ERAMURRA SOLAR SALT PROJECT

MINE CLOSURE PLAN

EGS CODE: TBD
ESSP-EN-01-APN-0001
REVISION 1, VERSION 0

15 APRIL 2025

Tenement	Tenement Holder
M47/1623	Leichhardt Salt Pty Ltd (Pending)
M47/1622	Leichhardt Salt Pty Ltd (Pending)
L47/1059	Leichhardt Salt Pty Ltd (Pending)
L47/1060	Leichhardt Salt Pty Ltd (Pending)
L47/1061	Leichhardt Salt Pty Ltd (Pending)

PREPARED FOR LEICHHARDT SALT PTY LTD

BY PRESTON CONSULTING PTY LTD

Proponent contact details:

LEICHHARDT SALT PTY LTD

Contact Person: Scott Nicholas– Chief Executive Officer
Email: admin@leic.com.au
Street Address: U7/435 Roberts Rd, Subiaco 6008, Western Australia
Postal Address: U7/435 Roberts Rd, Subiaco 6008, Western Australia

Document developed by:

PRESTON CONSULTING

Contact Person: Gavin Edwards - Director
Email: gedwards@prestonconsulting.com.au
Website: www.prestonconsulting.com.au
Phone: 0488 737 273
Street Address: Level 1, 226 Adelaide Terrace, Perth, Western Australia, 6000
Postal Address: PO Box 3093, East Perth, Western Australia, 6892

Disclaimer

ACKNOWLEDGEMENT OF COUNTRY

In the spirit of reconciliation, Leichhardt Salt Pty Ltd and Preston Consulting Pty Ltd acknowledge the Traditional Owners of the lands on which they work and on which this project resides on, the Whadjuk people of the Noongar Nation and the Mardudhunera people. We pay our respects to Elders past, present and emerging and recognise their continuing connection to land, sea, culture, and community.

DOCUMENT CONTROL

Document Title	Eramurra Solar Salt Project Mine Closure Plan		
Preston Consulting Document Number	LEI-ERA-MCP-02		
Leichhardt Salt Pty Ltd Document Number	ESSP-EN-01-APN-0001		
Revision Number	0		15/04/2025
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Status	FINAL		
Author	Phoebe Ranford - Environmental Consultant, Preston Consulting Pty Ltd		15/04/2025
Checked	Gavin Edwards – Director, Preston Consulting Pty Ltd		15/04/2025
Authorisation	Scott Nicholas– Chief Executive Officer, Leichhardt Salt Pty Ltd		15/04/2025

MINE CLOSURE CHECKLIST AND CORPORATE ENDORSEMENT

Q #	Mine Closure Plan Checklist	Y/ N/ N/A	Page #	Comments
1	Has the Checklist been endorsed by a senior representative within the tenement holder/operating company? (See bottom of checklist.)	Y		Endorsed at the end of this checklist.
PUBLIC AVAILABILITY				
2	Are you aware that from 2015 all MCPs will be made publicly available?	Y		
3	Is there any information in this MCP that should not be publicly available?	Y		The document supports a Mining Lease Application (MLA).
4	If "Yes" to Q3, has confidential information been submitted in a separate document/ section?	N/A		
COVER PAGE, TABLE OF CONTENTS				
5	Does the MCP cover page include: Project Title Company Name Contact Details (including telephone numbers and email addresses) Document identification (ID) and version number Date of submission (needs to match the date of this checklist)	Y		Cover page
SCOPE AND PURPOSE				
6	State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirements)	N/A		Legal requirement as part of MLA
PROJECT OVERVIEW				
7	Does the project summary include: Land ownership details (include any land management agency responsible for the land / reserve and the purpose for which the land/ reserve [including surrounding land] is being managed) Location of the project; Comprehensive site plan(s); Background information on the history and status of the project.	Y	1	
LEGAL OBLIGATIONS AND COMMITMENTS				
8	Does the MCP include a consolidated summary or register of closure obligations and commitments?	Y	23	
STAKEHOLDER ENGAGEMENT				
9	Have all stakeholders involved in closure been identified?	Y	24	
10	Does the MCP include a summary or register of historic stakeholder engagement with details on who has been consulted and the outcomes?	Y	30	
11	Does the MCP include a stakeholder consultation strategy to be implemented in the future?	Y	26	

Q #	Mine Closure Plan Checklist	Y/ N/ N/A	Page #	Comments
POST-MINING LAND USE(S) AND CLOSURE OBJECTIVES				
12	Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram?	Y	129	
13	Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post mining land use (including contaminated sites)?	Y	123, 137	
14	Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to DER as required under the *Contaminated Sites Act 2003*?	N/A		
DEVELOPMENT OF COMPLETION CRITERIA				
15	Does the MCP include an appropriate set of specific completion criteria and closure performance indicators?	Y	139	
COLLECTION AND ANALYSIS OF CLOSURE DATA				
16	Does the MCP include baseline data (including pre-mining studies and environmental data)?	Y	29	
17	Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)?	Y	33	
18	Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?	Y	125	
19	Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)?	Y	131	
20	Does the MCP include information relevant to mine closure for each domain or feature?	Y	145, 150	
IDENTIFICATION AND MANAGEMENT OF CLOSURE ISSUES				
21	Does the MCP include a gap analysis/risk assessment to determine if further information is required in relation to closure of each domain or feature?	Y	131	
22	Does the MCP include the process, methodology, and has the rationale been provided to justify identification and management of the issues?	Y	131	
CLOSURE IMPLEMENTATION				
23	Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site?	Y	143	
24	Does the MCP include a closure work program for each domain or feature?	Y	145	
25	Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations?	Y	6	
26	Does the MCP contain a schedule of research and trial activities?	Y	144	
27	Does the MCP contain a schedule of progressive rehabilitation activities?	Y	144	

Q #	Mine Closure Plan Checklist	Y/ N/ N/A	Page #	Comments
28	Does the MCP include details of how unexpected closure and care and maintenance will be handled?	Y	144	
29	Does the MCP contain a schedule of decommissioning activities?	Y	145	
30	Does the MCP contain a schedule of closure performance monitoring and maintenance activities?	Y	150	
CLOSURE MONITORING AND MAINTENANCE				
31	Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance?	Y	150	
FINANCIAL PROVISIONING FOR CLOSURE				
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	Y	153	
33	Does the MCP include a process for regular review of the financial provision?	Y	153	
MANAGEMENT OF INFORMATION AND DATA				
34	Does the MCP contain a description of management strategies including systems and processes for the retention of mine records?	Y	153	Sect 12

I hereby certify that to the best of my knowledge, the information within this Mine Closure Plan and checklist is true and correct and addresses all the requirements of the Guidelines for the Preparation of a Mine Closure Plan approved by the Director General of the Department of Energy, Mines, Industry Regulation and Safety.

