalent to a 100 year ARI event. In addition to the assessment of the potential erosion impacts of the 100 year ARI event on the coastline, the following additional allowances are also included in the determination of the appropriate allowances for coastal erosion hazards.

- Allowance for long term movement of the shoreline based on historical shoreline movement trends.
- Allowance for erosion caused by future sea level rise over a 100 year planning timeframe.
- Allowance of 0.2 m per year to account for uncertainty.

2. Inundation Assessment Methodology

The approach adopted by MRA to determine the storm surge inundation levels at MIE is contingent on the use of numerical modelling techniques. This approach is required due to the short availability of water level data within the Pilbara region as compared to the required recurrence interval for prediction. Specifically, water level records at King Bay (the closest location to MIE) are only available for a duration totalling approximately 31 years between 1985 and 2015.

The limited availability of water level data means that an extreme analysis of peak recorded levels would not provide meaningful results in predicting the 500 year ARI event. Consequently, there is the need to use numerical modelling techniques to create a synthetic water level record which can then be used to determine extreme water levels at the MIE. The overall modelling approach is summarised below.

- Setup, calibrate and validate the Delft3D cyclone, wave and hydrodynamic model for the region.
- Use the measured water level data at King Bay and historical cyclones that have affected the region and interrogate the cyclone tracks and measured water levels to determine a first order storm surge approximation.
- Use a Monte Carlo model to simulate 2,000 years of cyclone tracks and severity.
- Rank the 2,000 years of synthetic cyclones using a first order storm surge approximation combined with the predicted tide to determine the top events.
- Use the Delft3D model to simulate the top events and record the peak water levels at MIE.
- Complete an extreme analysis of peak recorded water levels for MIE.

Further details regarding the adopted approach and the results of the investigation are outlined in the following sections.

MRA have previously used the approach outlined above to determine the 100 year ARI water level in Port Hedland, where the period of available water level data is much longer. The results of this assessment provided good agreement with the prediction of the 100 year ARI event determined from analysis of the historical water level record. This result provides confidence that this modelling methodology can provide reliable and meaningful outcomes.

3. Delft Model Setup & Calibration

3.1 Model Setup

The Delft3D suite of models provides an integrated model approach that can be used to simulate atmospheric pressure differentials, wind fields, wave climates and water levels associated with the passage of tropical cyclones (Deltares, 2011a). The Delft suite of models has been extensively used around the world and are recognised as high quality models. This integrated modelling approach has been adopted for this study in order to best represent the physical processes that generate storm surge.

The physical processes that lead to the generation of cyclonic storm surge operate on a spatial scale equivalent to that of the cyclone itself. For this reason, to adequately model cyclonic storm surge requires large model domains. However, due to computational limitations it is not efficient to model large areas at high resolutions, therefore a Delft3D domain decomposition model configuration has been used.

Domain decomposition allows a section of the overall grid to be modelled at significantly greater resolution to capture the key features and bathymetry surrounding the area of interest. Figure 3.1 shows the model domain and bathymetry for the coarse and fine grid and Figure 3.2 shows the model domain, topography and bathymetry for the very fine grid used for this study.

Bathymetry and topography data was sourced from local nautical charts, Lidar survey, data from NASA's Shuttle Radar Topography Mission (SRTM) and the Australian Bathymetry and Topography dataset obtained from Geoscience Australia (Whiteway, 2009).

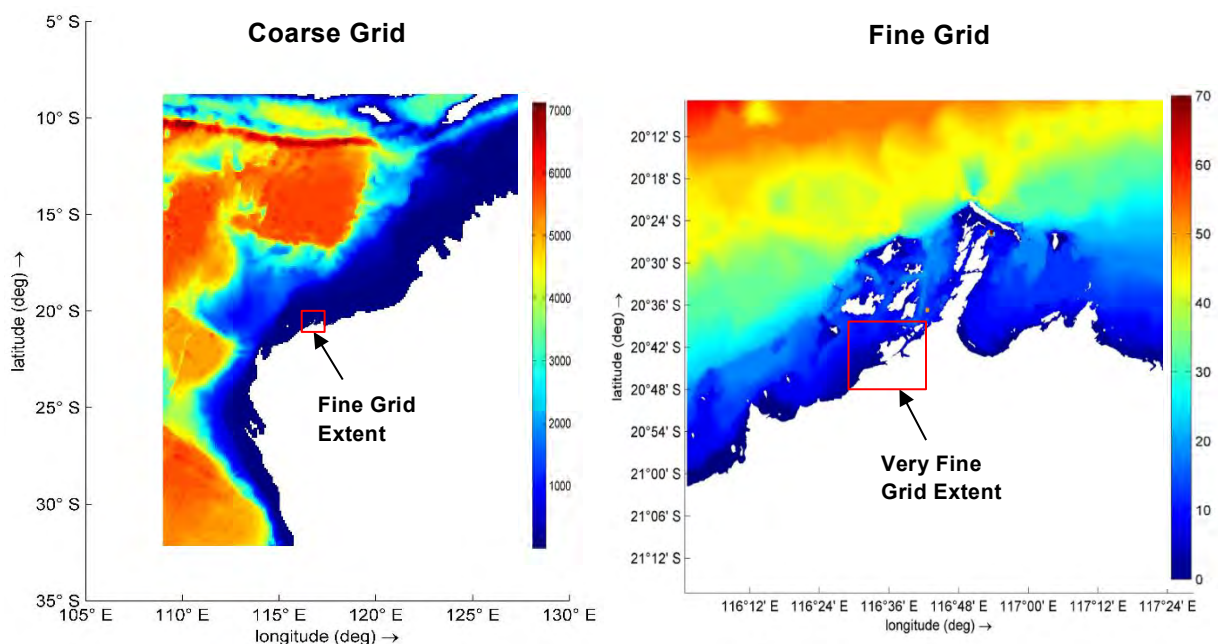


Figure 3.1 Model Domain & Bathymetry for Delft3D Coarse & Fine Grids

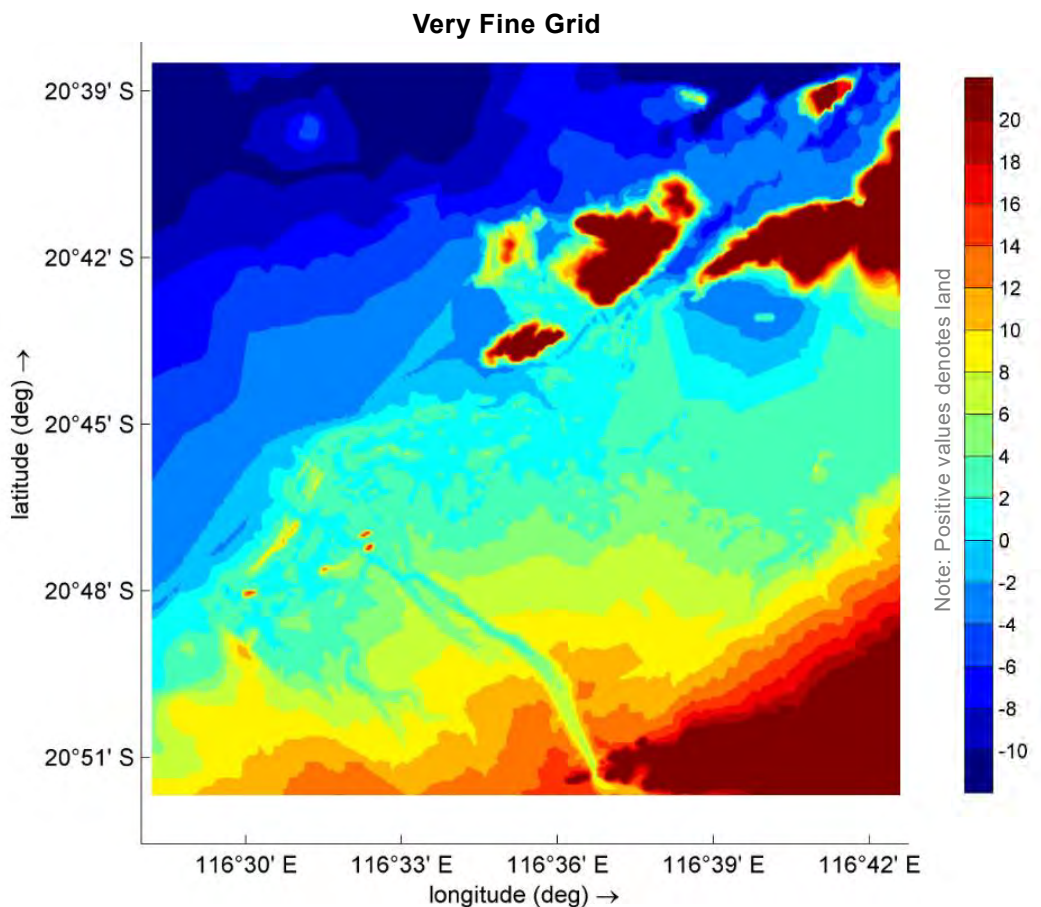


Figure 3.2 Model Domain, Topography & Bathymetry for Delft3D Very Fine Grid

To model the storm surge at the study site requires accurate topographic information. For the MIE the topographic input was based on the Lidar survey completed by Fugro Spatial Solution Pty Ltd (Fugro) during December 2012. It is noted that the Dampier Salt Pond 0 bund and the Dampier Highway near the study area could affect the flow of water during cyclone events. These features have been defined manually in the Delft3D model. The elevation of the Dampier Highway and Pond 0 bund were taken from the Lidar survey and information provided by Dampier Salt respectively.

It is noted that potential run off into the Pond 0 catchment may occur during the inundation events. Therefore to model storm surge inundation also requires an input water level at Salt Pond 0. Based on information provided by Dampier Salt, Salt Pond 0 maintains a water level of about 2.1 to 2.4 mAHD during operation. Therefore an initial water level of 2.4 mAHD was applied to the Salt Pond 0 area.

3.2 Model Calibration

With the model grids established, calibration and validation of the model system is critical in order to ensure that the model predictions adequately reflect the reality. To calibrate and validate the model's ability to accurately determine the storm surge requires historical water level and cyclone track data to be available. Using this information a selection of historical cyclones can be simulated within the model domain to determine if the model predictions match the observation record. To assist with this process historical water level data was obtained from DoT for King Bay. The water level record for King Bay provides a relatively continuous record dating back to 1985.

To determine suitable model calibration events, the periods of water level records were cross referenced against information regarding the passage of tropical cyclones within the region obtained from the Bureau of Meteorology (BoM) cyclone database (BoM, 2017). A summary of the cyclones that tracked within approximately 500 km of MIE are provided in Table 3.1. It should be noted that the cyclone record has been clipped to only include data from 1985 onwards as prior to this period water level records at King Bay are not available for cross reference.

Given the information above, three separate events were chosen for the calibration and validation of the Delft3D model. These events are outlined below.

- Tropical Cyclone (TC) Orson.
- TC Olivia.
- TC Glenda.

Track and intensity plots for each of these cyclones are presented in Figures 3.3, 3.4 and 3.5 respectively.

Table 3.1 Historical Cyclones affecting MIE Region since 1985

Name	Date	Name	Date
GERTIE	January/February 1985	CLARE	January 2006
RHONDA	February 1986	DARYL	January 2006
DAMIEN	January/February 1987	EMMA	February/March 2006
ILONA	December 1988	GLENDA	March 2006
ORSON	April 1989	HUBERT	April 2006
TINA	January 1990	JACOB	March 2007
IAN	February/March 1992	NICHOLAS	February 2008
BOBBY	February 1995	BILLY	December 2008
FRANK	December 1995	DOMINIC	January 2009
JACOB	January/February 1996	LAURENCE	December 2009
ISOBEL	January/February 1996	BIANCA	January 2011
OLIVIA	April 1996	CARLOS	February 2011
PHIL	January 1997	LUA	March 2012
BILLY	December 1998	PETA	January 2013
VANCE	March 1999	OLWYN	March 2015
JOHN	December 1999	QUANG	April 2015
STEVE	February/March 2000	STAN	January/February 2016
MONTY	February/March 2004		

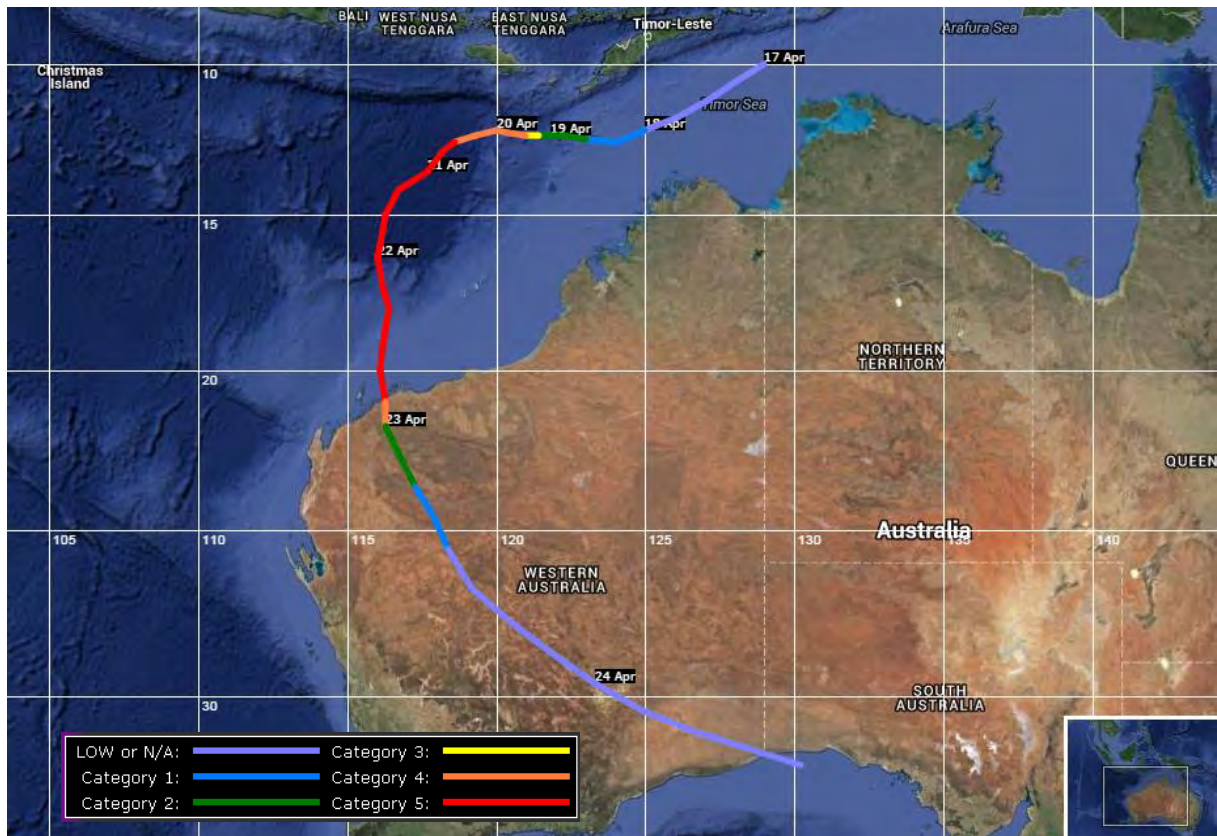


Figure 3.3 Track & Severity Plot for TC Orson

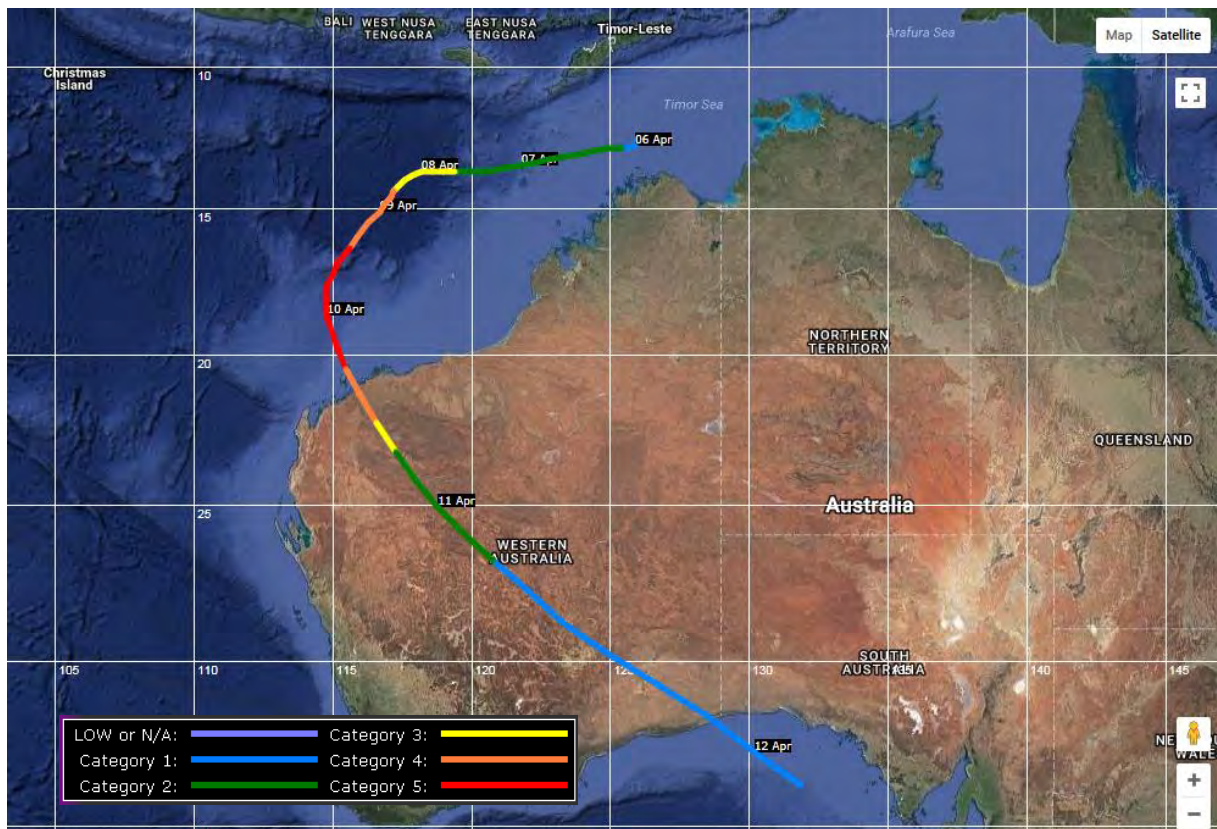


Figure 3.4 Track & Severity Plot for TC Olivia

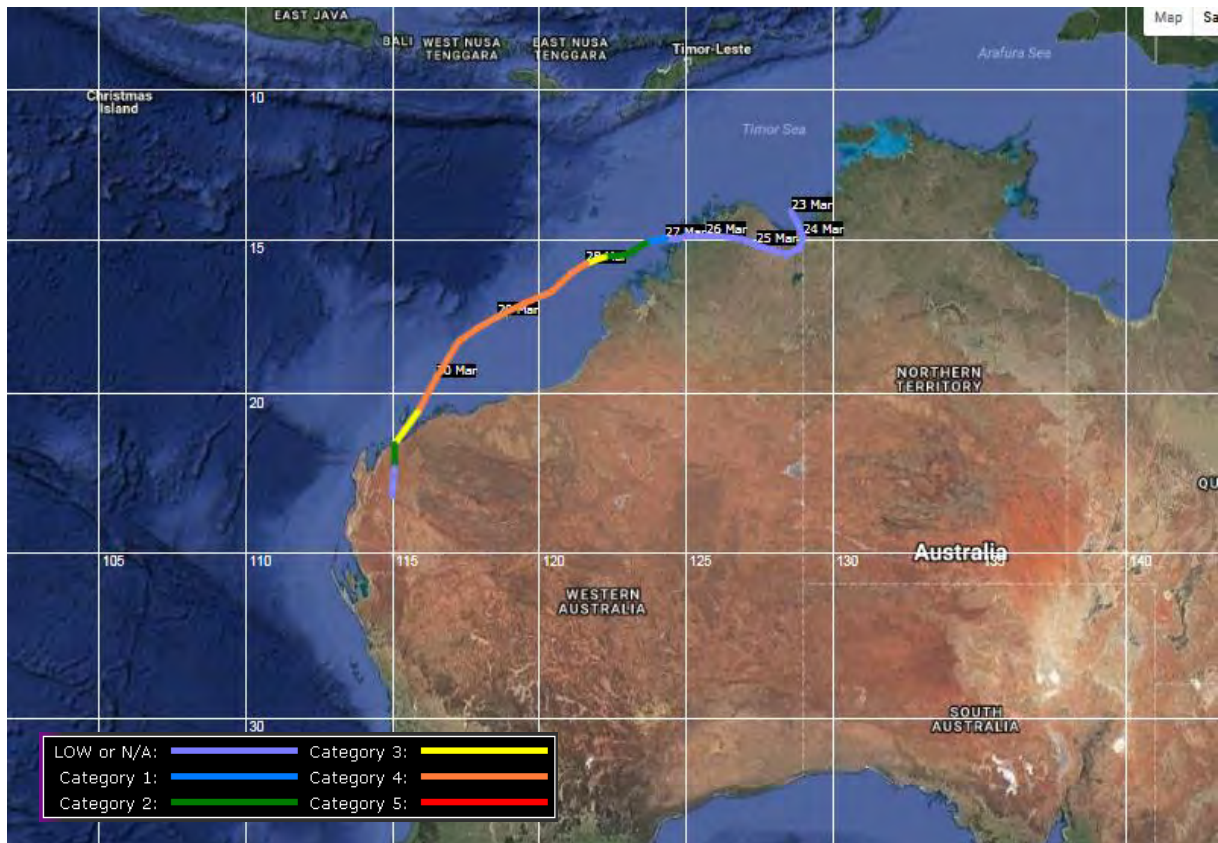


Figure 3.5 Track & Severity Plot for TC Glenda

Details of the cyclone track and severity were extracted from the BoM cyclone database and were used to generate cyclone wind and pressure fields for input to the Delft3D model. This process was completed using the Delft3D Wind Enhanced Scheme (WES) module (Deltares, 2011b) in combination with a wind field calculated for each event based on the results of Holland (1980).

Each cyclone event was simulated using the Delft3D model, with the modelled water level record extracted at the relevant location. The modelled water level at King Bay for TC Orson is presented in Figure 3.6 together with the observed water level and the predicted tide. Generally, the measured and modelled water levels show good agreement, as does the measured and modelled surge levels, with the model replicating the measured peak water level and surge within 0.1 of a metre. It does appear from the plots that the timing of the modelled peak surge differs slightly to the observed records. The difference is expected to be attributable to slight differences in the cyclone positions given by the cyclone data base (limited to three hour spacing between data points), as well as slight differences between the cyclone characteristics in reality compared to within the model. Regardless, the close agreement between the measured and modelled data provides confidence in the model as a reliable predictive tool.

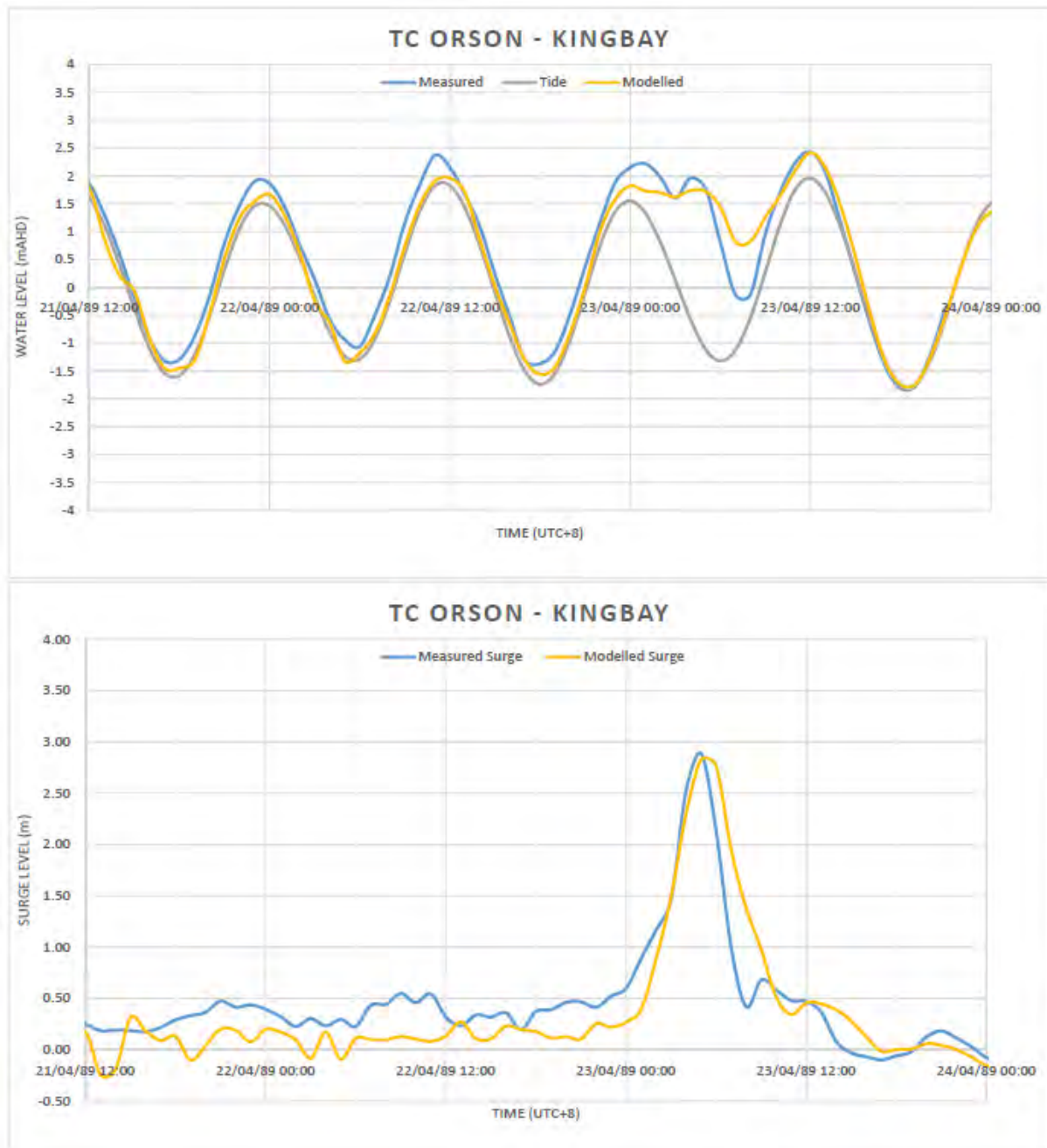


Figure 3.6 Modelled Water Level and Surge for TC Orson at King Bay

The results of the modelling of TC Olivia are presented in Figure 3.7. Generally, the measured and modelled water levels show good agreement, as does the measured and modelled surge levels, with the model replicating the measured peak water level and surge within 0.1 of a metre.

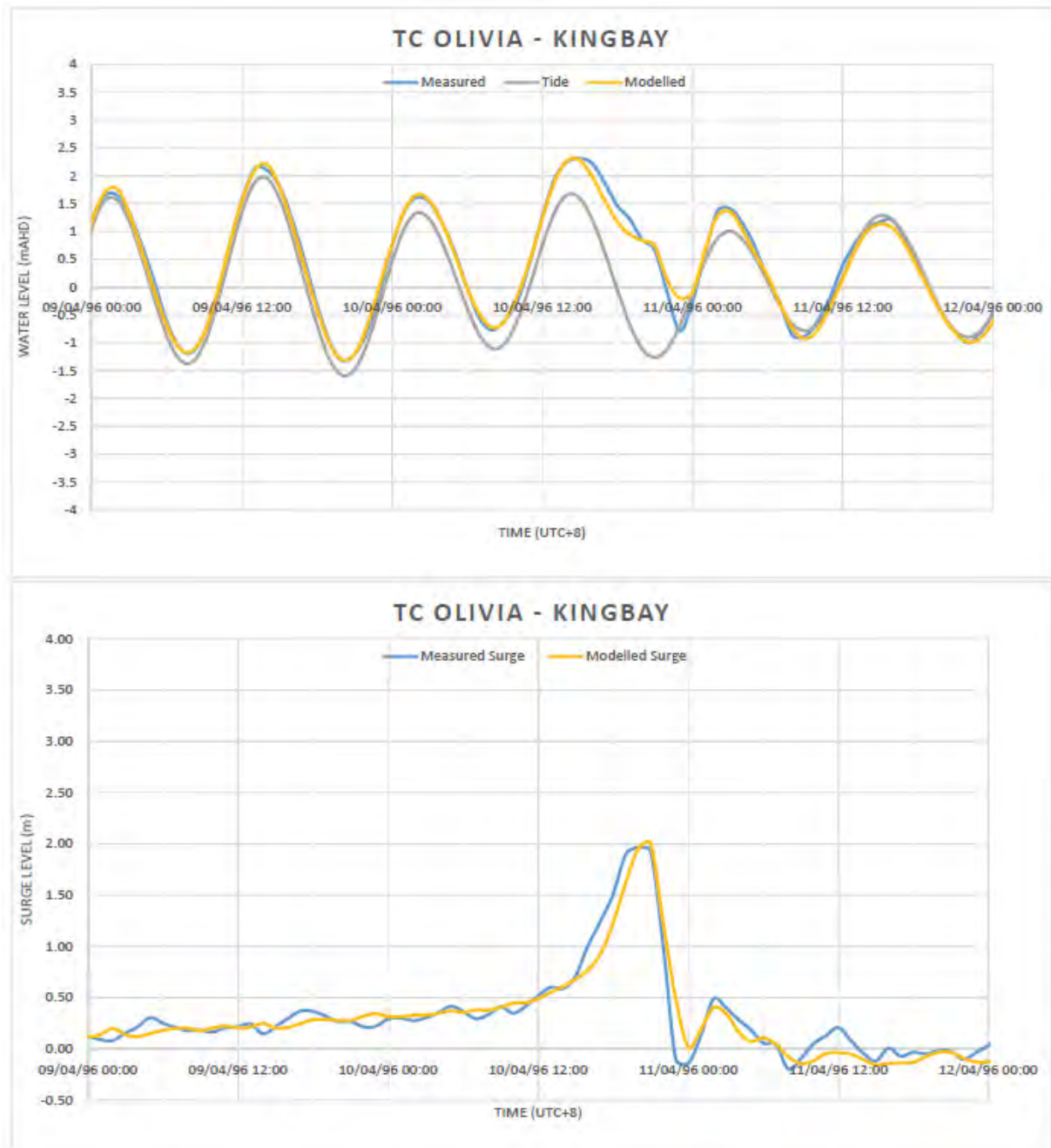


Figure 3.7 Modelled Water Level and Surge for TC Olivia at King Bay

The results of the modelling of TC Glenda are presented in Figure 3.8. Generally, the measured and modelled water levels show good agreement, as does the measured and modelled surge levels, with the model replicating the measured peak water level and surge within 0.2 of a metre.

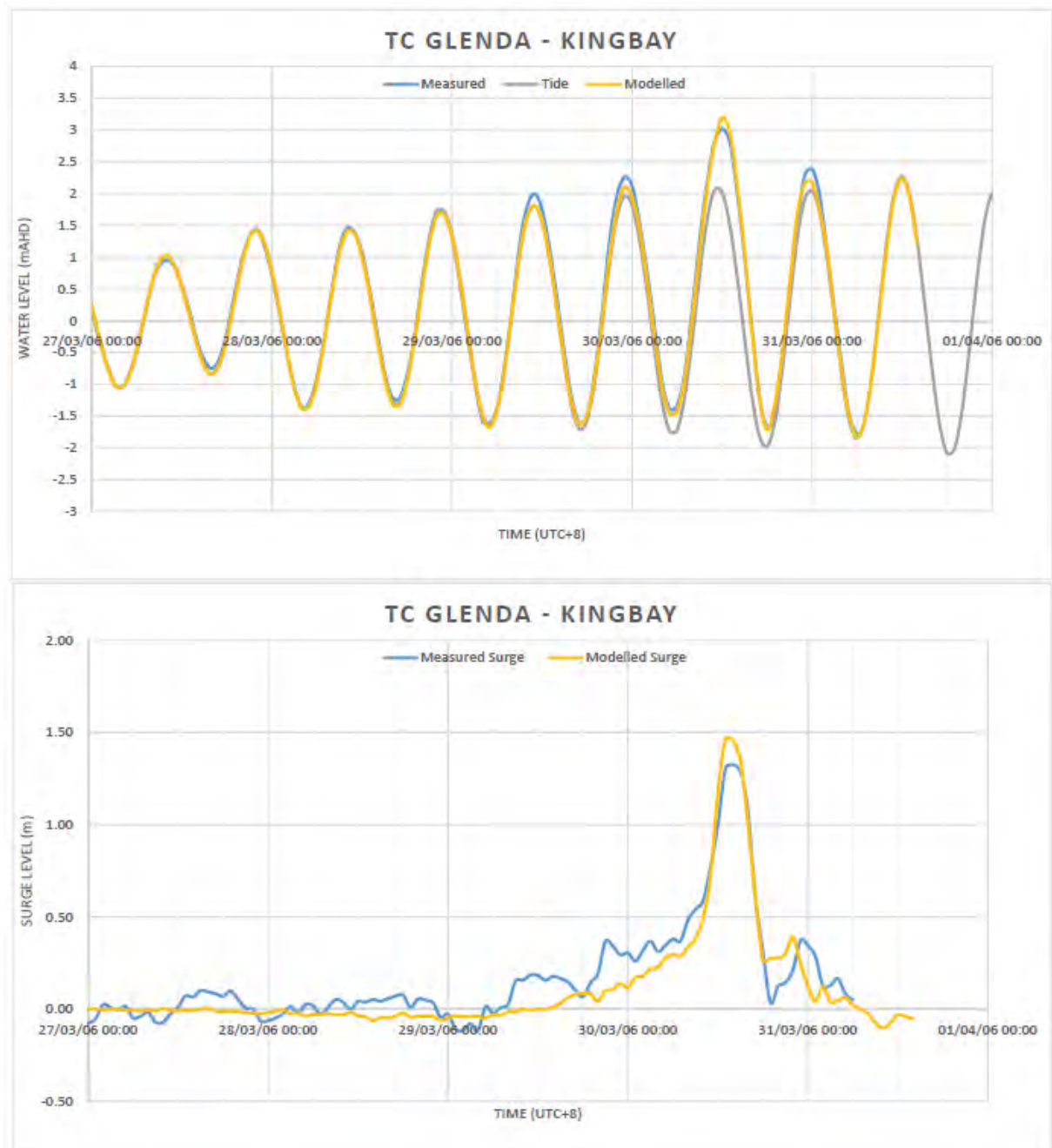


Figure 3.8 Modelled Water Level and Surge for TC Glenda at King Bay

4. Cyclone Track Synthesis

To develop a meaningful estimate of events with long average recurrence intervals requires a long duration of reliable data record. Statistically, the length of the record should be around a third the duration of the ARI that is being predicted. However, generally speaking, the longer the available record the greater the accuracy of the prediction. A long cyclone record is therefore required. However, reliable cyclone records only extend back to the early 1960's when satellite imagery became available to track cyclones off the coastline. Therefore the available cyclone track data only spans a period of around 50 years, which is insufficient to reliably predict the 500 year ARI event.

As a result, synthetic data needs to be generated to populate the data space. The extreme conditions can then be determined using extreme value analysis on the outputs from the synthetic events.

A Markov Chain Monte Carlo (MCMC) model was developed for this study based on the methodology described in Risi (2004) and Emanuel et al (2006). A schematic diagram of the MCMC model is provided in Figure 4.1. Further details of the key steps in the process are provided in the following sections.

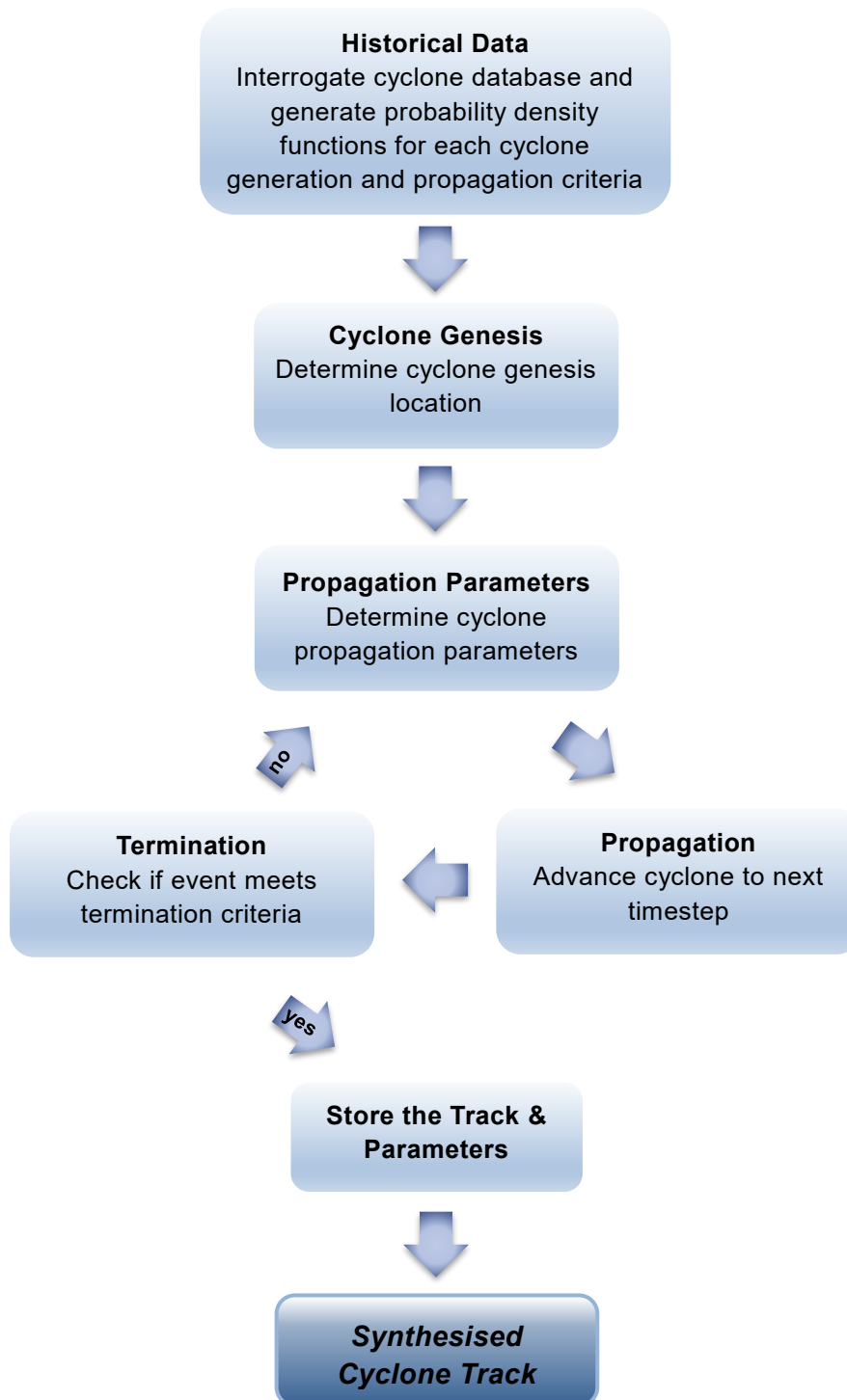


Figure 4.1 Monte Carlo Simulation Scheme

4.1 Historical Data Analysis

BoM maintains a cyclone database that contains information regarding tropical cyclones experienced between 1906 and 2017 for the Australian region (BoM, 2017). This database includes information such as cyclone location, central pressure, maximum wind speed and other

relevant cyclone track parameters. However, as previously discussed, to ensure data accuracy, the raw cyclone database was filtered to include only data after 1960.

Analysis of the historical cyclone database was completed in order to ascertain spatial and temporal changes in the key parameters required for cyclone generation and propagation. These key parameters include the following.

- Location of origin (referred to as the cyclone genesis location).
- Forward speed of the cyclone.
- Cyclone direction / heading.
- Central pressure.

Statistical distributions for each of the key parameters were then developed on a 2° latitude by 2° longitude grid covering the whole of the Australian region. A separate distribution was developed for each grid in order to ensure that spatial variations in cyclone track and intensity characteristics were captured within the model.