Name: Scott Nicholas

Position: Chief Executive Officer

Signed: **Date**:

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LIST OF FIGURES

LIST OF TABLES

1 PROJECT SUMMARY

Leichhardt Salt Pty Ltd (Leichhardt) seeks to develop the Project, a high-quality salt project in the Pilbara region of Western Australia (WA), approximately 55 kilometres (km) south-west of Karratha (Project) (Figure 1-1).

The Project is an evaporative solar project that utilises seawater to produce raw salts as a feedstock for dedicated processing facilities that will produce a high purity salt. The Project aims for average annual production rates of 5.2 million tonnes per annum (Mtpa). To meet this production, the following infrastructure will be developed:

- Seawater intake, basin and pump station;
- Concentration ponds totalling approximately 10,060 ha;
- Crystallisers, totalling approximately 1,840 ha;
- Drainage channels and bunds;
- Process plant and product dewatering facilities;
- Water supply (desalination plant);
- Bitterns disposal pipeline and outfall;
- Pumps, pipelines, roads, and support buildings including offices and communications facilities;
- Workshops and laydown areas;
- Landfill; and
- Other associated infrastructure.

The export of salt is proposed to be via a trestle jetty. The jetty and associated stockpiles will be located at the Cape Preston East (CPE) Port approved by Ministerial Statement (MS) 949. Dredging of the proposed channel and berth pocket will be undertaken as part of this Project to remove high points at the CPE Port. Dredged material will either be disposed of at an offshore disposal location, or onshore.

Bitterns will be transported by pipeline attached to the trestle jetty structure and discharged via a diffuser located off the trestle jetty.

The Project includes the former Mardie and Karratha part pastoral lease areas that are currently being managed by the Department of Biodiversity, Conservation and Attractions for the control of fire, feral animals and weeds and proposed for formal reservation under the *Conservation and Land Management Act 1984* (CALM Act).

The boundaries of the proposed development envelopes, identified in Figure 1-2, have been adjusted where practicable to avoid and minimise potential environmental impacts relevant to mangroves, algal mats and other sensitive biological receptors.

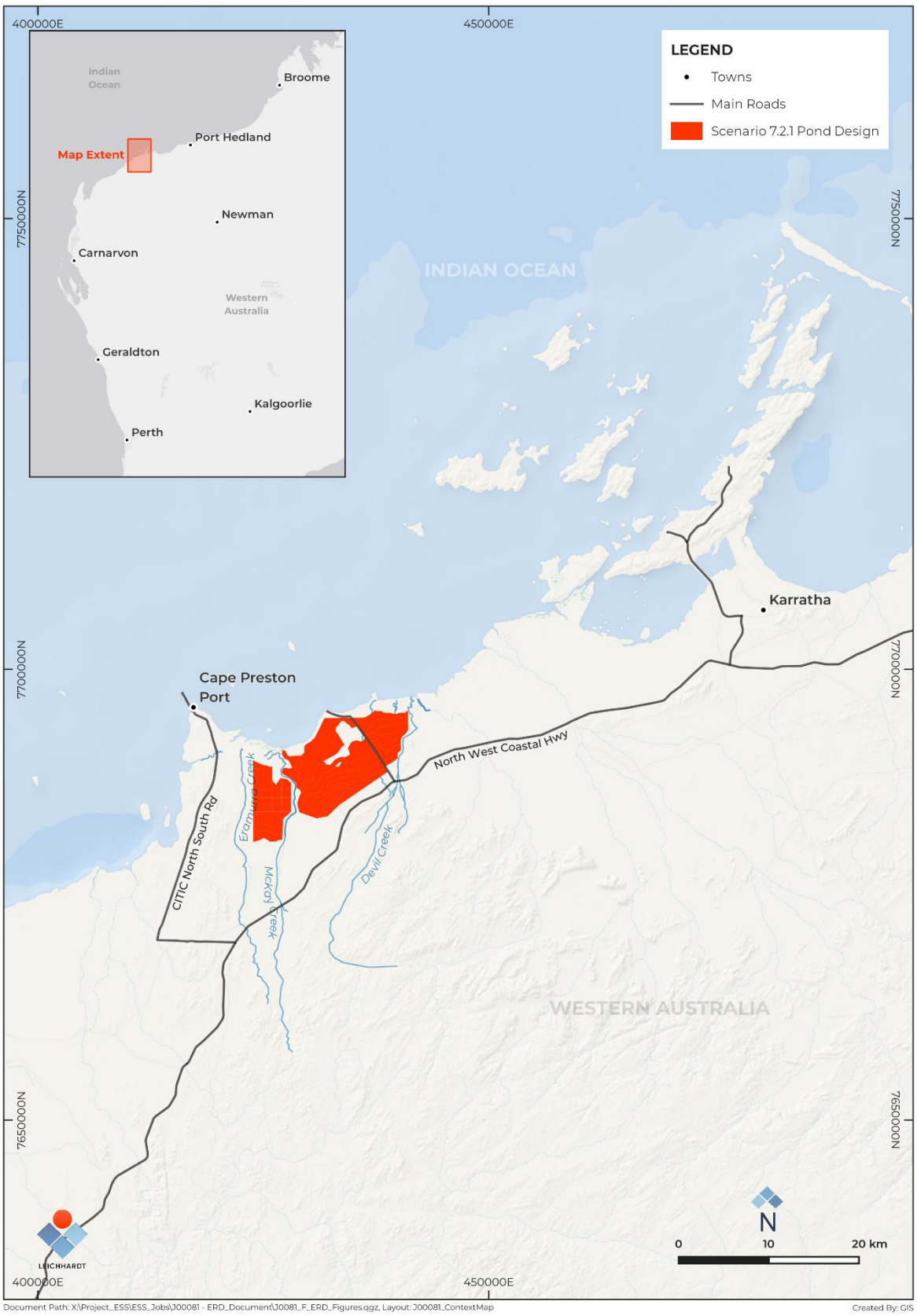


Figure 1-1: Regional location of the Project

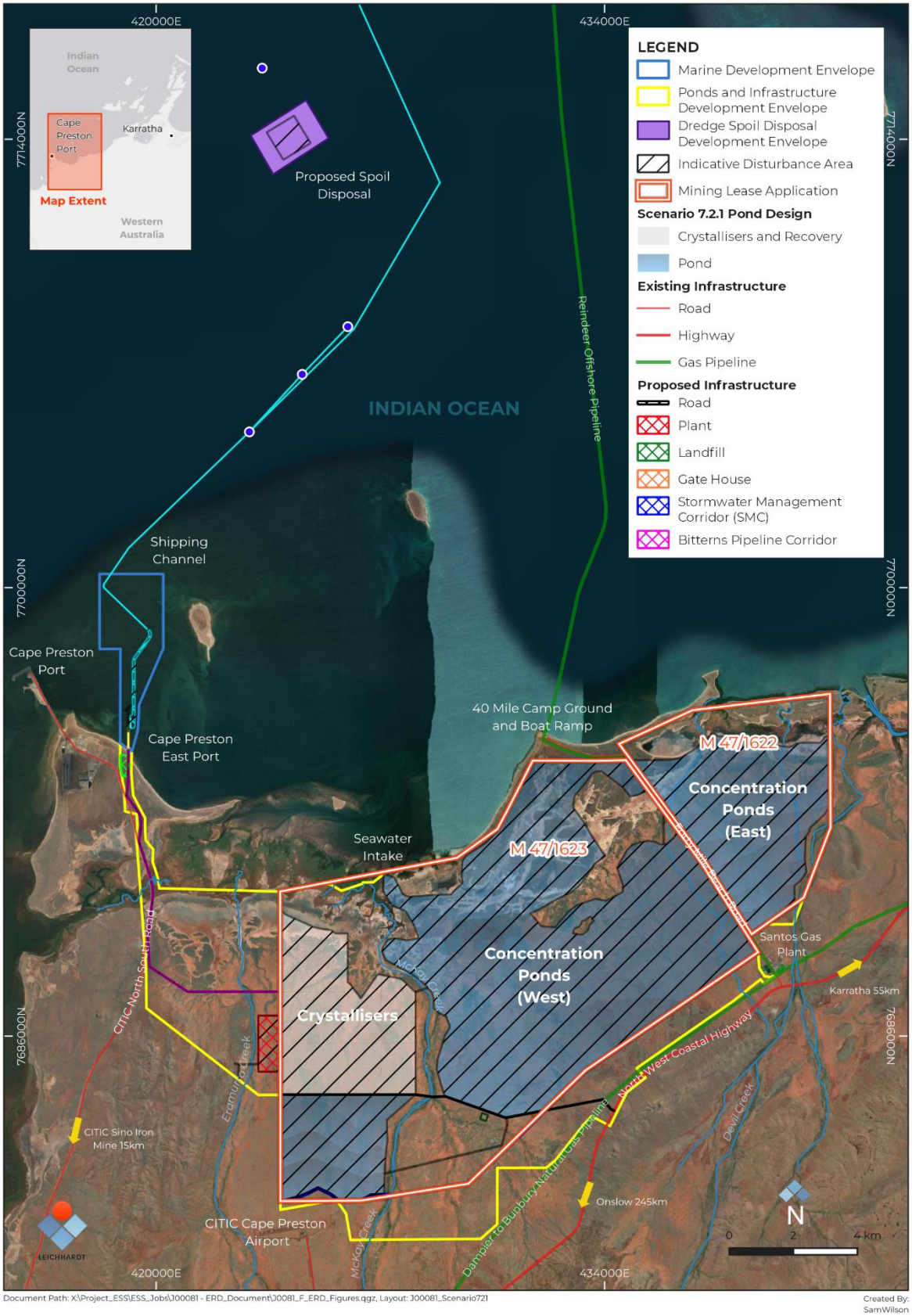


Figure 1-2: Proposed disturbance envelope and indicative layout

1.1 SCOPE

Leichhardt is a wholly owned subsidiary of Leichhardt Industrials Group Pty Ltd (LIG). Leichhardt is an Australian owned company that is planning to develop the Project located in the western Pilbara region of Western Australia (WA), approximately 55 km southwest of Karratha (Figure 1-1). The Mine Closure Plan (MCP) applies to those components of the Project that are located within Mining and General Purpose Lease Applications (MLA) as outlined in Table 1-1 and shown in Figure 1-3, as well as plant and infrastructure connecting the mining operations to the port operations, including salt stockpile areas and bitterns discharge.

Table 1-1: Mining lease applications

Tenement ID	Type	Tenement Status	Tenement Holder
M47/1623	Mining Lease	Pending	Leichhardt Salt Pty Ltd
M47/1622	Mining Lease	Pending	Leichhardt Salt Pty Ltd
L47/1059	General Purpose Lease	Pending	Leichhardt Salt Pty Ltd
L47/1060	General Purpose Lease	Pending	Leichhardt Salt Pty Ltd
L47/1061	General Purpose Lease	Pending	Leichhardt Salt Pty Ltd

This MCP is submitted as part of the requirements of Section 84AA of the *Mining Act 1978* (Mining Act). This version of the MCP has been developed to support the Environmental Review Document (ERD) for the Project and has been prepared in accordance with the Guidelines for the Preparation of a MCP (Department of Mines, Industry Regulation and Safety (DMIRS), 2020a) and submitted in the format proposed under the Statutory Guidelines for Mine Closure Plans in WA (DMIRS, 2020b).