4.2 Cyclone Genesis Location

Within the MCMC model, cyclone genesis positions are obtained by sampling from a 3D parametric probability distribution. In order to create the parametric probability distribution, the historical cyclone database was filtered to include only the first recorded location for each cyclone. The filtered genesis information was then smoothed using a Gaussian smoothing kernel in order to ensure a continual coverage over the entire region. The smoothed probability distribution for cyclone genesis is shown in Figures 4.2 and 4.3. It should be noted that this data relates only to cyclone genesis within the Australian region. Additionally, the genesis model was confined to ensure that cyclone genesis could not occur over land.

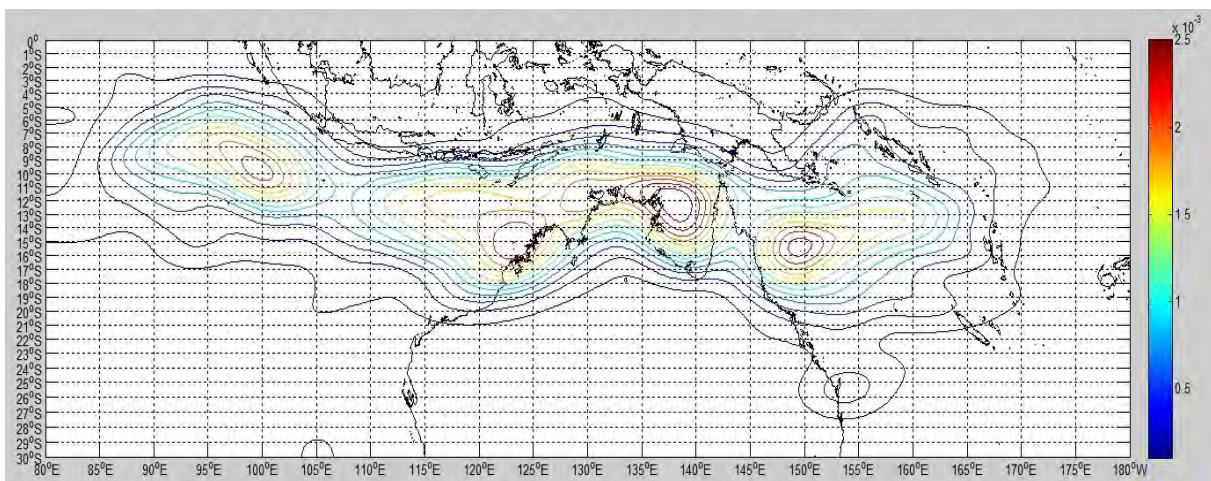


Figure 4.2 Smoothed Genesis Probability Distribution – 2D Plan View

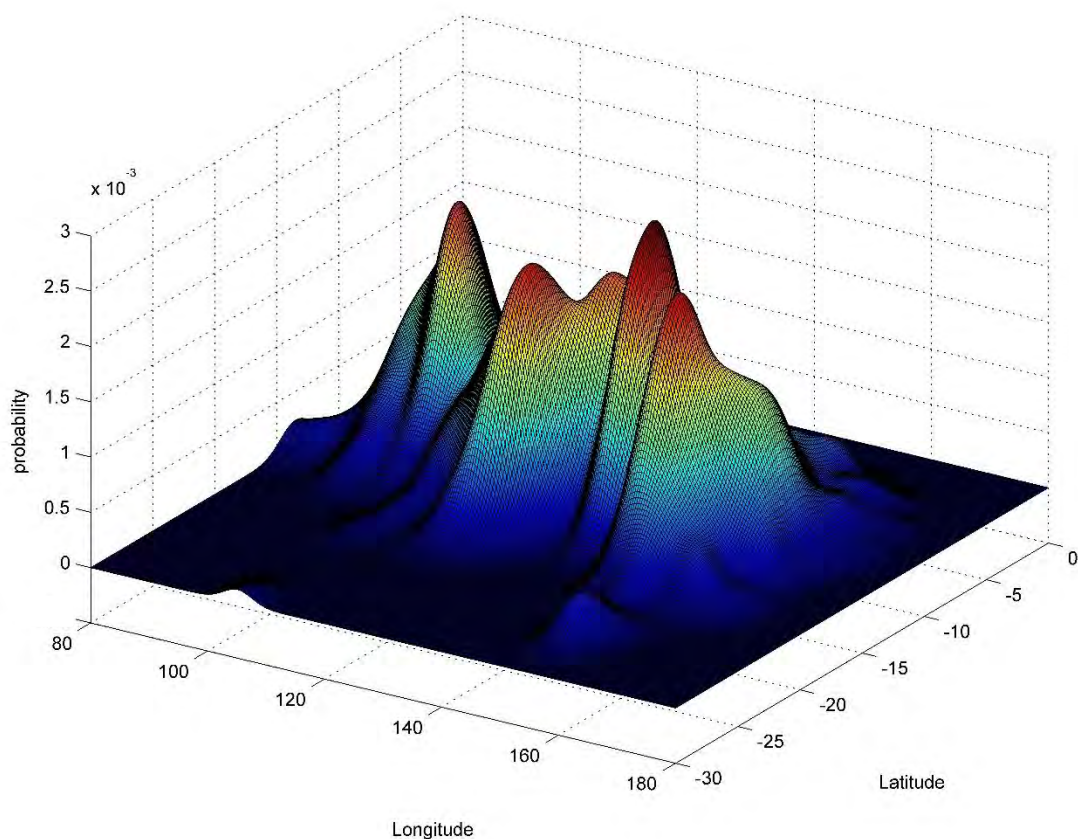


Figure 4.3 Smoothened Genesis Probability Distribution – 3D View

In order to establish a cyclone genesis position for each synthesised cyclone track, an initial genesis location was sampled from the genesis probability distribution using a random 3-dimensional (3D) hit and miss algorithm.

4.2.1 Genesis Time

To generate a genesis time for each cyclone, the cyclone genesis points within the historical cyclone database were discretised into histograms based on the number of cyclone genesis events per year and the monthly genesis occurrences. These histograms are presented in Figures 4.4 and 4.5 respectively.

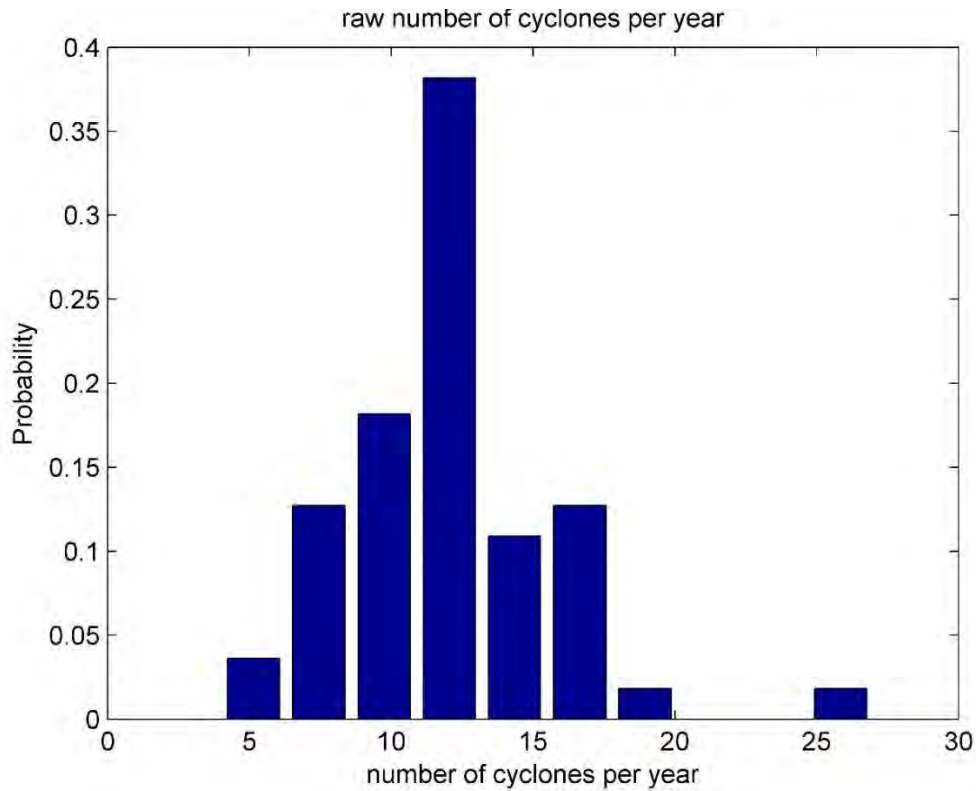


Figure 4.4 Probability of the number of cyclones per year within the Australian Region

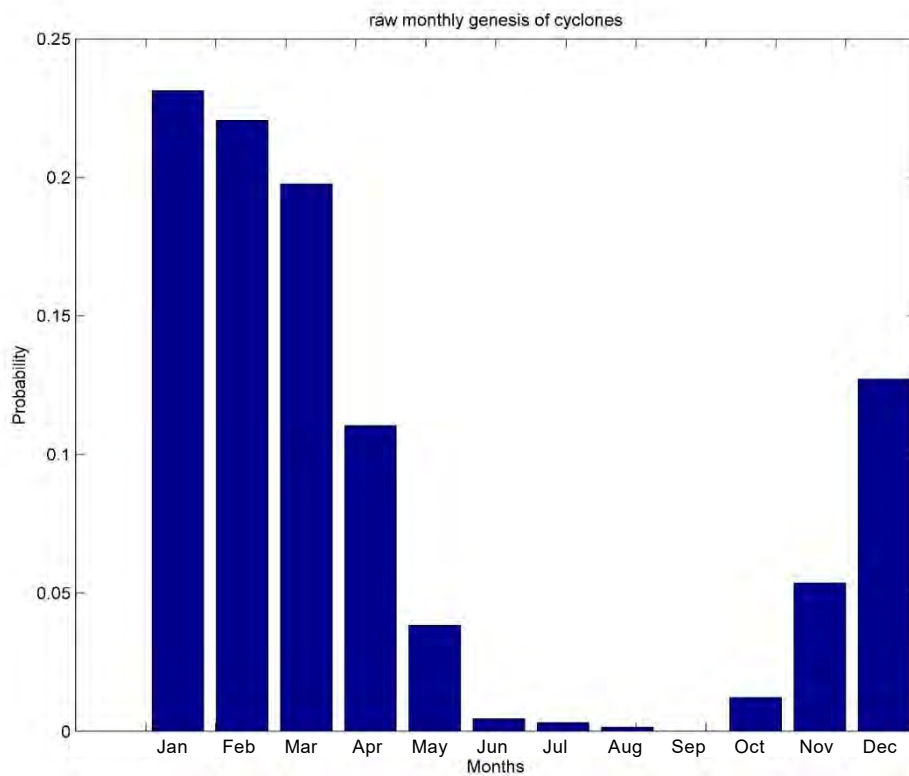


Figure 4.5 Probability of monthly occurrence within the Australian Region

Within the MCMC model the number of cyclones within each year and the times for cyclone generation within that year were randomly sampled from the parametric probability distribution histograms. To sample from the parametric probability distribution (histograms), a one dimensional hit and miss algorithm was adopted.

4.2.2 Genesis Parameters

To initiate a cyclone, initiation parameters were required in addition to the genesis position and time. These parameters included the following.

- Initial forward speed of the cyclone (km/h).
- Initial direction of the cyclone (Cartesian degrees between -180° to 180°).

The initiation parameters were obtained from their corresponding probability distributions. The probability distributions were generated by interrogating the BoM cyclone database.

4.3 Propagation

Once the genesis position, time and parameters were determined, the cyclone propagation parameters were required for the cyclone to progress to its next location / timestep.

The main issue with randomly sampling the propagation parameters is that the sampled values must be dependent on the value in the previous state. This is required to prevent random selection of parameters that would otherwise not reflect the physical drivers of cyclone development such as ocean temperature and barometric effects that exist in reality. For example, the central pressure at the current location must be dependent on the central pressure at the previous location, otherwise anomalies such as an increase in central pressure may be observed during the intensification stage of the cyclone.

To resolve this issue the concept of predictor and predictands (Risi, 2004) was adopted. A predictor is a variable which is used to predict the predictand. In this case, multiple predictors are required for each predictand. Once the predictors are determined, multiple 3D probability surfaces are subsequently created. The propagation parameters are then sampled from the 3D probability density surface via a 3D hit and miss algorithm.

This is discussed in the following sections.

4.3.1 Choice of Predictor and Predictands

For propagation, the following parameters are required and are therefore chosen as predictands.

- Rate of change of speed.
- Direction.
- Rate of change of central pressure.

To define the new state of the cyclone, the following predictors are adopted.

Geographical Positions (Latitude, Longitude)

A cyclone will have relatively different characteristics depending on its location. For example, cyclones are more likely to intensify at latitudes above 21° S than below due to the sea temperature, and are more likely to dissipate over land.

Previous Rate of Change of Speed

The rate of change of forward speed of a cyclone may not be continuous. In other words, a cyclone could be accelerating at the previous location, but may decelerate at the present location. Therefore, it is essential that the previous rate of change of speed be considered when determining the current rate of change of forward speed.

Rate of Change of Direction

The rate of change of direction is used to predict the propagation direction of the cyclone. It is anticipated that over a long term record there is a very low correlation between the current and previous direction, therefore, it is believed that the rate of change of direction is a more appropriate predictor for direction.

Previous Rate of Change of Central Pressure

To predict the central pressure at a specified location and time, it is again appropriate to adopt the more continuous rate of change of central pressure as a predictor. This enables the cyclone to intensify / dissipate based on a previous rate of change, this eliminates anomalies such as increases in pressure during the intensification of a cyclone.

4.3.2 Propagation Probability Surfaces

Once the predictors were determined, probability surfaces were generated. The probability surfaces generated are as follow

- Rate of change of speed versus previous rate of change of speed.
- Rate of change of direction versus direction.
- Rate of change of central pressure versus previous rate of change of central pressure.

An example of the probability surfaces generated for rate of change of direction versus direction at one grid cell is provided in the following Figure 4.6.

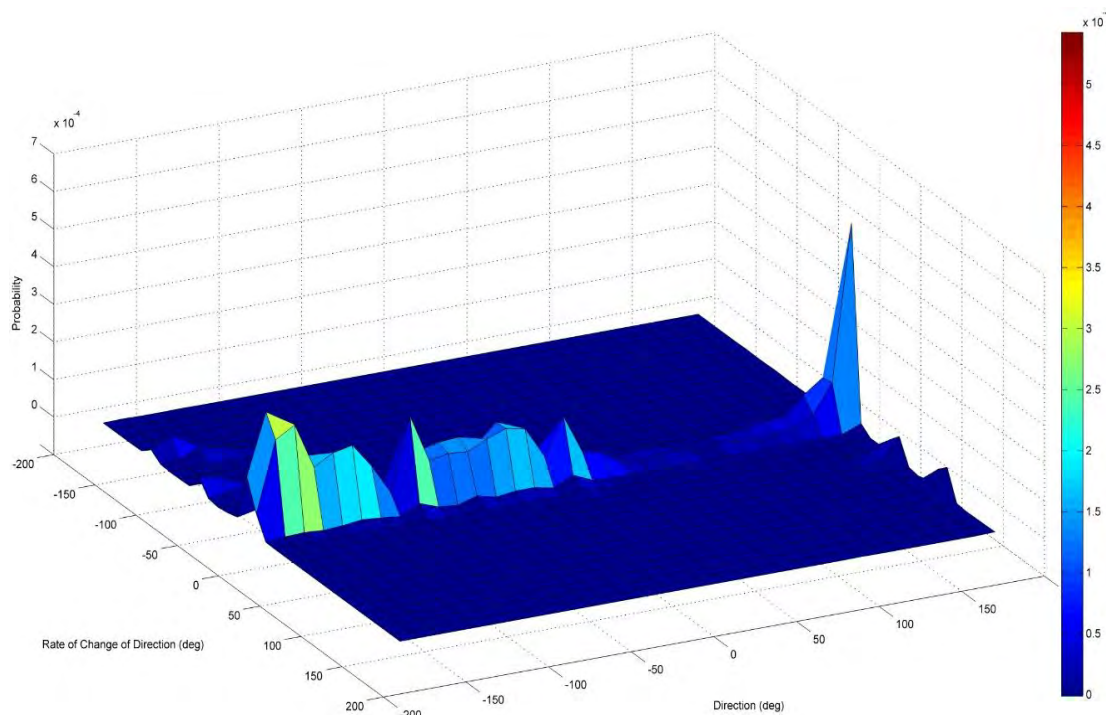


Figure 4.6 Probability Surface for Rate of Change of Direction vs Direction

4.4 Track Ranking

In order to rank the synthesised cyclone events based on their influence on the water level at the study site, the cyclonic storm surge combined with the predicted tidal level was considered.

A parametric calculation of likely storm surge was included within the MCMC model in order to provide predictions of the potential storm surge at the study location. This parametric calculation is based on three cyclone parameters, this includes the bearing (B) of the cyclone, the barometric pressure drop (P_{drop}) caused by the cyclone and the distance (D) from the study site.

To estimate the total water level at the site, the astronomical tide is also calculated and added to the parametric calculation of the storm surge. The tidal level at the study location during the time of the cyclone is calculated using a harmonic analysis (Luick, 2004). The following equation was adopted.

$$h(t) = h_0 + \sum f_n(t) H_n \cos(wt - g_n + V_n(t_0) + u_n(t_0))$$

Where

h_0 – the tidal prediction datum.

f_n – the nodal factor for the equilibrium constituents.

H_n – the amplitude of the specific tidal constituent.

w – the speed (deg/hr) of the tidal constituent.

g_n – the phase lag of the constituent behind $V_n(t_0) + u_n(t_0)$.

$V_n(t_0)$ – the phase of the equilibrium constituent of speed w , evaluated at time t_0 .

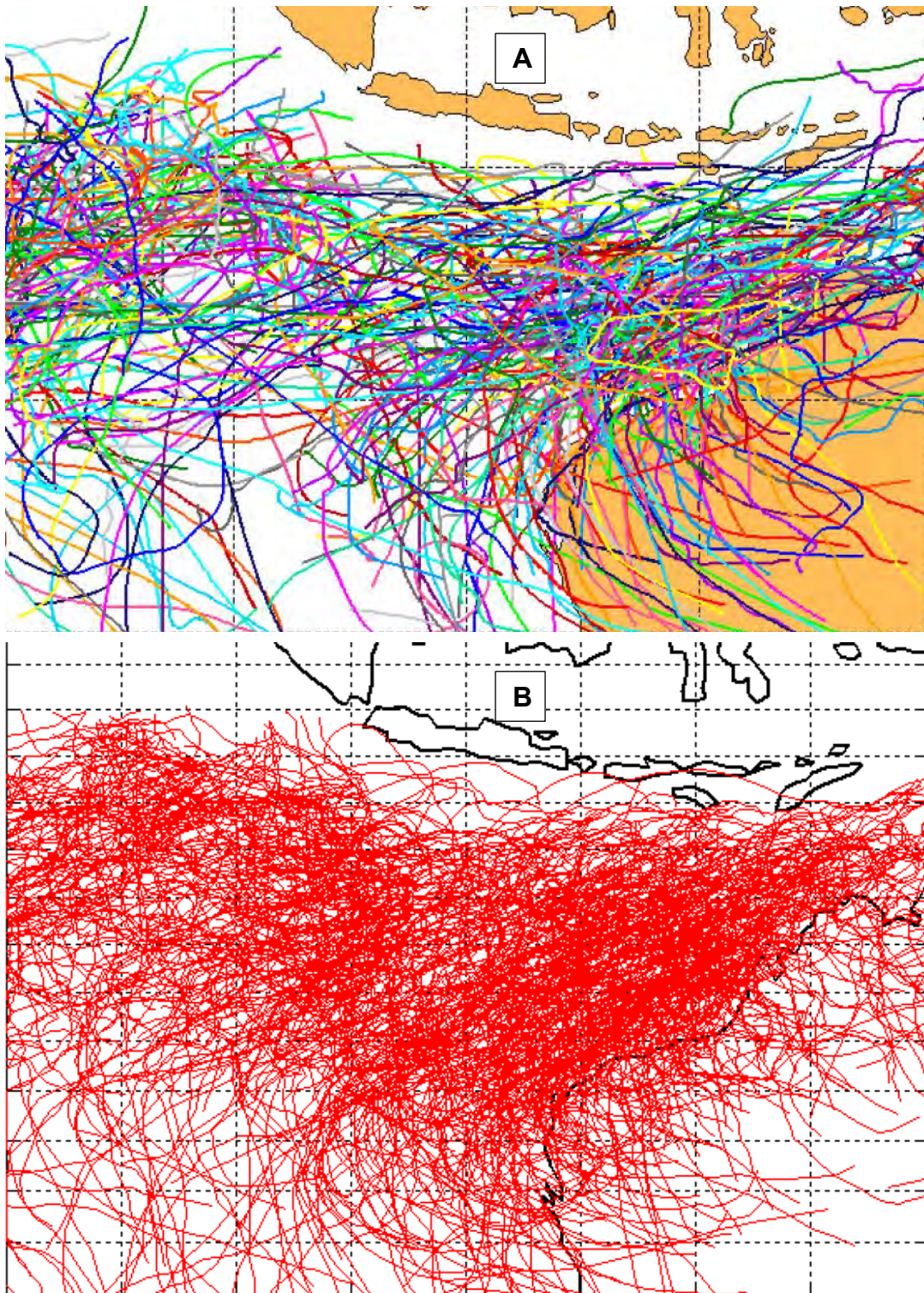
The use of the above equation generally provides a reasonable prediction of the tidal level.