The operation life of the Project has been determined as 60 years, with a four-year construction phase, a maximum project life of 64 years. Decommissioning is determined to constitute five years.

In accordance with the DMIRS (now Department of Energy, Mines, Industry Regulation and Safety (DEMIRS); 2020a) guidelines, the MCP has been established to ensure the Project will meet the following principal closure objectives:

- All disturbed areas should be rehabilitated such that they are rendered physically safe to humans and animals, geotechnically stable, geo-chemically non-polluting/non-contaminating and capable of sustaining an agreed post-mining land use; and
- Premises are decommissioned and rehabilitated in an ecologically sustainable manner.

1.2 PURPOSE

The purpose of the MCP is to provide a strategic plan that will facilitate closure activities throughout the life of the Project. The approach that has been taken includes:

- Identifying those aspects related to decommissioning and closure which may impact on environment, health and safety outcomes and which may be of concern to stakeholders;
- Providing a basis for consultation with identified stakeholders (including regulators) regarding post-mining land use and developing agreed completion criteria;
- Outline objective criteria for measuring closure performance and completion;

- Developing strategies based on site knowledge, industry experience and research which will be implemented during the life of the Project (from the feasibility stage through to post-closure) to minimise impacts and closure requirements;
- When operating, evaluating financial provisions, as accurately as possible, to assess the liabilities associated with closure; and
- Outlining processes required for closure rehabilitation monitoring, the maintenance of data and the ability to report progress towards completion criteria.

The MCP describes the long-term elements of the mine planning cycle and the relationship to shorter term, responsive operational needs, as well as dealing with project and environmental uncertainties. The MCP follows an approach of structured adaptive management, from a strong information and performance baseline, with an emphasis on continual improvement.

This MCP is limited to the infrastructure associated with the parts of the operation that have not been previously approved under third party *Environmental Protection Act 1986* approvals. Such infrastructure excluded from this MCP includes infrastructure and roads on Port land, trestle jetty export facility and the transhipment channel (Figure 1-3).

The key initial mine closure activities are likely to include:

- Removal of redundant pumping and pipeline infrastructure (including bitterns discharge pipeline where above ground), seawater intake, and constructed surface water management infrastructure;
- Decommissioning the crystalliser ponds including removing the crystallised (sodium salts) salt floor, then flattening or opening up external walls to restore water movement across the landscape;
- Stabilising any unstable landforms for closure;
- Investigate and remediate sources of contamination;
- Rehabilitate access road (if not required by other parties); and
- Remove residual infrastructure to leave no safety hazards if not retained by Mardie Station or Pilbara Ports Authority (PPA).

1.3 LAND OWNERSHIP

The Cape Preston East port facility will be used for the export of salt. This facility, run by the Pilbara Port Authority, is already approved under the EP Act (Ministerial Statement 949 and 1149).

Leichhardt is the current registered applicant of all Project tenements for the creation and processing of salt. The mining operations and processing infrastructure for the Project will lie within the boundaries of Leichhardt's pending leases, M47/1622, M47/1623, L47/1059, L47/1060 and L47/1061.

The haul road for salt for stockpiling and shipping at the Cape Preston East port as well as the bitterns discharge pipeline, wash plant and associated non-process infrastructure (NPI), will access tenure owned by Pilbara Port Authority under agreement (Figure 1-4).