Each of the synthesised cyclones was then ranked in order of peak water levels, with the top events extracted for further investigation using the Delft3D numerical storm surge model. An additional check was also completed to ensure that any cyclones that track within 150 km of the study site were also extracted for further modelling given limitations in the parametric storm surge estimation. This methodology helps to ensure that all of the top events within the synthesised record are investigated further.

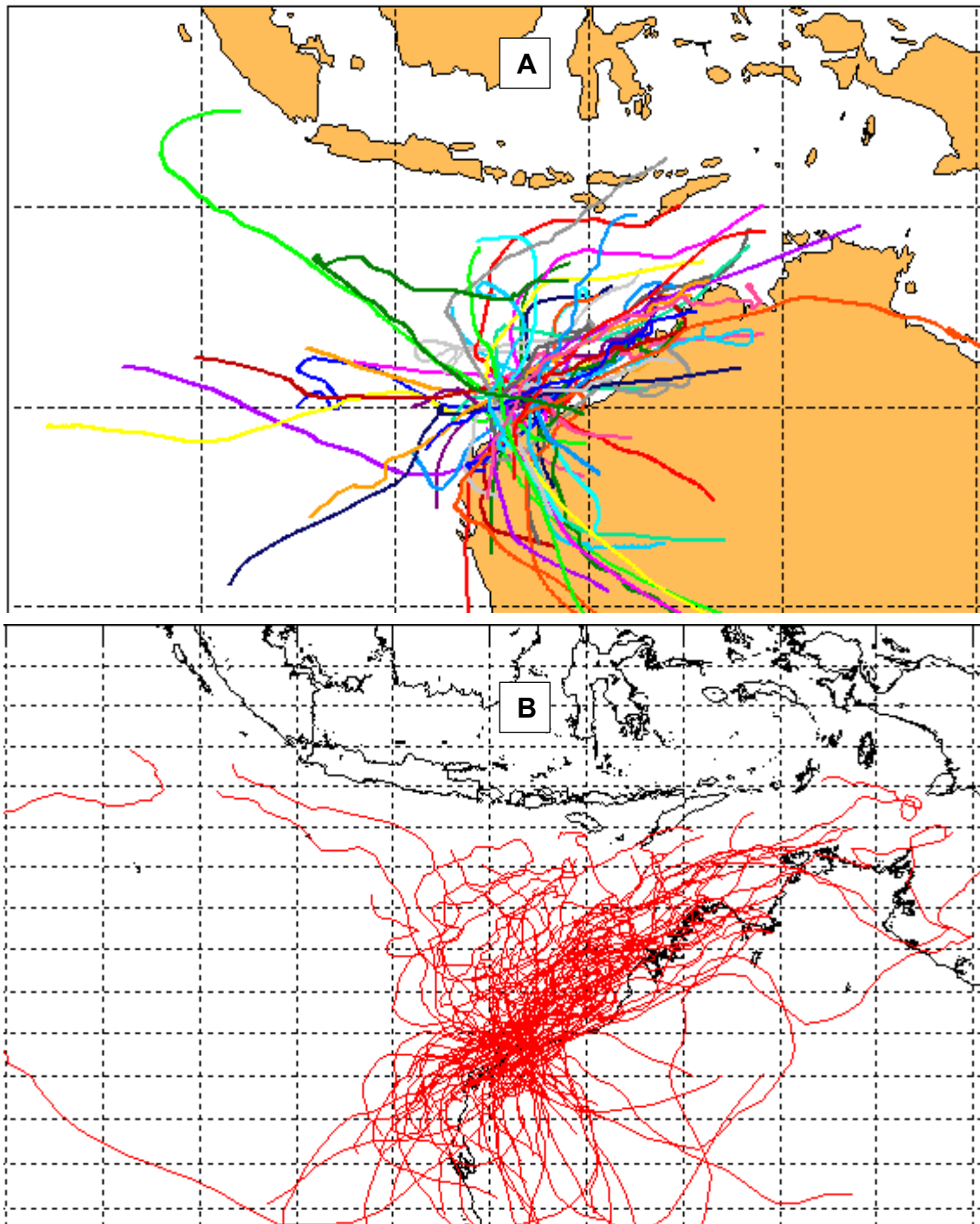
4.5 Model Validation

To ensure that the cyclone track model was generating sensible cyclone tracks and parameters, the track model was validated against the historical cyclone database. For this purpose, the model was used to synthesise a 50 year period, equivalent to the period of reliable historical record. By design the model should not exactly reproduce the details of individual historical events, however on average, the characteristics of the entire record should be similar.

Plots of the recorded and modelled cyclone tracks are provided in Figure 4.7. The tracks show general agreement with regard to the densities of events in different areas, although it is difficult to tell with any certainty. To enable a better comparison the data has been further interrogated to show a comparison of the tracks affecting the MIE region (Figure 4.8) as well as the key predictands (Figures 4.9 to 4.12).



**Figure 4.7 (A) Historical cyclone tracks since 1960; &
(B) Modelled cyclone tracks for the same period**



**Figure 4.8 (A) Historical cyclone tracks affecting MIE since 1960;
(B) Modelled cyclone tracks affecting MIE for the same period**

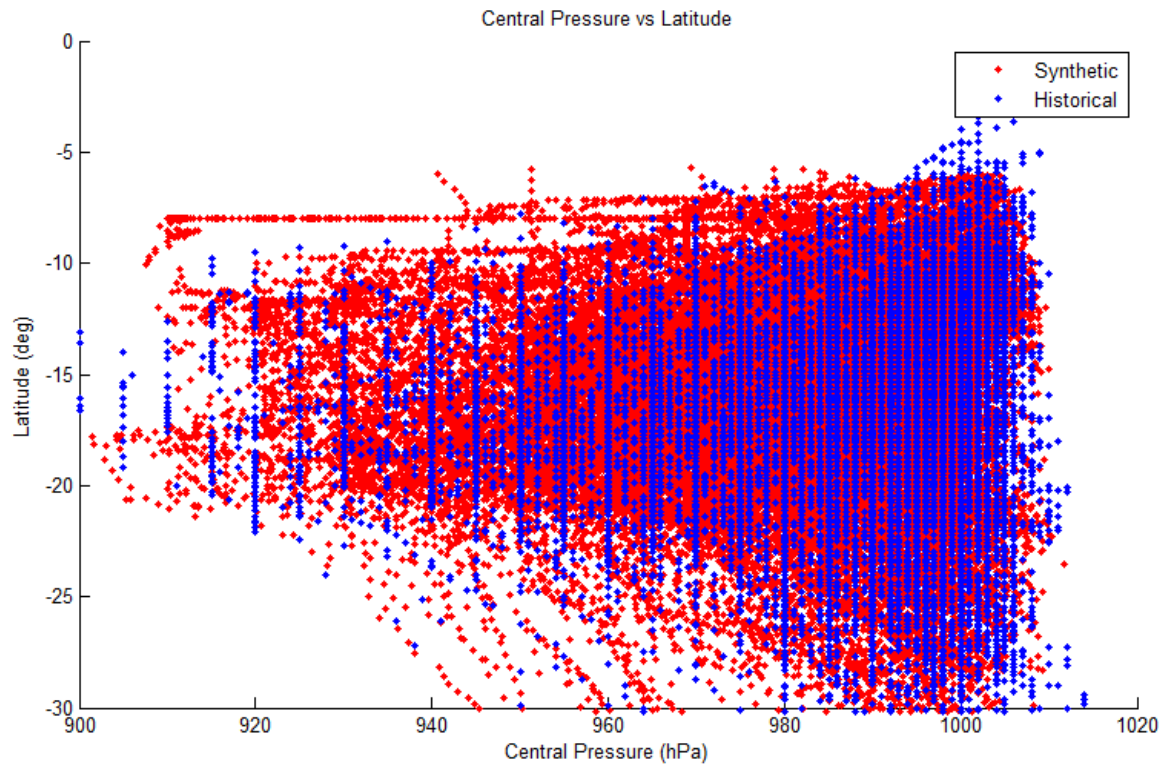


Figure 4.9 Scatter plot of central pressure versus latitude; measured and modelled

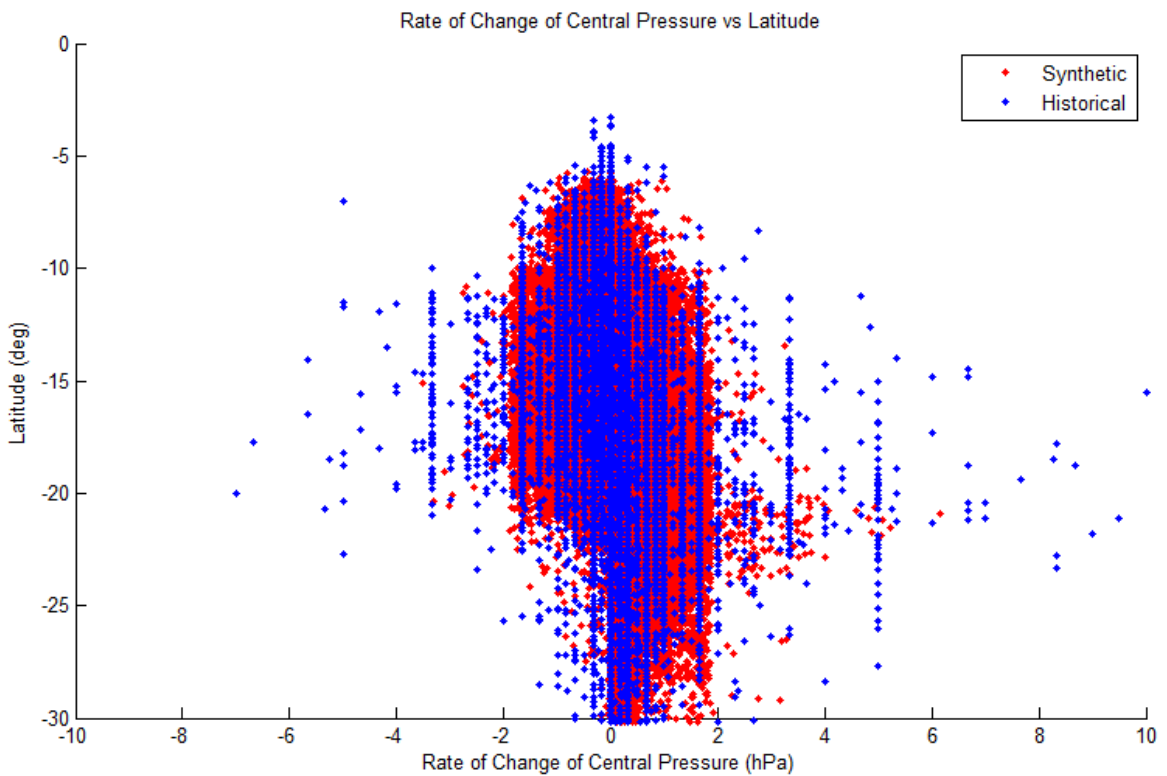


Figure 4.10 Scatter plot of rate of change of central pressure versus latitude; measured and modelled

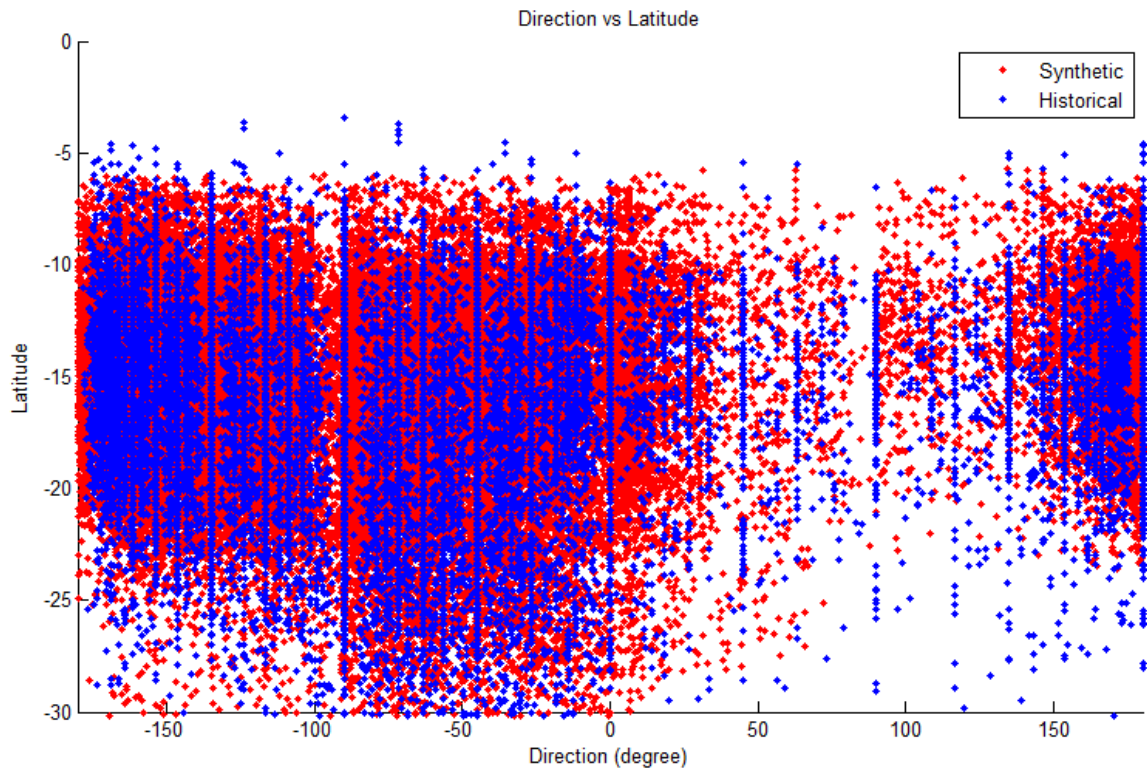


Figure 4.11 Scatter plot of cyclone travel direction versus latitude; measured and modelled

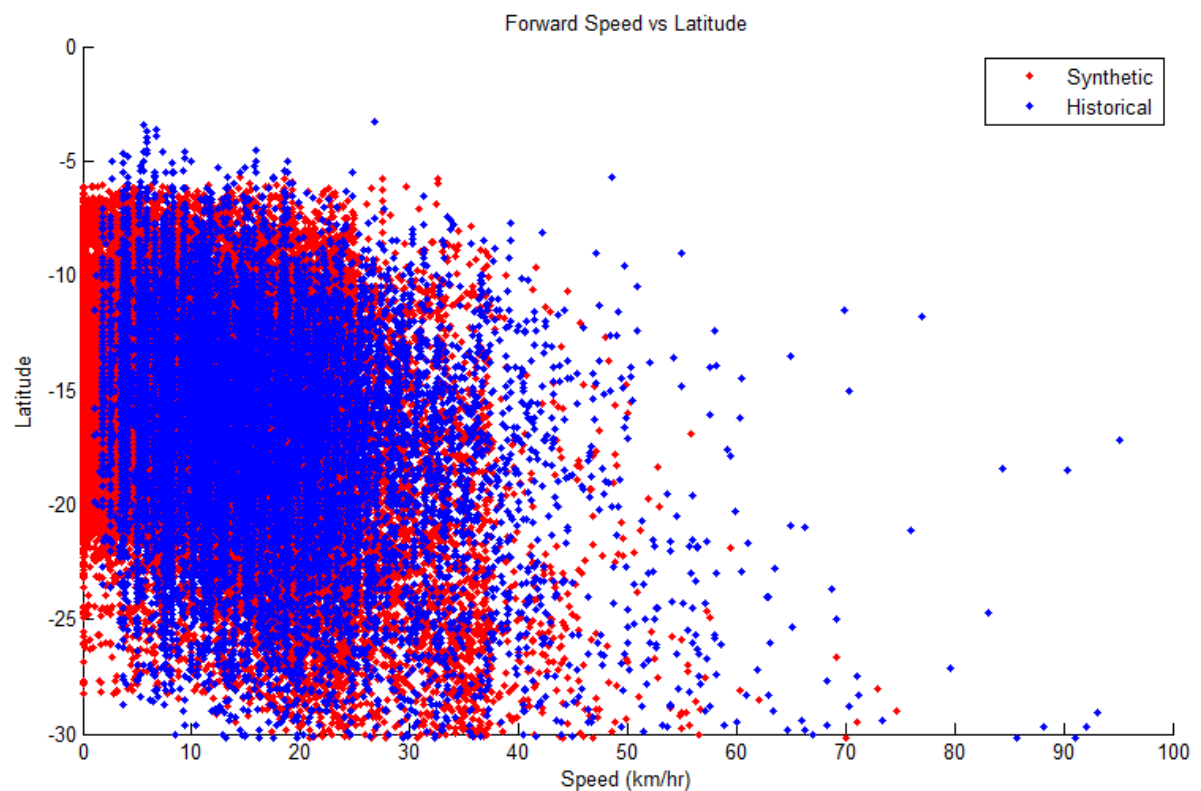


Figure 4.12 Scatter plot of cyclone forward speed versus latitude; measured and modelled

Review of the figures shows a high level of agreement between the recorded and modelled data. This high level of agreement confirms that the model provides a suitable tool for the synthesis of a long term cyclone record.

4.6 MCMC Model Results

A 2,000 year cyclone record was simulated using the validated MCMC cyclone track model. The synthesised cyclone database was then interrogated based on the proximity of each event to MIE and the results of the first order parametric approximation of the water level. Figure 4.13 shows the main events within the synthesised record that would have effected MIE.

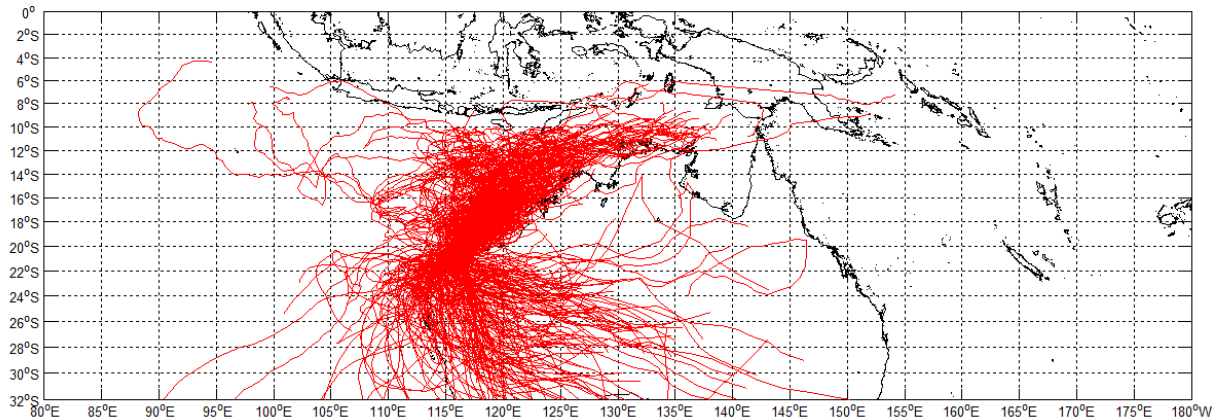


Figure 4.13 Plot of synthesised cyclone tracks within 150 km of MIE

Using the track ranking algorithm a total of 242 events were extracted for further simulation within the Delft3D model.