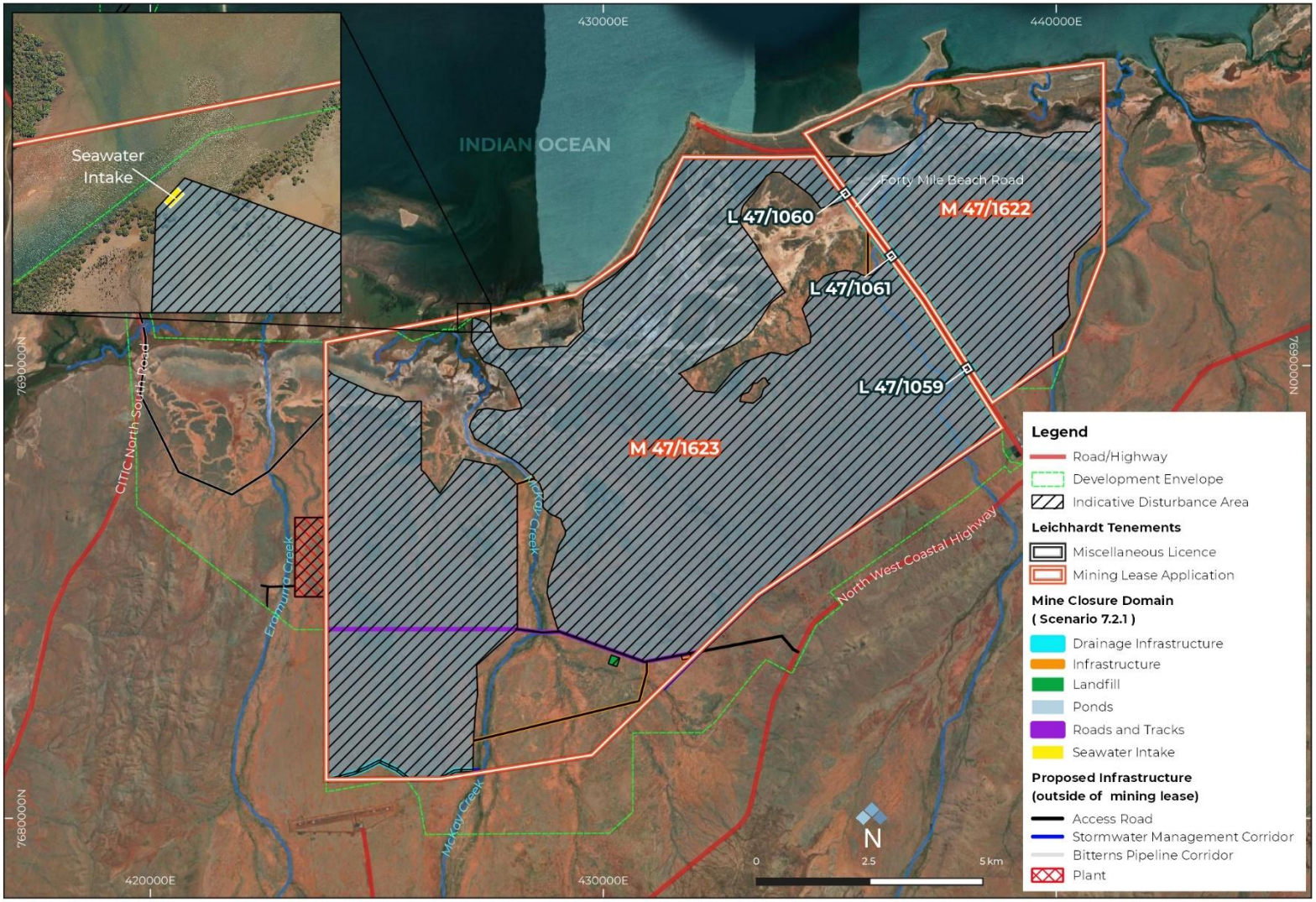


Figure 1-3: Mining lease applications and closure domains

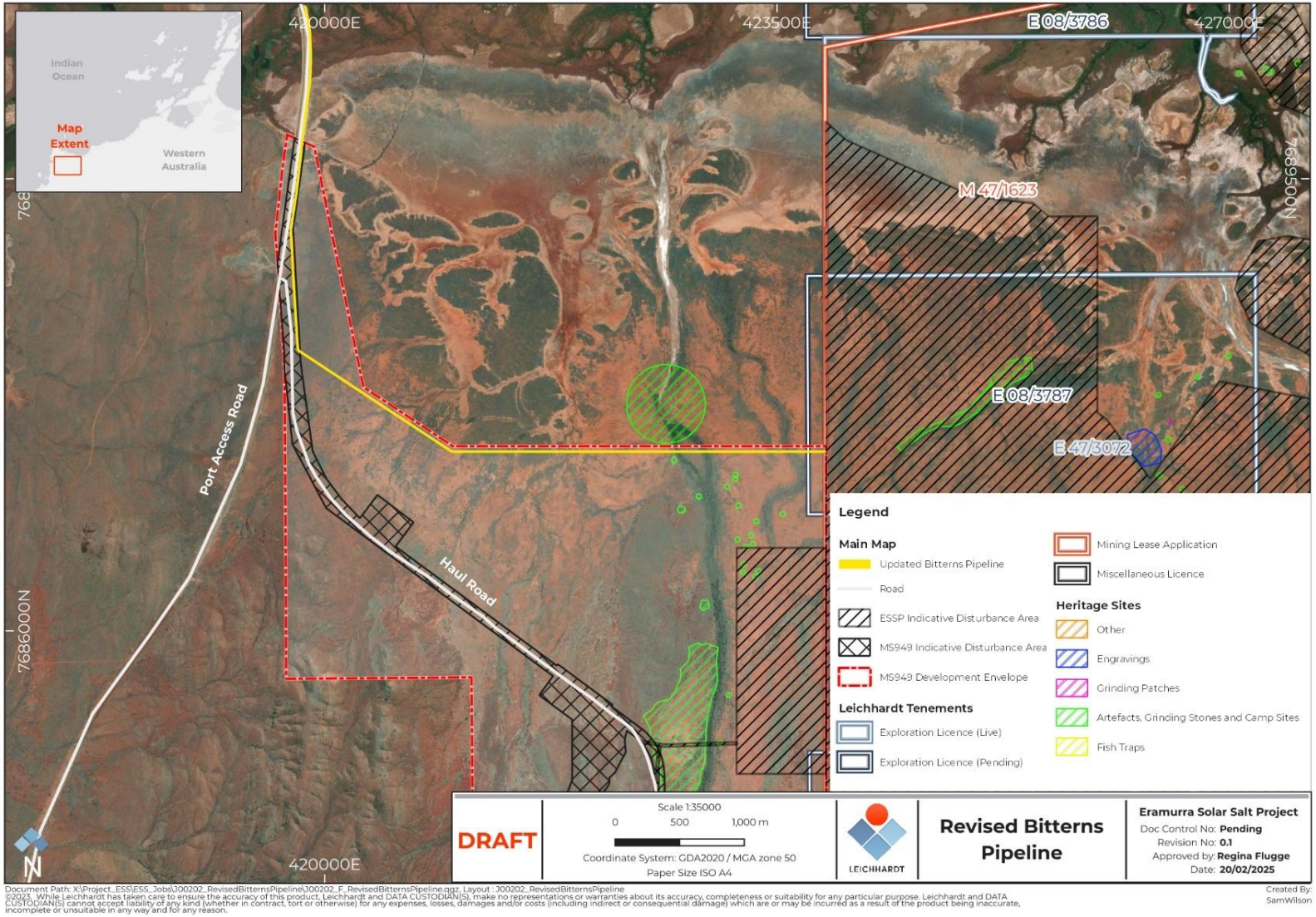


Figure 1-4: Bitterns discharge pipeline route and port haul road

1.4 PROJECT DESCRIPTION

The following sections contain information relevant to closure of the Project. A description of operational activities is provided in the Mining Proposal.

1.4.1 SEAWATER INTAKE

The seawater intake will feed the concentration ponds and wash water for the wash plant and feed to the desalination plant. Figure 1-5 and Figure 1-6 illustrate the proposed intake design and cross-section.

The proposed intake is in a tidal zone just east of McKay Creek (Figure 1-2). The design concept utilises multiple axial flow pumps housed within a screened enclosure to abstract water from a sump, which draws from the mouth of McKay Creek. It discharges through the embankment wall to concrete risers inside the concentration pond. The concrete risers are used to avoid scouring the pond floor, and prevent backflow when pumps are stopped.

1.4.2 CONCENTRATION PONDS AND CRYSTALLISERS

The layout of the concentration ponds has been determined by the Project design requirements, including the existing topography, geotechnical, hydraulic environmental and heritage conditions, and the position of existing infrastructure (Figure 1-7).

To achieve 5.2 Mtpa production, a total area of 11,900 ha will be developed into evaporation ponds. Approximately 10,000 ha of the area will serve as concentration ponds and 1,900 ha as crystallisers (Figure 1-7).

The intention is to locate the wash plant and associated non-process infrastructure within the PPA Lease, west of the Project mining lease area.

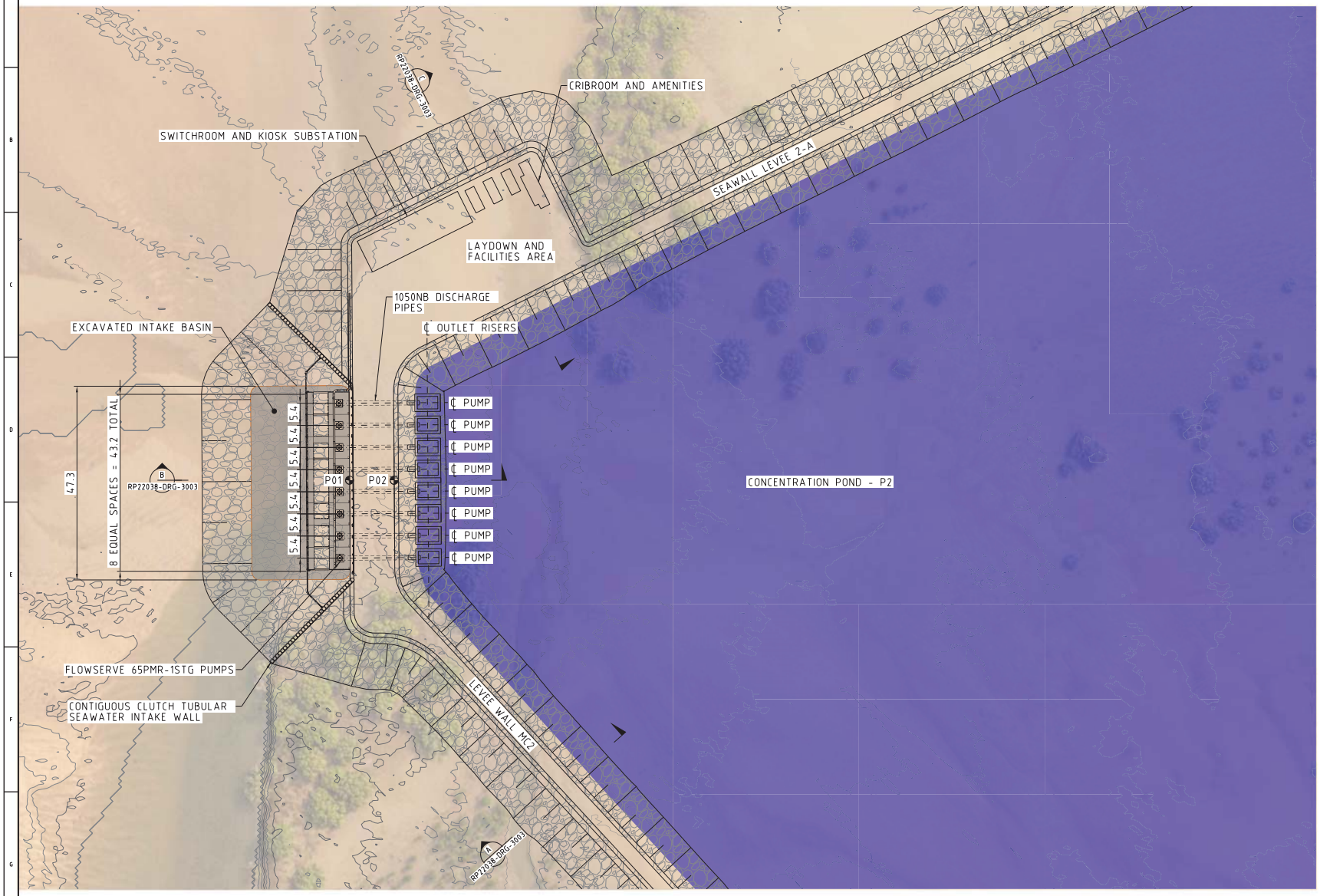


Figure 1-5: Seawater intake pump station design

PLAN
SCALE 1:500

NOTES:

1. ALL CO-ORDINATES ARE IN METRES TO MGA 2020 ZONE 50.
2. ALL ONSHORE LEVELS ARE IN METRES TO AHD.
3. ALL DIMENSIONS ARE IN METRES U.N.O.
4. CONCENTRATION POND BRINE LEVELS BASED UPON LEICHHARDT PROCESS DESIGN VERSION 6.2 - APRIL 2022.