5. Storm Surge Inundation Modelling Results

The top 242 events generated by the MCMC model were simulated using the calibrated Delft cyclone model. The results of the model simulations were then interrogated in order to identify the peak water level and extent of inundation for each event at MIE.

To identify the 100 and 500 year ARI events, the resulting peak inundation levels within the MIE site were ranked and an extreme analysis was completed in accordance with the method outlined in Petruskas & Aagaard (1971). Simulations were also completed to investigate the effects of wave setup and a 0.9 m rise in sea level for the 100 and 500 year ARI events, as required by SPP2.6. The spatial plots of inundation for the 100 and 500 year ARI events, both at present day and in 2117 (including 0.9 m sea level rise) are shown in Figures 5.1 to 5.4.

Due to the flat and complex topography at MIE, the flow pattern during the 100 and 500 year ARI inundation events appears to be a combination of typical coastal inundation (consists of inundation flow with high water depths) over lower elevations and “diffusive” type inundation (consists of a wide spread “sheet like” flow with small water depths) over higher elevations.

As shown in Figures 5.1 to 5.4, the extent of typical coastal inundation during these events reached an elevation of between 6 to 7 mAHd. Beyond this elevation, the modelling indicates that inundation is governed by shallow “sheet like” flow generated by cyclonic onshore wind. Such flows were typically focused on shallow gullies that provided a constrained flow pathway, with shallow flows reaching elevations of around 10 mAHd. The water depths of these shallow sheet flows are typically in the order of 0.2 m - 0.4 m.

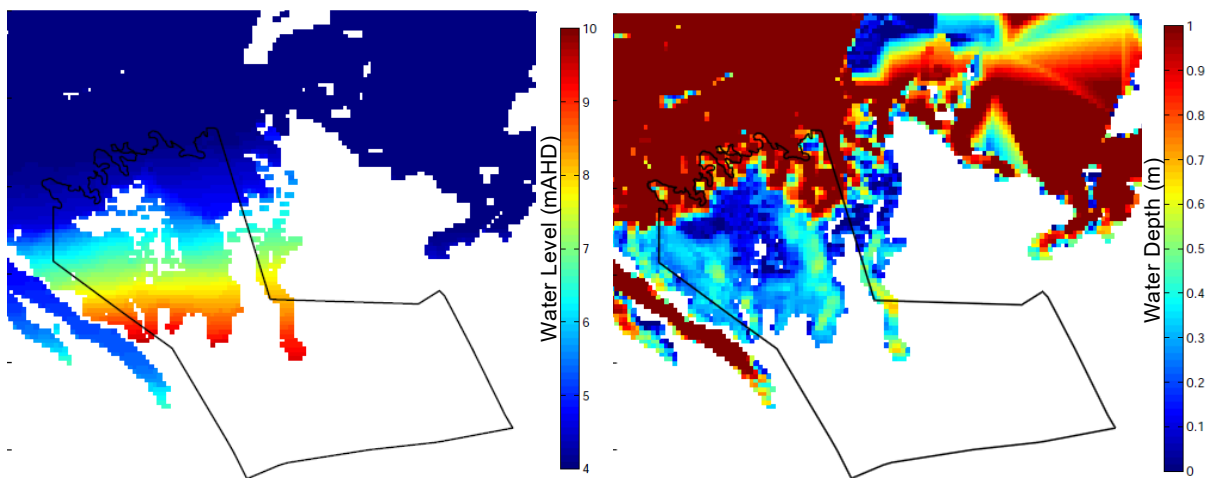


Figure 5.1 Present day 100 year ARI water level and depth at MIE

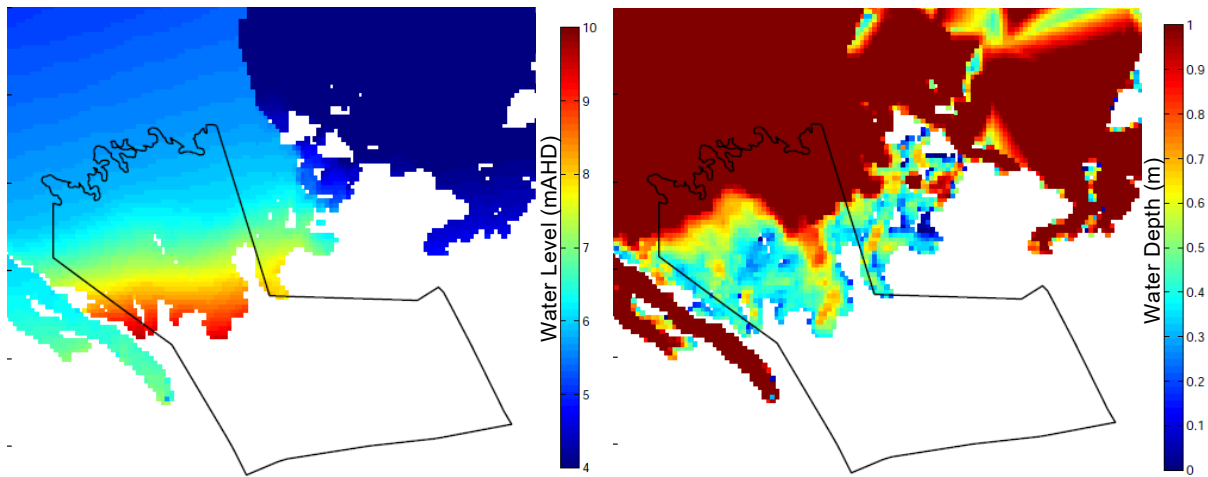


Figure 5.2 Present day 500 year ARI water level and depth at MIE

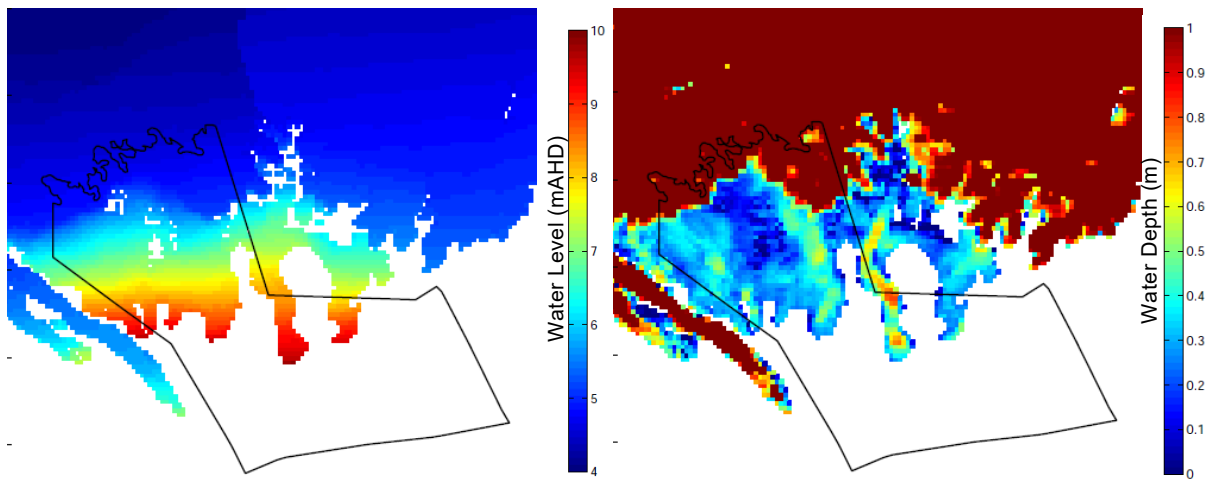


Figure 5.3 2117 100 year ARI water level and depth at MIE

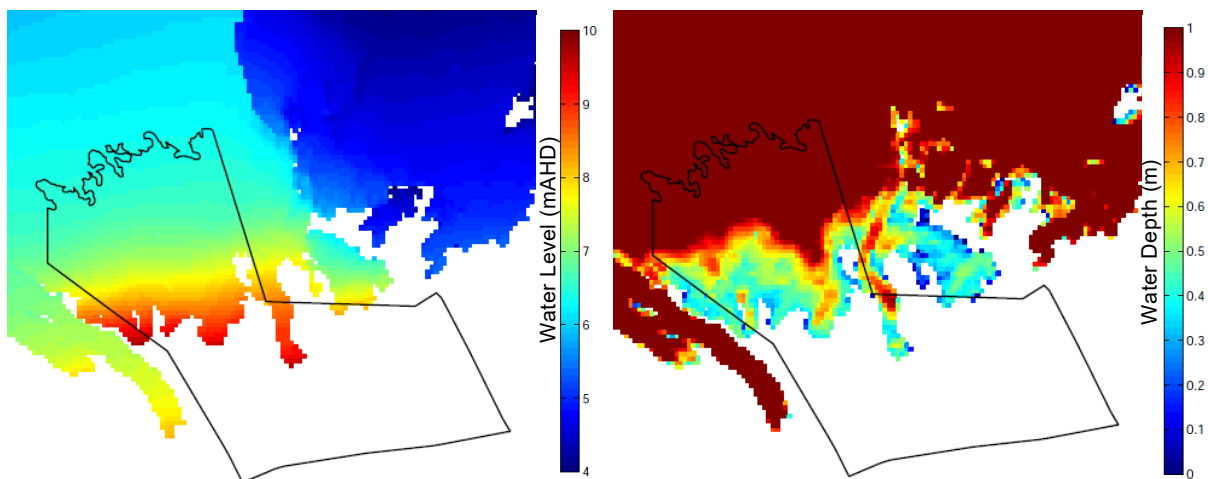


Figure 5.4 2117 500 year ARI water level and depth at MIE

While the area affected by shallow sheet flow is still considered to be inundated by the respective events, a distinction has been made to identify shallow water flow with inundation depths less than 0.5 m. The results from the 100 and 500 year ARI events are presented in Appendix A as

Coastal Inundation Hazard Maps. The maps show the expected inundation of the MIE site for both present day and 2117 (to include 0.9 m of sea level rise) timeframes.

Whilst SPP2.6 is primarily focused on the 500 year ARI event, details of the 100 year ARI event have been included in order to help provide guidance regarding the potential exposure as well as to inform the future CHRMAP process.

6. Coastal Processes Allowances

An understanding of the coastal hazards and risks is critical for the assessment and determination of management and adaptation actions in areas close to the active coastline.

Schedule One of SPP2.6 presents the recommended methodology for calculation of coastal erosion hazards for coastal development. This assessment methodology requires that consideration be given to the potential impacts of each of the following:

- Acute storm erosion associated with the 100 year ARI event (termed the S1 Allowance).
- Long term shoreline movement (termed the S2 Allowance).
- Sea level rise (termed the S3 Allowance).
- Appropriate allowances for uncertainty.

Whilst a 100 year planning horizon needs to be considered to meet the requirements of SP2.6, interim planning horizons of 25, 50 and 75 years have been considered within this report to help inform development planning. The calculation of the respective allowances is presented in the following sections.

6.1 Site

MIE is located south west of Dampier and the Burrup Peninsula, approximately 24 km west of Karratha. The Peninsula and surrounding islands directly offshore of the site provide protection against wave attack from the open ocean.

Northeast of the site, exists a series of salt ponds operated by Dampier Salt. Seaward of the site, MIE's coastal frontage consists of mangroves behind sections of subtidal sandy beaches and mud flats as shown in Figure 6.1.

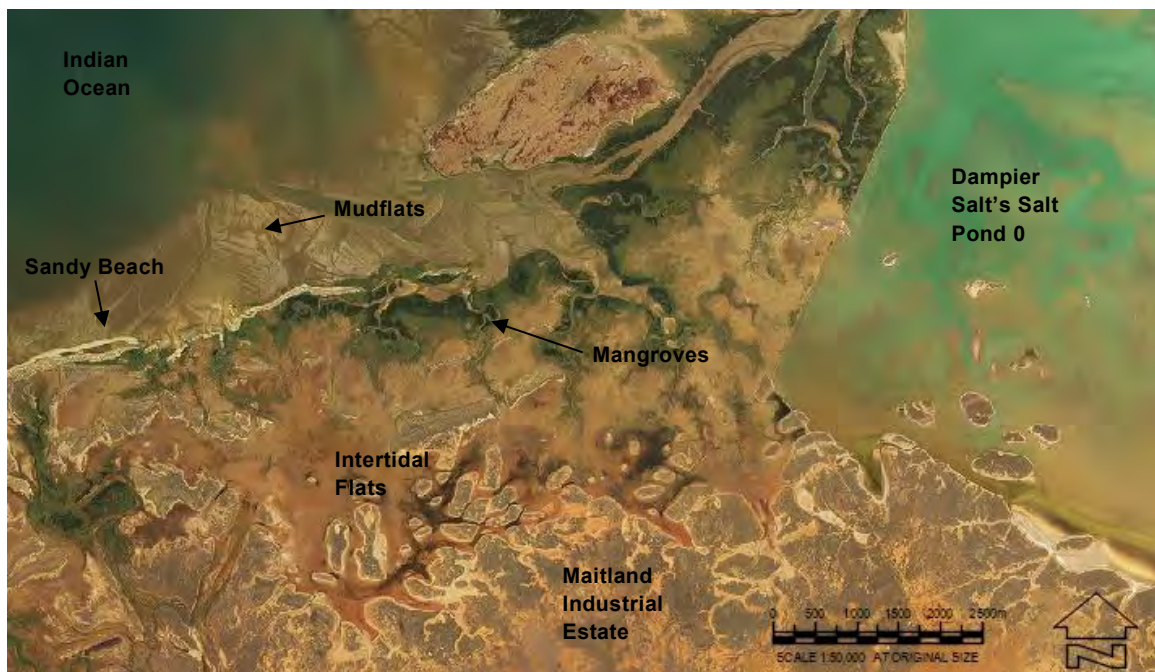


Figure 6.1 MIE site and shoreline

6.2 Acute Storm Erosion Allowance (S1)

Severe storm events have the potential to cause increased erosion to a shoreline, through the combination of higher, steeper waves generated by sustained strong winds, and increased water levels. These two factors acting in concert allow waves to erode the upper parts of the beach not normally vulnerable to wave attack.

If the initial width of the surf zone is insufficient to dissipate the increased wave energy, this energy is often spent eroding the beach face, beach berm and sometimes the dunes. The eroded sand is transported offshore with the return water flow to form offshore bars. As these bars grow, they can cause incoming waves to break further offshore, decreasing the wave energy available to attack the beach. This is shown diagrammatically in Figure 6.2 for a sandy coastline.

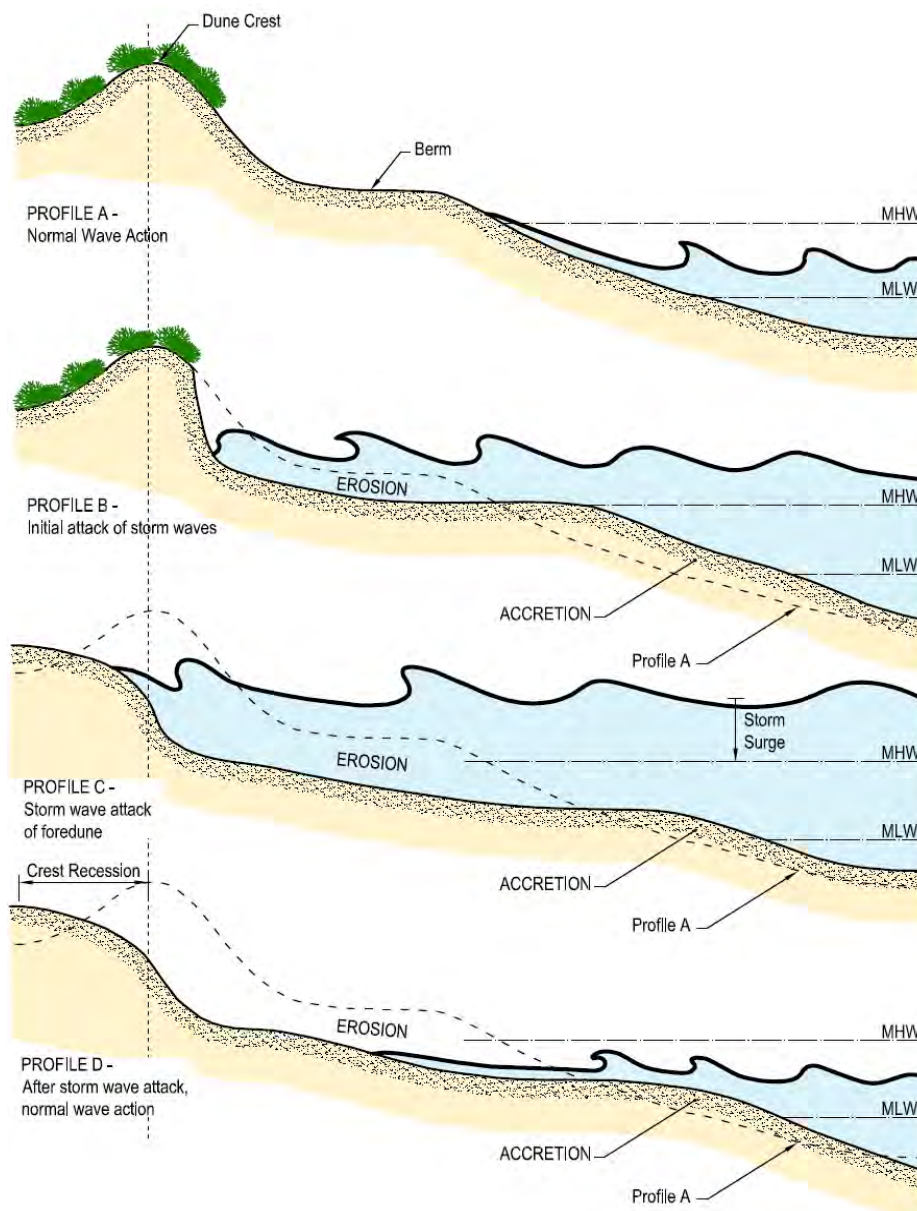


Figure 6.2 Storm Erosion Process (Source: CERC 1984)

SPP2.6 recommends that the allowance for absorbing acute erosion be determined using a credible sediment transport model such as SBEACH (WAPC 2013). The SBEACH computer model was developed by the Coastal Engineering Research Centre (CERC) to simulate beach profile evolution in response to storm events. The SBEACH model has been extensively used for storm erosion modelling within Western Australia, and has been proven to be a credible model for this purpose. It is described in detail by Larson & Kraus (1989).

SPP2.6 also specifies that the modelled storm event should have an annual exceedance probability (AEP) of 1% with regard to beach erosion. This is equivalent to a storm event with an ARI of 100 years. The policy further dictates that the selection of the storm event be based on the coastal area defined in Figure 1 (presented as Figure 6.3). As MIE is located within Area 2, the allowance for the current risk of erosion should be based on a tropical cyclone event.