POND	BRINE LEVEL (m)	DENSITY (kg/m³)
P2	4.0	1.034

5. SEAWATER PUMP STATION DESIGNED FOR LEICHHARDT MASS BALANCE WITH AVERAGE ANNUAL INTAKE OF 263 GL/YEAR.

LEGEND:

- MINOR CONTOUR (0.2m INTERVAL)
- MAJOR CONTOUR (0.6m INTERVAL)
- P01 SETOUT POINT
- BATTER
- CONCENTRATION PONDS
- ROCK ARMOUR

SETOUT TABLE		
POINT	NORTHING	EASTING
P01	7691041.474	427118.249
P02	7691033.820	427126.009

PRELIMINARY
NOT FOR CONSTRUCTION

10 0 10 20 30 40 50
SCALE OF METRES 1:500

DRAWING NUMBER	REFERENCE DRAWING TITLE	REV	DATE	DESCRIPTION	DRN	CHK	APP
		A	09.06.22	ISSUED FOR CLIENT REVIEW	GVD	JH	

LEICHHARDT

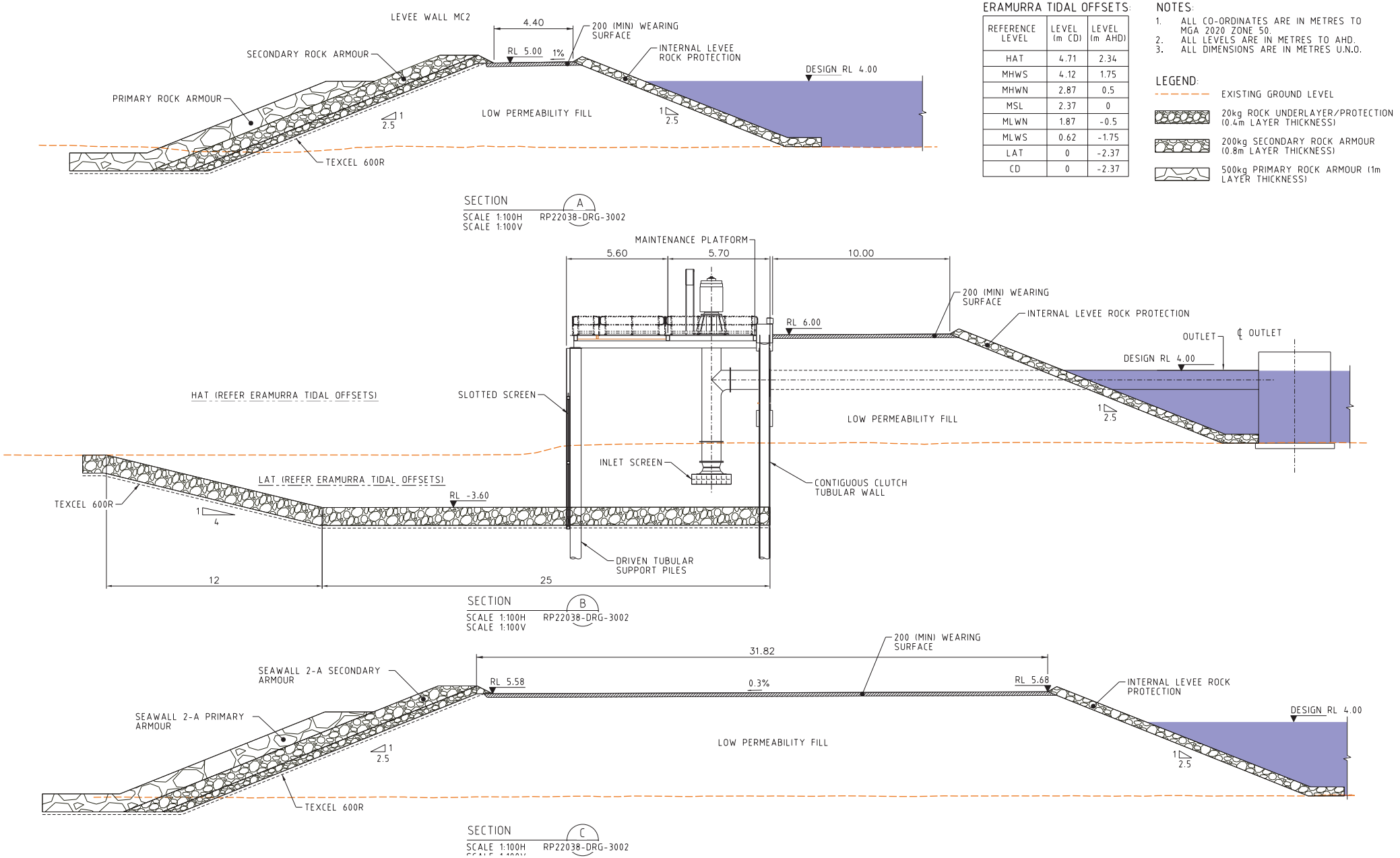
BG&E Resources

DESIGNED	GVD
DRAWN	JB
CHECKED	JH
APPROVED	
APPROVED DATE	
DATUM	

PROJECT NUMBER
RP22038

ERAMURRA SOLAR SALT PROJECT
TRADE OFF STUDIES
SEAWATER INTAKE PUMP STATION PS-01
GENERAL ARRANGEMENT - PLAN

A1	SCALE 1:500	DRG No: RP22038-DRG-3002	REV: A



ERAMURRA TIDAL OFFSETS:

REFERENCE LEVEL	LEVEL (m CD)	LEVEL (m AHD)
HAT	4.71	2.34
MHWS	4.12	1.75
MHWN	2.87	0.5
MSL	2.37	0
MLWN	1.87	-0.5
MLWS	0.62	-1.75
LAT	0	-2.37
CD	0	-2.37

NOTES:
1. ALL CO-ORDINATES ARE IN METRES TO MGA 2020 ZONE 50.
2. ALL LEVELS ARE IN METRES TO AHD.
3. ALL DIMENSIONS ARE IN METRES U.N.O.