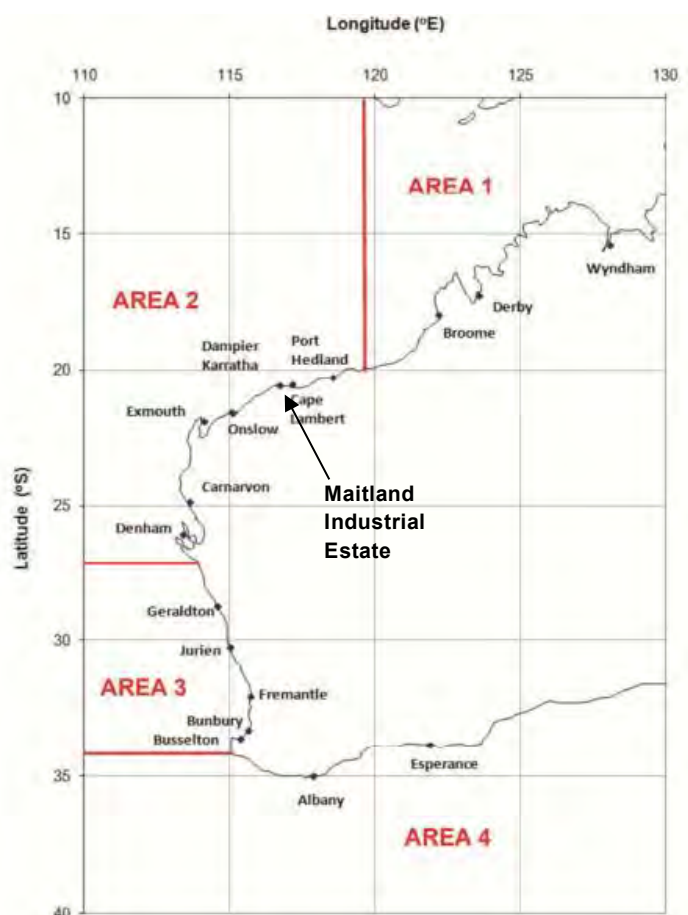


Figure 6.3 Coastal Areas as Defined by SPP2.6

Given the relatively shallow nature of the nearshore area surrounding MIE, the amount of wave energy that reaches the shoreline during extreme events is typically limited by depth induced wave breaking. As a result, it is expected that events that cause high water levels at the shoreline will result in significantly greater shoreline erosion than events with comparably lower water levels. The 100 year ARI event for erosion at MIE is therefore expected to occur during the event that results in the 100 year ARI water level.

To assess the current risk of erosion, the synthesised cyclone event that resulted in the 100 year ARI inundation extent was modelled in SBEACH. This event had elevated water levels for a period of approximately 6 days (150 hours). The 100 year ARI event conditions were extracted

from the results of the inundation assessment. SPP2.6 requires that this storm is simulated three times successively in order to determine the S1 allowance.

6.2.1 SBEACH Modelling

To simulate the shoreline response to the cyclone event and corresponding waves described above, an input pre-storm profile was developed. The input profile location used in SBEACH was developed using a combination of:

- Topography based on Lidar Data supplied by LandCorp as shown in Figure 6.4 (right).
- Bathymetry based on local Navionics boating charts extending offshore to an approximate -12.67mAHD water depth as shown in Figure 6.4 (left). Chart datum was converted to AHD.

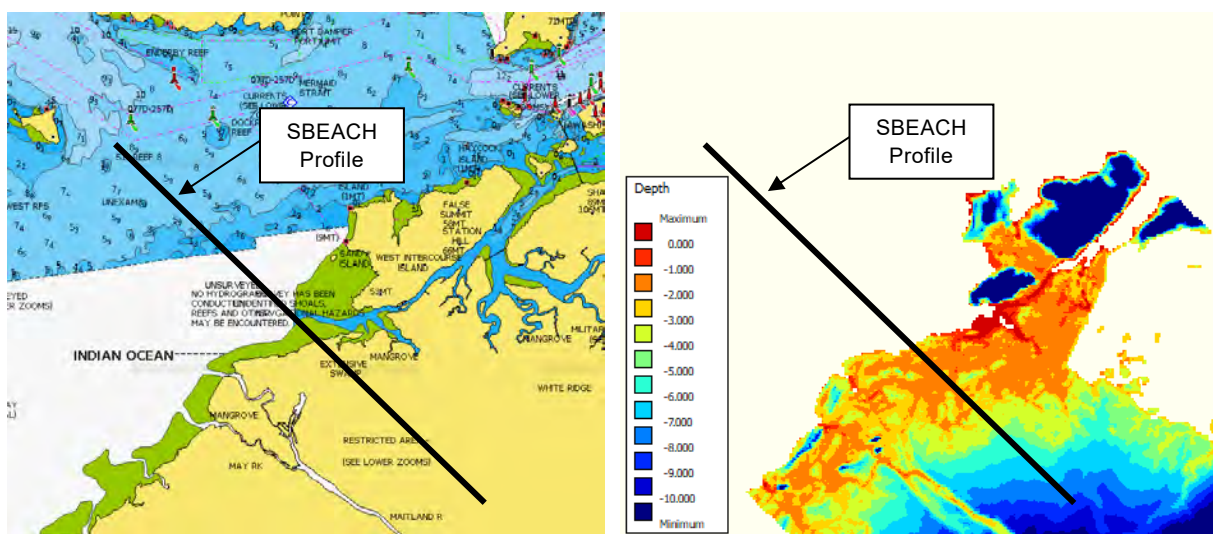


Figure 6.4 SBEACH Profile Location and Alignment

This profile was used to investigate the response of the shoreline to the design storm.

As per SPP2.6, to determine the allowance for the current risk of storm erosion, three repeats of the 100 year ARI cyclone event conditions were run in SBEACH for a combined total of 641 hours.

The results of the SBEACH modelling are presented in Figure 6.5. This figure shows the initial (pre-storm) profile, final profile and the maximum wave heights and water levels predicted during the cyclone event.

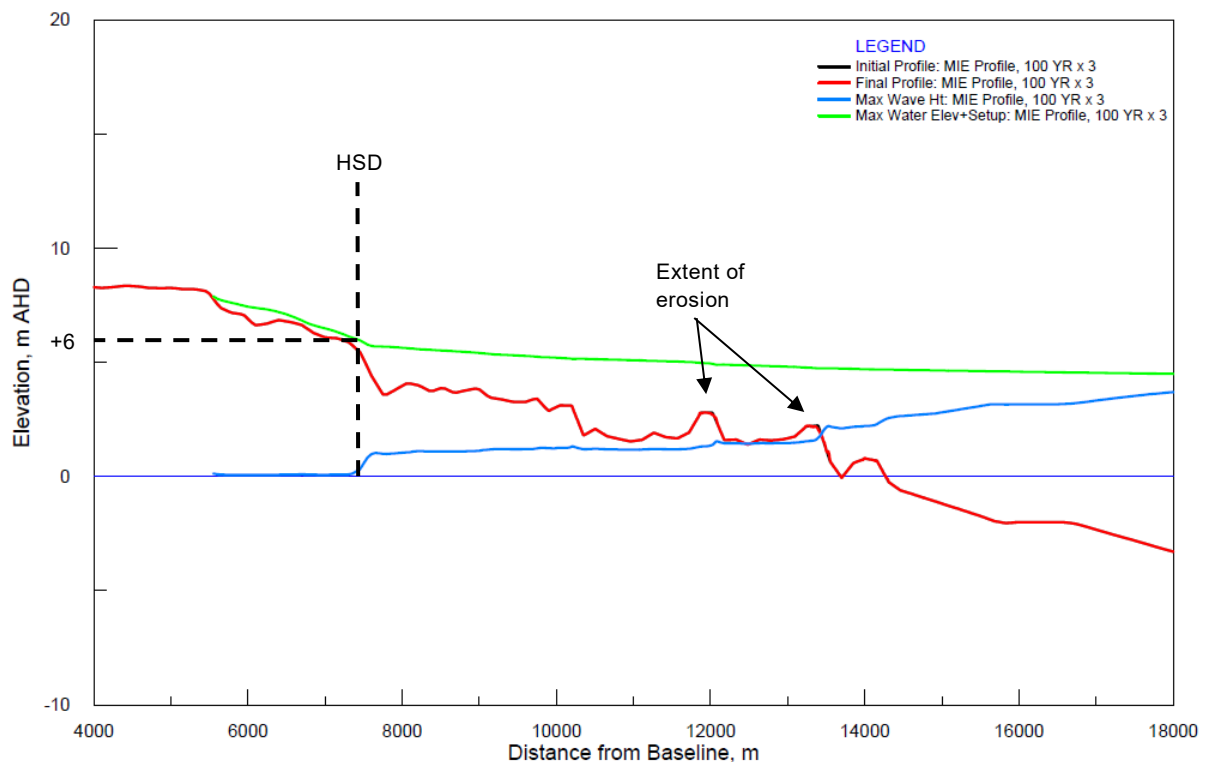


Figure 6.5 SBEACH Simulation Results

SPP2.6 requires that the allowance for severe storm erosion be calculated by determining the extent of erosion predicted behind the Horizontal Shoreline Datum (HSD). The HSD is defined by the active limit of the shoreline under storm activity. In most instances it is defined as the landward contour corresponding to the peak water level elevation that is experienced during severe storm activity at the site. As shown in Figure 6.5, the peak water level reached about 8 mAHD. However, as discussed in Section 5, water levels above approximately 6 mAHD at MIE are governed by shallow “sheet like” flow generated as a result of water being pushed to higher elevations by cyclonic onshore winds. Figure 6.5 also shows that wave heights reduce to approximately 0 m beyond an elevation of about 6 mAHD.

As previously discussed, for storm erosion to occur would require a combination of higher and steeper waves generated by strong onshore wind, and high water levels. Therefore, although the peak water level is above 6 mAHD, the majority of the wave energy required for erosion is dissipated seaward of the 6 mAHD contour.

Therefore, for the purposes of assessing coastal erosion hazards, the HSD is defined as the 6.0 mAHD contour as this is deemed to represent the active limit of the shoreline. Each of the erosion allowances shall therefore be assessed landward of this contour. The HSD is shown in the coastal erosion hazard map in Appendix C.

The extent of the erosion simulated by three repeats of the 100 year cyclone event is shown in Figure 6.5 and is far below the 6.0 mAHD HSD contour. The occurrence of minimal erosion at the HSD contour is not surprising given the relatively short period that cyclonic water levels are actually at their peak. Therefore, an S1 allowance of 0 m is recommended for MIE.

6.3 Allowance for Shoreline Movement Trend (S2)

Historically, changes in shorelines occur on varying timescales from storm to post storm, seasonal and longer term (Short 1999). The S1 erosion allowance accounts for the short term storm timescale of beach change. The S2 erosion allowance is intended to account for the longer term movement of the shoreline that may occur within the planning horizon. To determine the S2 erosion allowance, historical shoreline movement trends are examined, and likely future shoreline movements predicted.

6.3.1 Shoreline Movement Analysis

SPP2.6 recommends that shoreline movement trends be based on the review of available shoreline records. This can include analysis of historical aerial photography, High Water Mark (HWM) surveys or previously extracted coastal vegetation lines available from DoT. Available aerial photographs that include the shoreline at MIE only extend back to 2000. The following aerial photographs were obtained to determine the S2 erosion allowance:

- August 2000 from Landgate
- November 2008 from Landgate
- August 2012 from Landgate
- March 2013 from LandCorp

The images were orthorectified and analysed. The typology of the shoreline fronting the MIE is characterised by a fringing mangrove ecosystem backed by extensive intertidal flats. Other than mangroves, limited vegetation or features exist along what would be considered the typical shoreline. Therefore, in the absence of clearly defined vegetation near the shoreline, the most seaward and well defined coastal vegetation line was extracted using the methodology outlined in DoT (2009). The accuracy of the photogrammetry technique is expected to be in the order of $\pm 5\text{m}$. The location of the coastal vegetation lines between 2000 and 2013 are shown in Appendix B.

From review of the shoreline movement plan, the following can be noted:

- The most seaward vegetation line that can be defined clearly at MIE has been extremely stable over the mapped timeframe.
- Isolated sections of accretion exist within the mapped timeframe, though these sections are typically less than 10 m (over 14 years).
- Isolated sections of erosion exist within the mapped timeframe. typically less than 5 m (over 14 years) and may be attributable to the accuracy of the photogrammetry.

Further analysis of the available aerial imagery indicates that the mangroves, intertidal flats, sandy beach areas and mudflats have been stable over time. The only clearly defined coastal vegetation lines seaward of these shoreline areas confirm this stability. Therefore, for the shoreline at MIE an S2 allowance of 0 m/year is recommended.

6.4 Sea Level Rise Allowance (S3)

The effect of sea level rise on the coast is difficult to predict. Komar (1998) provides a reasonable treatment for sandy shores, including examination of the Bruun Rule (Bruun 1962). The Bruun Rule relates the recession of the shoreline to the sea level rise and slope of the nearshore sediment bed:

$$R = \frac{1}{\tan(\theta)} S$$

where: R = recession of the shore;

θ = average slope of the nearshore sediment bed; and

S = sea level rise.

Komar suggests that the usual range of recession is $R = 50S - 100S$. However, the “Bruun Rule” does not take into account possible changes in the balance of sediment transported along the shore in response to sea level rise. SPP2.6 recommends that for sandy shores the potential recession be taken as 100 times the estimated sea level rise.

The DoT (2010) completed an assessment of the potential increase in sea level that could be experienced on the Western Australian coast in the coming 100 years. This assessment extrapolated work by Hunter (2009) to provide sea level rise values based on the IPCC (2007) A1F1 climate change scenario projections to the year 2110. The derived sea level rise scenario was subsequently adopted by the Western Australian Planning Commission (and SPP2.6) for use in coastal planning along the Western Australian coast. The adopted sea level rise scenario is presented in Figure 3.2.

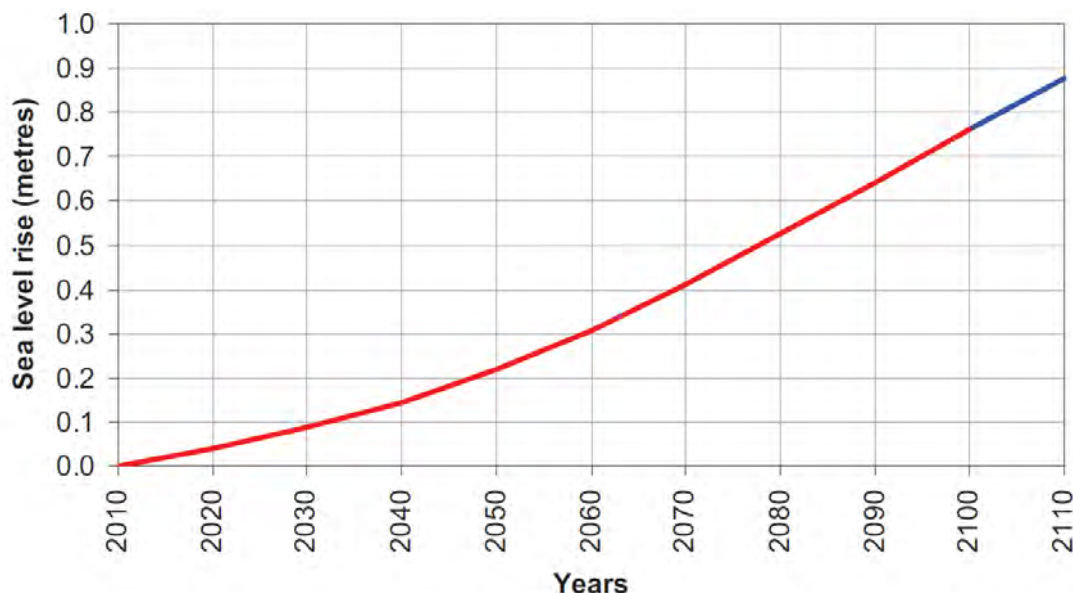


Figure 6.6 Recommended Sea Level Rise Scenario for Coastal Planning in Western Australia (DoT 2010)

Based on Figure 3.2, the required allowances for sea level rise from 2017 to each of the three key time frames, 2042, 2067 and 2117 are presented in Table 3.1.

Table 6.1 Sea Level Rise Allowances (S3)

Planning Timeframe	SLR Allowance (m)
Present day (2017)	0.00
2042	0.15
2067	0.37
2117	0.90

It should be noted that the policy requires that the coastal processes allowances for development be completed based on a 100 year planning horizon. Therefore an allowance for sea level rise of 0.90 m has been adopted for 2117. Given the 100S value, the potential recession of the MIE shoreline that could occur as a result of the increases in sea level is 90 m in 2117.

7. Total Coastal Erosion Hazard Allowance

The total recommended allowance for the future action of coastal processes should include the allowances determined in previous sections of this report. Additionally, an allowance for uncertainty of 0.2 m/year should also be included as per the requirements of SPP2.6. The total recommended coastal processes allowances for the 100 year planning timeframe is presented in Tables 6.

Table 7.1 Total Recommended Coastal Processes Allowances

Timeframe	S1 (m)	S2 (m)	S3 (m)	Allowance for Uncertainty (m)	Total Allowance (m)
2117	0	0	90	20	110

The physical coastal processes allowances are to be measured from the HSD, which was discussed in Section 6.2.1. The location of the coastal erosion hazard allowance for the 100 year planning timeframe is presented in Appendix C.

8. Conclusions

The absence of long term water level records within King Bay, and in particular at MIE, makes it impossible to develop meaningful estimates of design storm surge levels from interrogation of the water level record on its own. This is particularly problematic given that SPP2.6 requires that freehold development area to be set based on the 500 year ARI inundation level plus an allowance for sea level rise.

To develop a statistically relevant prediction of extreme inundation levels required the development of a numerical model system. This system comprised a cyclone track generation model that simulated all facets of cyclone generation, propagation and decay over the entire Australian region. Coupled with the cyclone track model, the integrated Delft3D hydrodynamic model was used to determine the effects of the most severe water level events in the MIE region. The components of the numerical model system were calibrated against available measurements to ensure the system adequately reflected the reality and was therefore suitable to be used as a predictive tool for the estimation of extreme inundation levels. Overall a high level of agreement was observed between the modelled and observed data sets.

To determine the design ocean inundation levels at MIE the calibrated model system was used to synthesise and interrogate a 2,000 year cyclone period. An extreme value analysis was completed on the resultant peak water levels extracted at MIE. The results of this analysis have been used to map the coastal inundation hazard extent for the 2117 (including a 0.9 m sea level rise allowance) 500 year ARI cyclone event as required by the SPP2.6. Development beyond the 2117 500 year ARI mapped inundation extent will be unrestricted. Development proposed within the 2117 500 year ARI cyclone mapped inundation extent will be required to ensure the risk of ocean inundation is appropriately managed and mitigated in line with SPP2.6.

As identified by the modelling process, shallow “sheet like” flow with depths less than 0.5 m at MIE resulted in a much greater inundation extent. It is expected though, that this shallow inundation is much more manageable than inundation depths greater than 0.5 m experienced elsewhere at the site.

The coastal erosion hazards were assessed in line with SPP2.6, considering allowances for:

- Severe storm erosion (100 year ARI beach erosion event).
- Long term trends in shoreline movement.
- Erosion due to sea level rise.

An uncertainty allowance was also included in line with the recommendations of SPP2.6. These factors were used to determine a total coastal erosion hazard allowance.

The coastal erosion hazard for the MIE shoreline was assessed using the simulated 100 year ARI event from detailed cyclone modelling completed by MRA. The prepared coastal erosion hazard map indicates that only the very northern portions of the MIE could be impacted by coastal erosion over the 100 year planning timeframe.

This would also require further assessment and justification through the CHRMAP process, however is far exceeded by the more critical coastal inundation risks identified. While both inundation and erosion hazards require consideration, it is expected that the main focus of further work for MIE would be on the coastal inundation risks.

9. References

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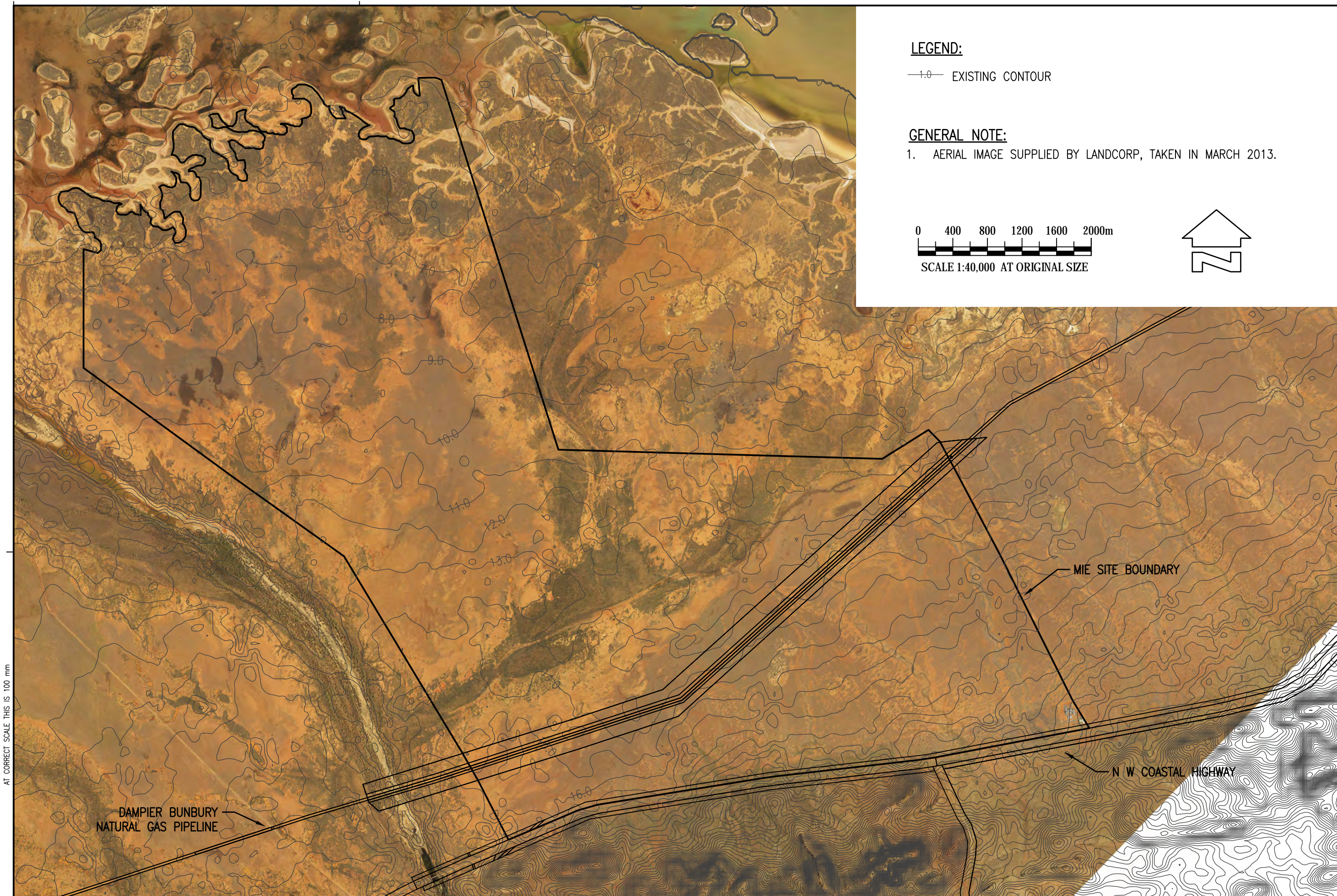
10.Appendices

Appendix A Coastal Inundation Hazard Maps

Appendix B Shoreline Movement Plan

Appendix C Coastal Erosion Hazard Map

Appendix A Coastal Inundation Hazard Maps



LEGEND:

—1.0— EXISTING CONTOUR

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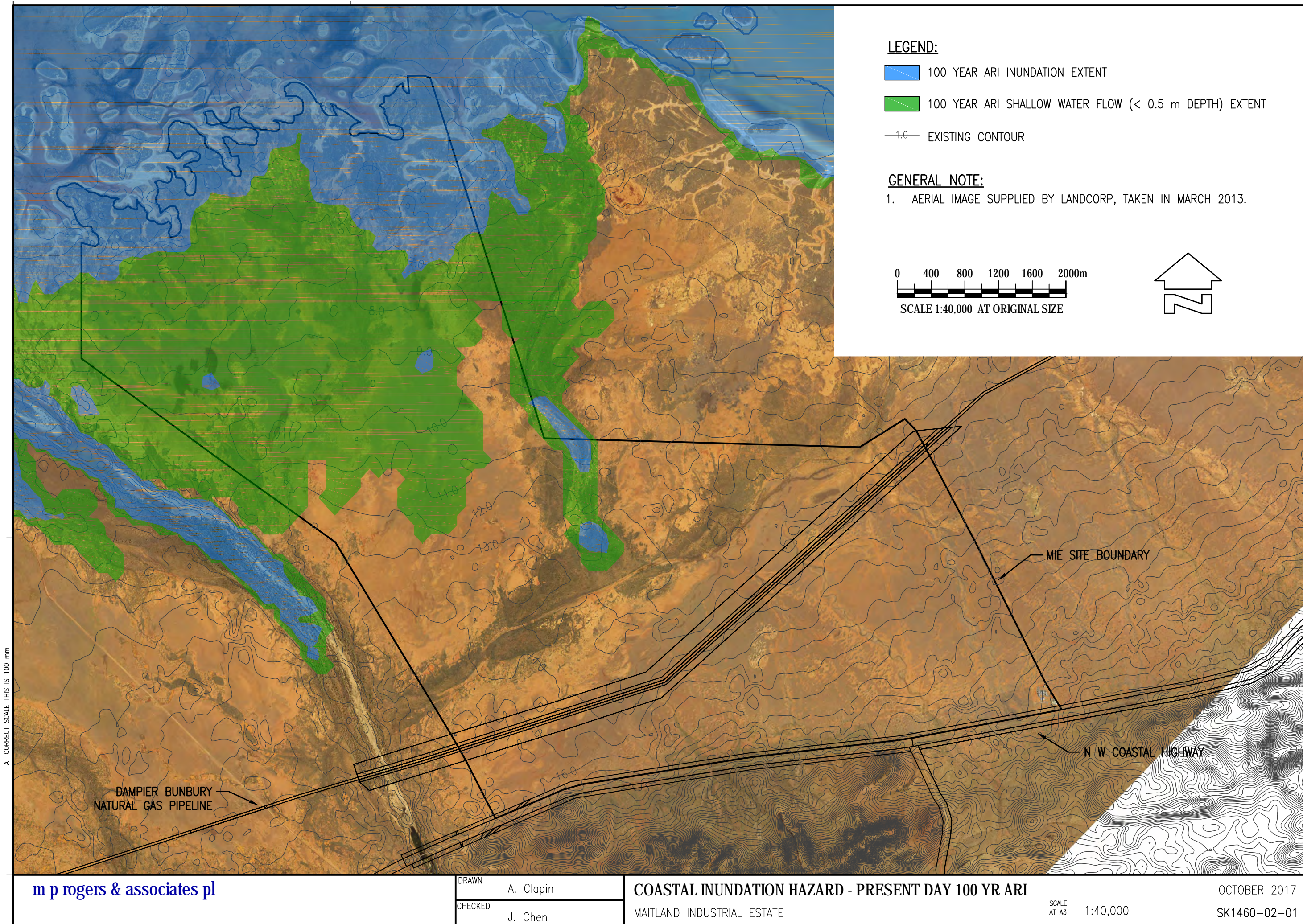
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DAMPIER BUNBURY
NATURAL GAS PIPELINE

MIE SITE BOUNDARY

N W COASTAL HIGHWAY



LEGEND:

- 100 YEAR ARI INUNDATION EXTENT
- 100 YEAR ARI SHALLOW WATER FLOW (< 0.5 m DEPTH) EXTENT
- EXISTING CONTOUR

GENERAL NOTE:

- AERIAL IMAGE SUPPLIED BY LANDCORP, TAKEN IN MARCH 2013.

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SCALE 1:40,000 AT ORIGINAL SIZE



AT CORRECT SCALE THIS IS 100 mm

DAMPIER BUNBURY
NATURAL GAS PIPELINE

MIE SITE BOUNDARY

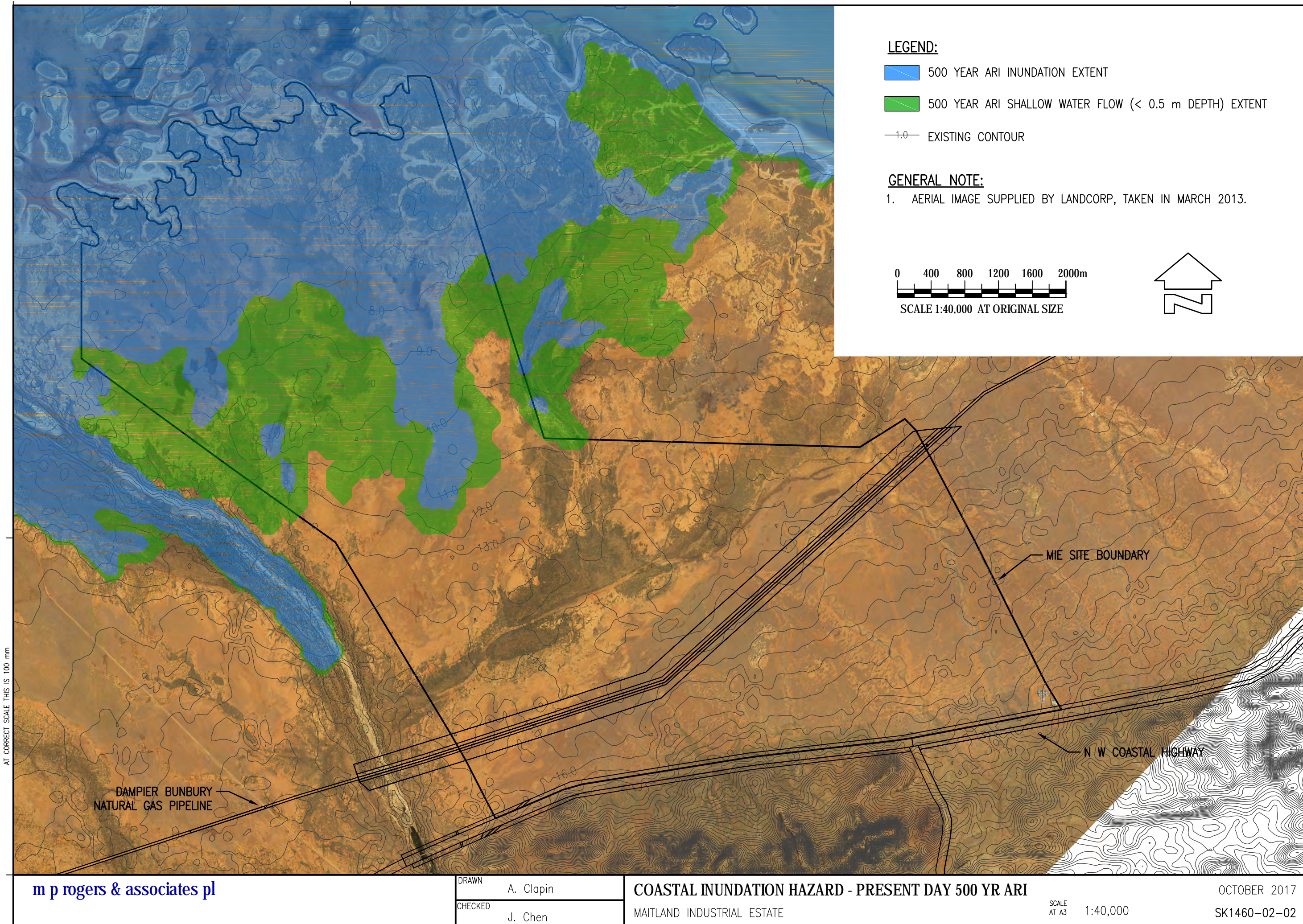
N W COASTAL HIGHWAY

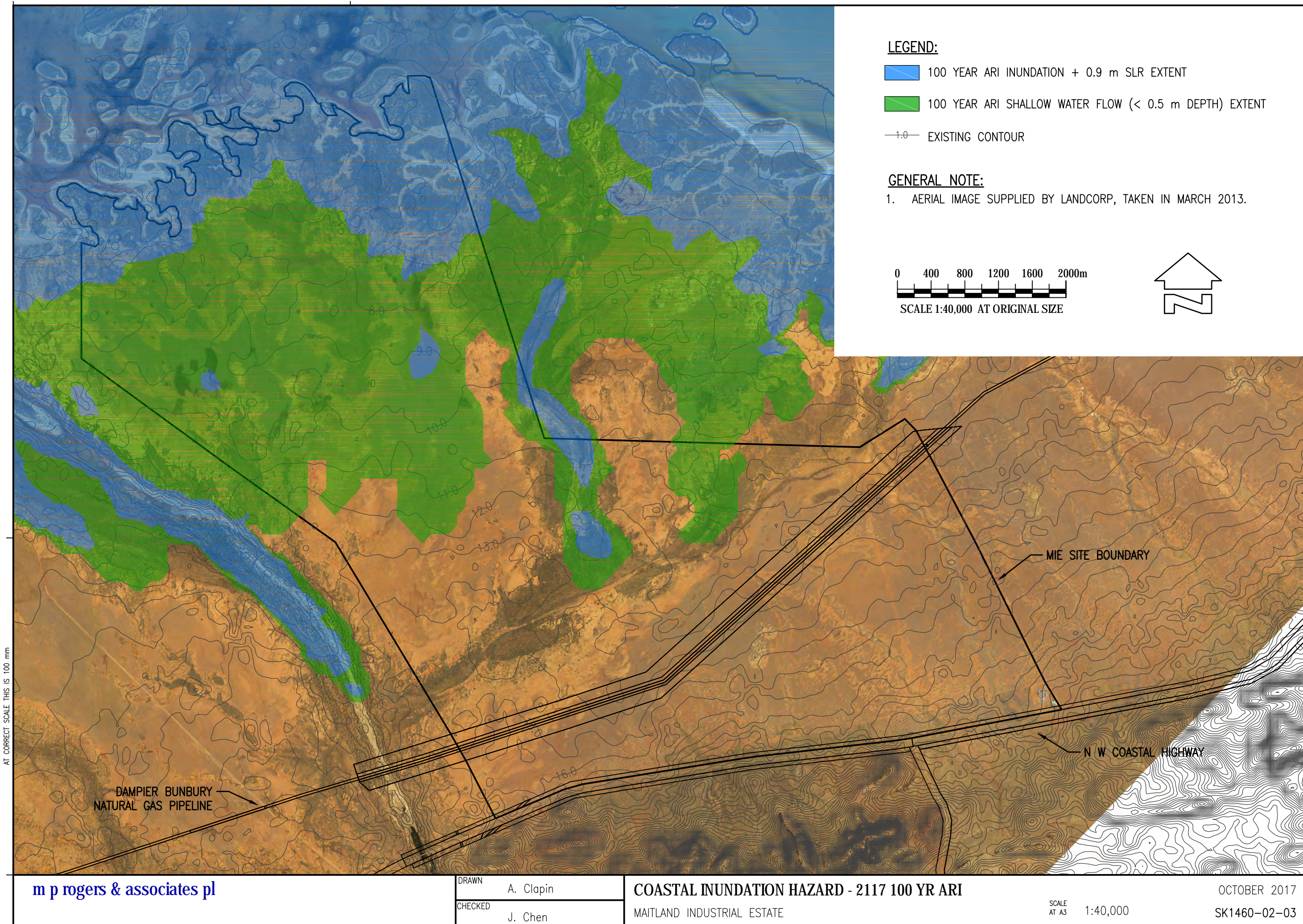
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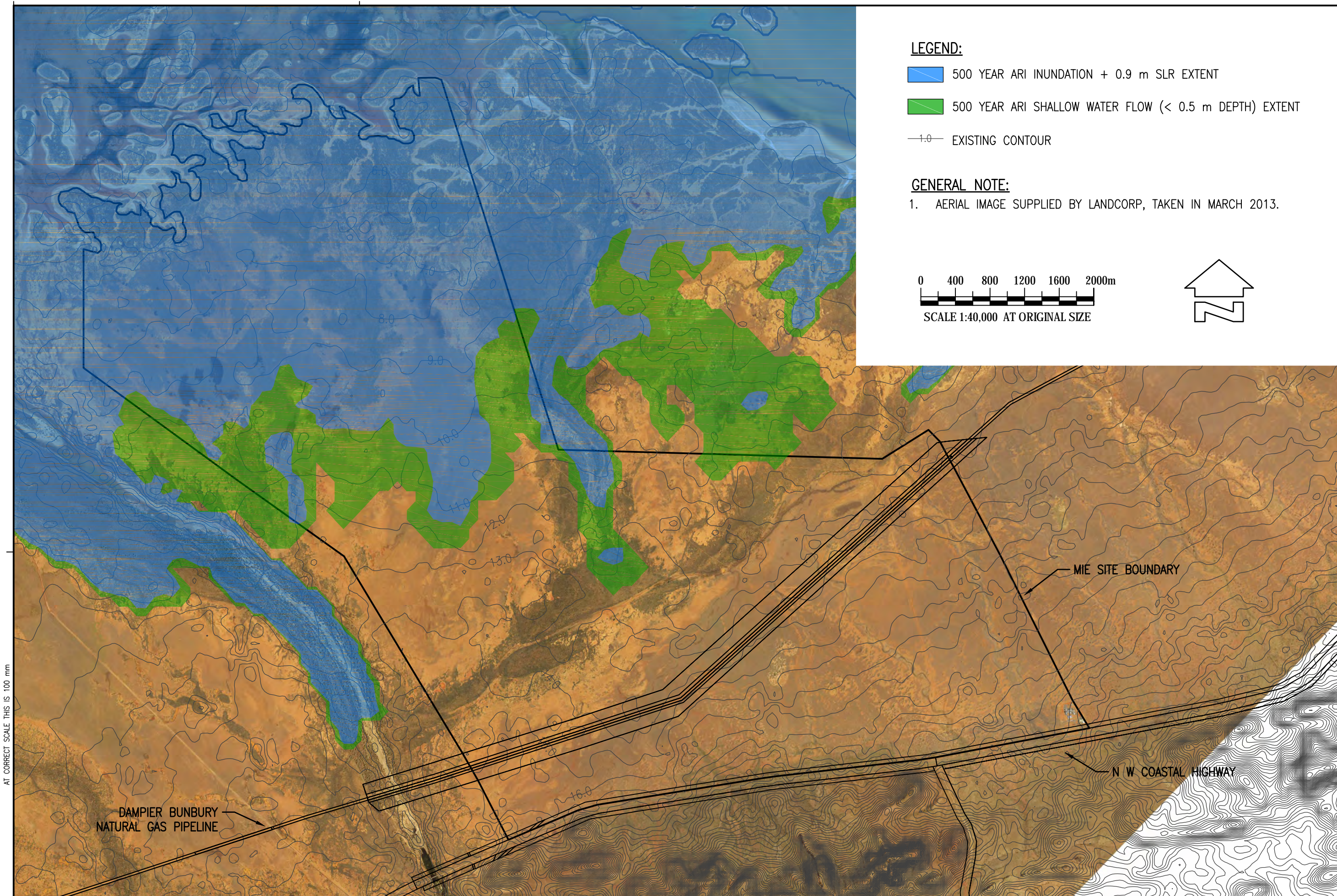
DRAWN A. Clapin
CHECKED J. Chen

COASTAL INUNDATION HAZARD - PRESENT DAY 100 YR ARI
MAITLAND INDUSTRIAL ESTATE




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OCTOBER 2017
SK1460-02-01





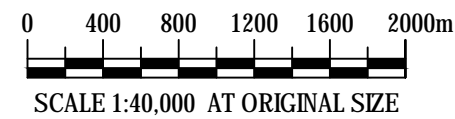


LEGEND:

-  500 YEAR ARI INUNDATION + 0.9 m SLR EXTENT
-  500 YEAR ARI SHALLOW WATER FLOW (< 0.5 m DEPTH) EXTENT
-  EXISTING CONTOUR

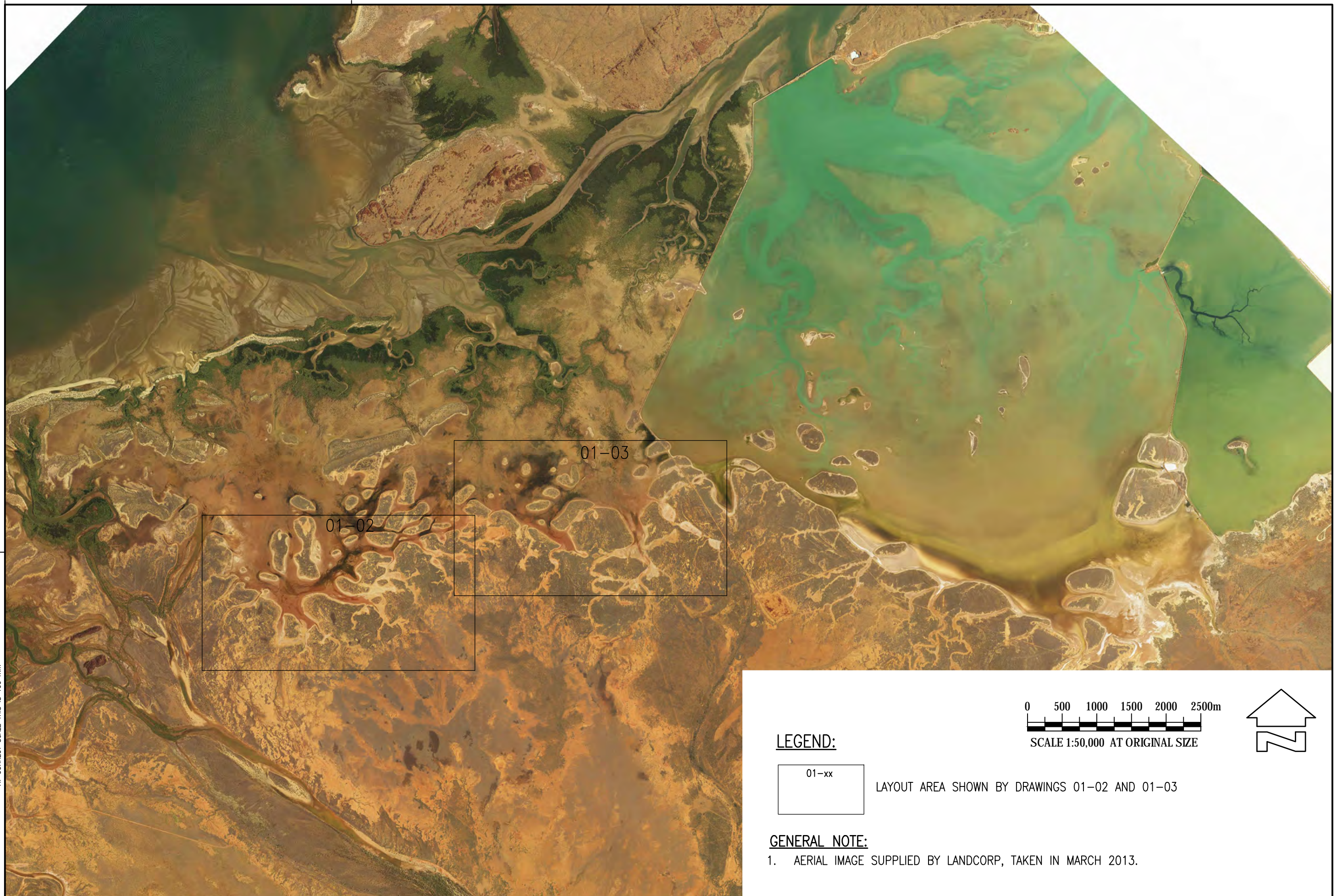
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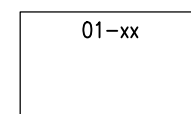


Appendix B Shoreline Movement Plan

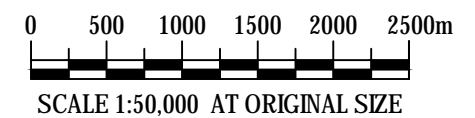
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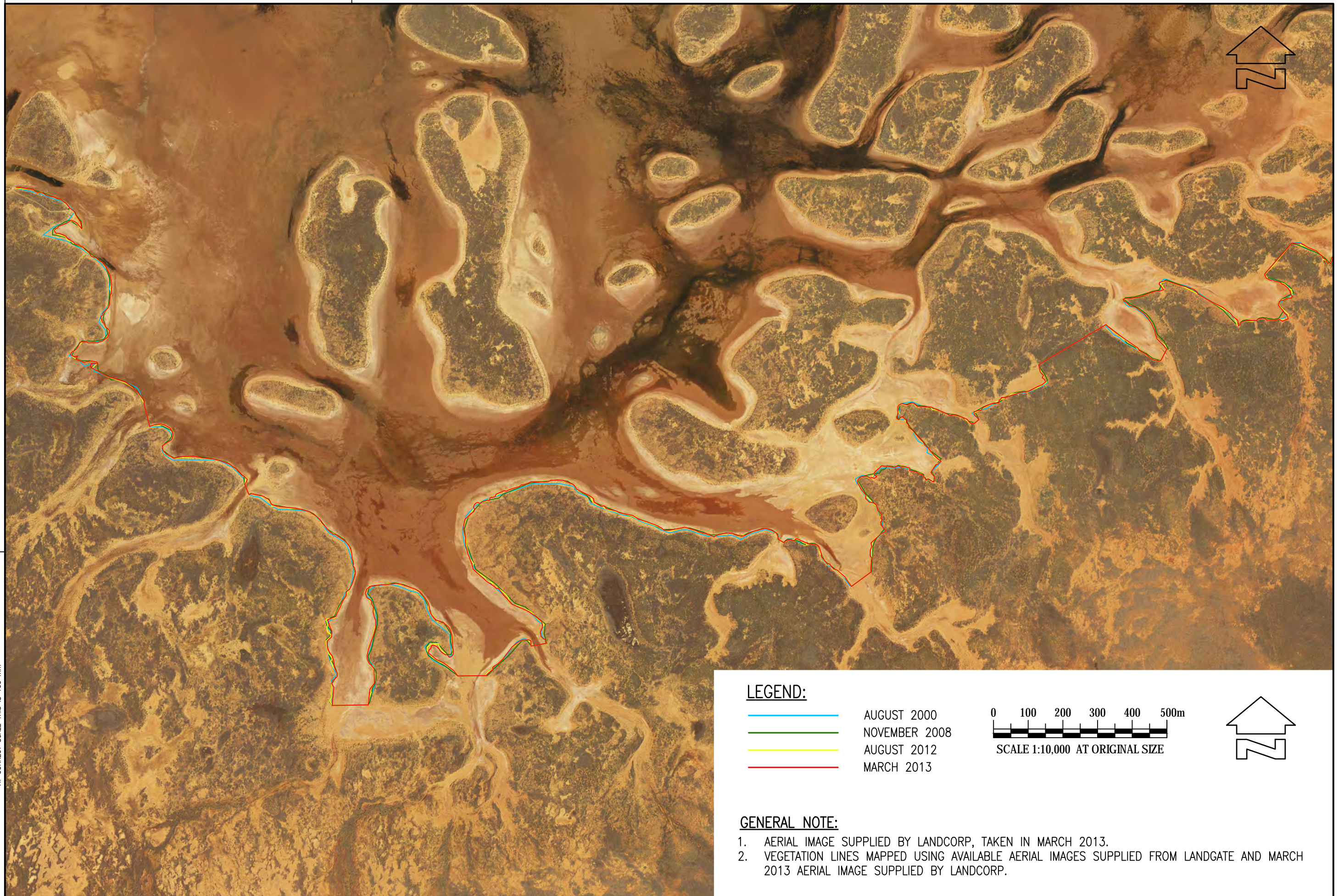
LAYOUT AREA SHOWN BY DRAWINGS 01-02 AND 01-03



GENERAL NOTE:

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AT CORRECT SCALE THIS IS 100 mm



LEGEND:

	AUGUST 2000
	NOVEMBER 2008
	AUGUST 2012
	MARCH 2013

0 100 200 300 400 500m

SCALE 1:10,000 AT ORIGINAL SIZE



GENERAL NOTE:

1. AERIAL IMAGE SUPPLIED BY LANDCORP, TAKEN IN MARCH 2013.
2. VEGETATION LINES MAPPED USING AVAILABLE AERIAL IMAGES SUPPLIED FROM LANDGATE AND MARCH 2013 AERIAL IMAGE SUPPLIED BY LANDCORP.

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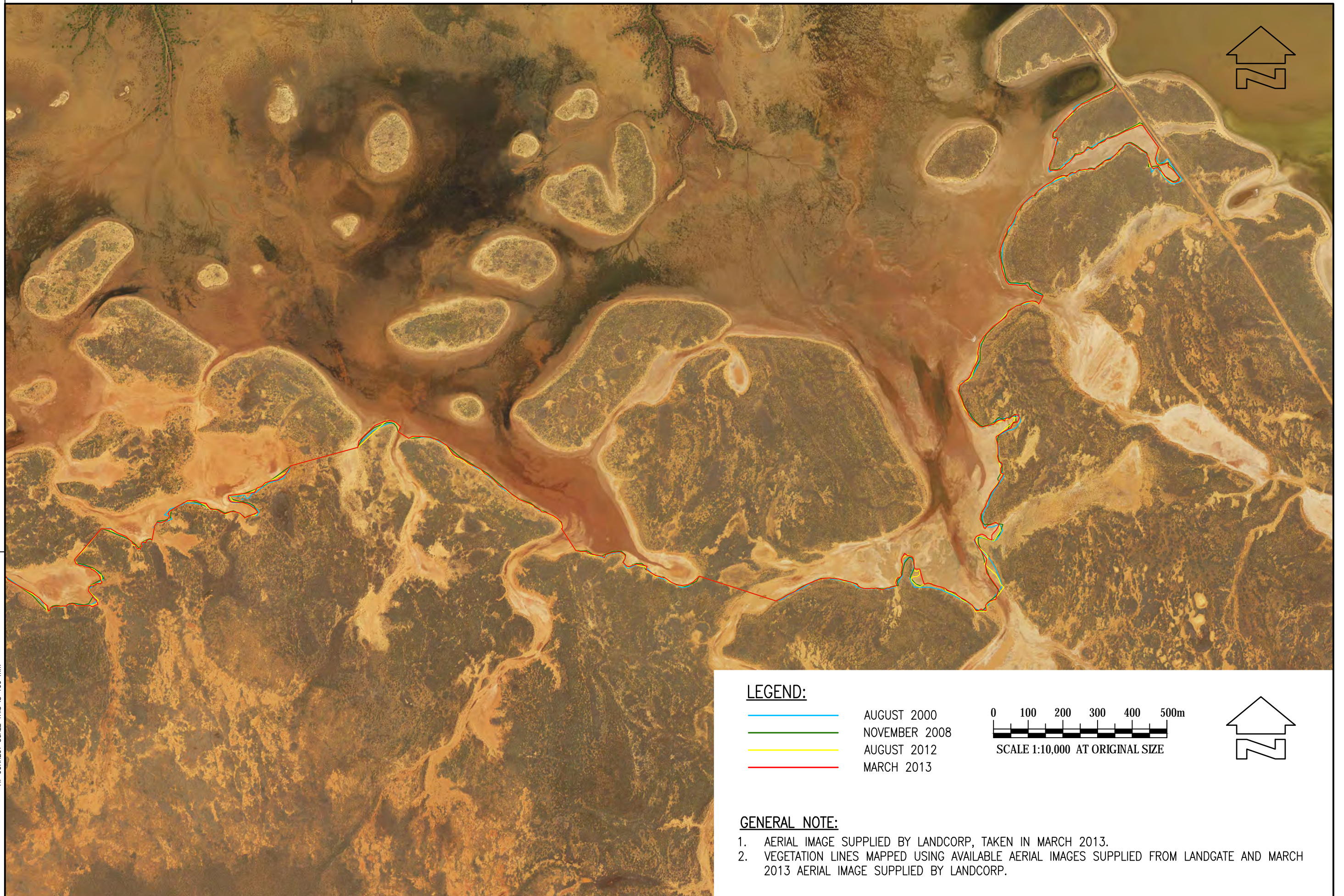
DRAWN A. Clapin
CHECKED J. Chen

SHORELINE MOVEMENT PLAN 01-02
MAILLAND INDUSTRIAL ESTATE

SCALE
AT A3 1:10,000

OCTOBER 2017
SK1460-01-02

AT CORRECT SCALE THIS IS 100 mm

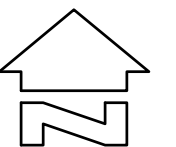


LEGEND:

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- NOVEMBER 2008
- AUGUST 2012
- MARCH 2013

0 100 200 300 400 500m

SCALE 1:10,000 AT ORIGINAL SIZE



GENERAL NOTE:

1. AERIAL IMAGE SUPPLIED BY LANDCORP, TAKEN IN MARCH 2013.
2. VEGETATION LINES MAPPED USING AVAILABLE AERIAL IMAGES SUPPLIED FROM LANDGATE AND MARCH 2013 AERIAL IMAGE SUPPLIED BY LANDCORP.

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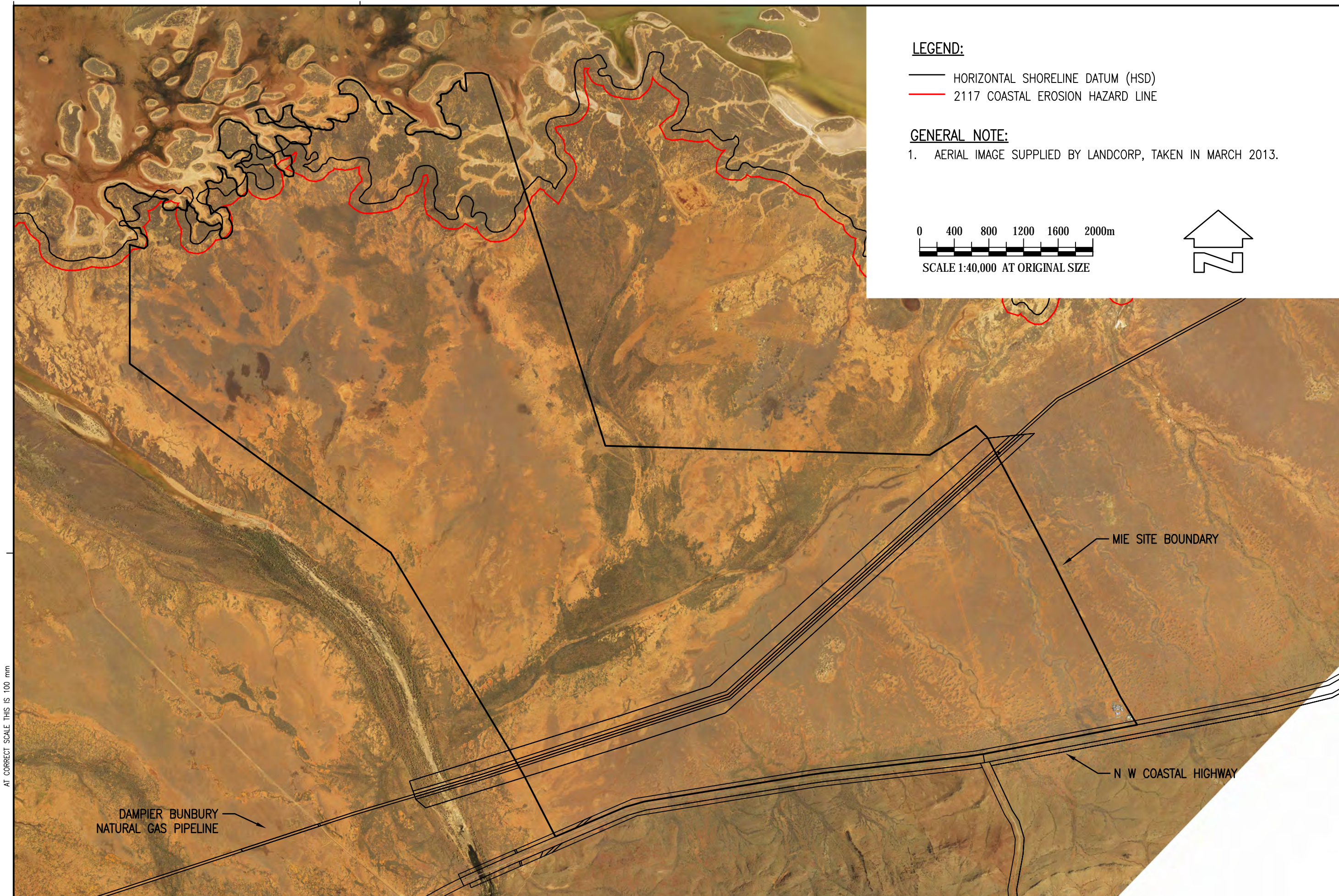
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SHORELINE MOVEMENT PLAN 01-03
MAILLAND INDUSTRIAL ESTATE

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Appendix C Coastal Erosion Hazard Map

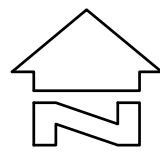
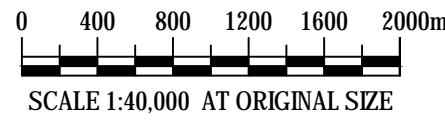


LEGEND:

- HORIZONTAL SHORELINE DATUM (HSD)
- 2117 COASTAL EROSION HAZARD LINE

GENERAL NOTE:

1. AERIAL IMAGE SUPPLIED BY LANDCORP, TAKEN IN MARCH 2013.



AT CORRECT SCALE THIS IS 100 mm

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DRAWN	A. Clapin
CHECKED	J. Chen

COASTAL EROSION HAZARD MAP
MAITLAND INDUSTRIAL ESTATE

SCALE
AT A3 1:40,000

OCTOBER 2017
SK1460-03-01

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Appendix C

Office of the EPA email advice

Doris Clarke

From: Steve Rolls
Sent: Thursday, 9 March 2017 3:58 PM
To: 'Stephen Pavey'
Cc: Liesl Rohl; John Halleen
Subject: RE: Maitland SIA Ecological Summary

Thanks for your advice Steve, I will inform our client that no further ecological investigations are required at this time.

Best wishes

Steve



Steve Rolls
Business Director
Environment - Land & Infrastructure
RPS Australia Asia Pacific

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www: <http://rpsgroup.com.au>



UDIA 2016 AWARDS FOR EXCELLENCE WINNERS

- Alkimos Beach - EnviroDevelopment Chairman's Choice Award
- Eliza Ponds - Residential Development under 250 lots
- The Playground at Coolbellup - Urban Renewal
- New North Project - Urban Renewal
- Annie's Landing Ellenbrook - Residential Development over 250 lots



UDIA 2015 AWARDS FOR EXCELLENCE WINNERS

- Elements - Russel Perry Award for Urban Development Excellence & Affordable Development
- Eliza Ponds - Urban Water Excellence & Urban Renewal
- The Primary at Coolbellup - Residential Development under 250 lots

UDIA 2014 AWARDS FOR EXCELLENCE WINNERS

- Frasers Landing - National Environmental Excellence
- Eliza Ponds - Rising Star Award

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From: Stephen Pavey [mailto:Stephen.Pavey@epa.wa.gov.au]
Sent: Thursday, 9 March 2017 2:52 PM
To: Steve Rolls
Cc: Liesl Rohl
Subject: RE: Maitland SIA Ecological Summary

Hi Steve

Thank you for providing the summary of the known ecological information and the Aecom 2013 Due Diligence report for the Maitland SIA.

The Environmental Planning Branch (EPB) has reviewed the documents and considers the information provided as sufficient for the EPA to make a determination under S48A of the EP Act when the Improvement Scheme is referred.

The EPB recommends the Improvement Scheme text, Guide Plan and Scheme Report adequately address potential impacts to identified environmental factors and take into account the unknown nature and size of future industries that may be located at the site.

If you require further information please feel free contact me.

Regards

Steve

Steve Pavey

Environmental Planning Branch
Strategic Policy and Planning Division

Office of the Environmental Protection Authority

The Atrium, Level 8, 168 St George's Terrace, Perth WA 6000

Locked Bag 10, East Perth WA 6892

direct: 08 6145 0837; reception: 08 6145 0800; fax: 08 6145 0895.

email: stephen.pavey@epa.wa.gov.au; web: www.epa.wa.gov.au

From: Steve Rolls [<mailto:Steve.Rolls@rpsgroup.com.au>]

Sent: Monday, 27 February 2017 4:28 PM

To: Liesl Rohl; Stephen Pavey

Cc: BRADY, Jamie; HERBERT, Ella; Simon Thomson; John Halleen

Subject: Maitland SIA Ecological Summary

Hello Liesel and Stephen

Further to our meeting on the Maitland SIA, as agreed we provide here a summary of known ecological information for the site.

As discussed, we seek your guidance whether the completed studies are satisfactory in terms of providing the Office of the Environmental Protection Authority (OEPA) with sufficient information to set a level of assessment for the project, given that an Improvement Scheme will be introduced. Or, more specifically, whether targeted or full Level 2 flora, vegetation and fauna studies are required at this time.

I will also forward Aecom's 2013 Environmental Due Diligence report in full separately.

We would be pleased to discuss or clarify any aspect.

Kind regards

Steve



Steve Rolls
Business Director
Environment - Land & Infrastructure
RPS Australia Asia Pacific

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