LEGEND:
- EXISTING GROUND LEVEL
- 20kg ROCK UNDERLAYER/PROTECTION (0.4m LAYER THICKNESS)
- 200kg SECONDARY ROCK ARMOUR (0.8m LAYER THICKNESS)
- 500kg PRIMARY ROCK ARMOUR (1m LAYER THICKNESS)

Figure 1-6: Seawater intake pump station design cross section

PRELIMINARY
NOT FOR CONSTRUCTION

SCALE OF METRES 1:100

DRAWING NUMBER	REFERENCE DRAWING TITLE	REV	DATE	DESCRIPTION	DRN	CHK	APP
		A	09.06.22	ISSUED FOR CLIENT REVIEW	GVD	JH	

LEICHHARDT

BG&E Resources

DESIGNED	GVD	PROJECT NUMBER
DRAWN	JB	RP22038
CHECKED	JH	
APPROVED		
APPROVED DATE		
DATUM		

ERAMURRA SOLAR SALT PROJECT
TRADE OFF STUDIES
SEAWATER INTAKE PUMP STATION PS-01
CROSS SECTIONS

A1 | SCALE 1:100 | DRG No: RP22038-DRG-3003 | REV: A

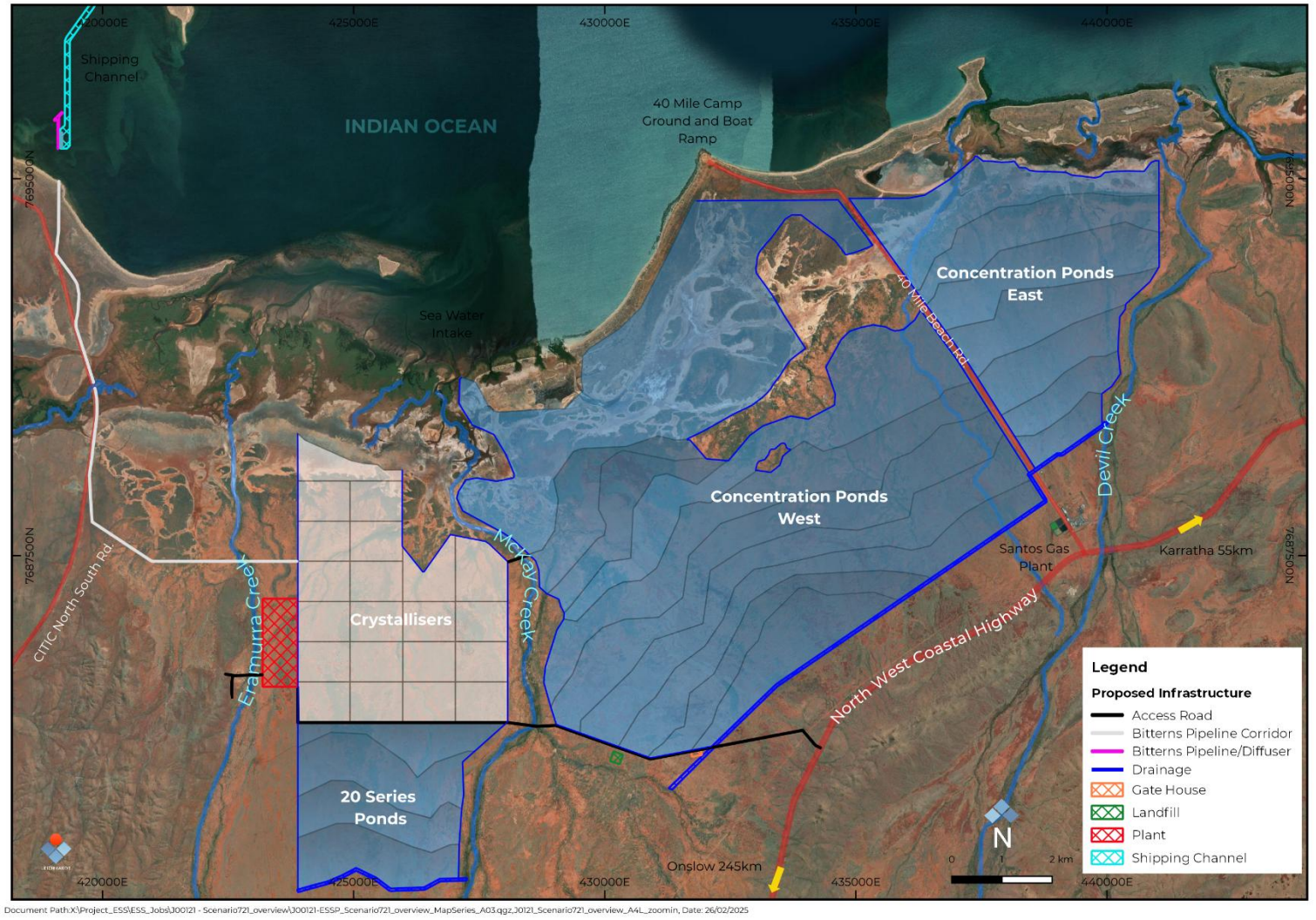


Figure 1-7: Pond layout and configuration

1.4.3 EMBANKMENT DESIGN

The primary purpose of the embankments is to contain the brine within the concentration ponds and crystallisers. To achieve this, the core of the embankment will be constructed from locally sourced, low permeability clay and soils. This will be contiguous and (if necessary) keyed with the floor of the pond. Figure 1-8 provides a general illustration of typical embankment sections.

The top of some embankments will be used as roads to access weirs and valves which regulate flow between the ponds. Maintenance personnel will use these roads to conduct inspections and maintenance of the rock armour. On the seawalls, the width of the road will be sufficient to accommodate light vehicles, light trucks and cranage for placement of large armour rock. In the crystalliser area roads are more generous to facilitate the large trucks used for salt haulage.

The height of the internal embankments will be set by the required pond depth, adjusted to account for significant rainfall events and wind set up and fetch within the concentration ponds. The preliminary design has a nominal 700 mm freeboard between the brine level and the top of embankment. The sections with direct coastal exposure will be rock armoured to protect against erosion. The height of the external sea wall at the northern boundary of the site will be 5.0 m Australian Height Datum (AHD) or higher, which exceeds the storm surge level of a one in 100-year storm event.

Further inland, the walls will be constructed to limit permeability between adjacent ponds. The southern boundary of the ponds will generally follow natural topography. Minor bunds will be provided to contain brine, and external channels will divert external runoff from storm events. Some of the embankments on low-lying areas will be constructed on clay which compresses under load. Provision will be made for settlement, in accordance with recommendations by the geotechnical consultant.

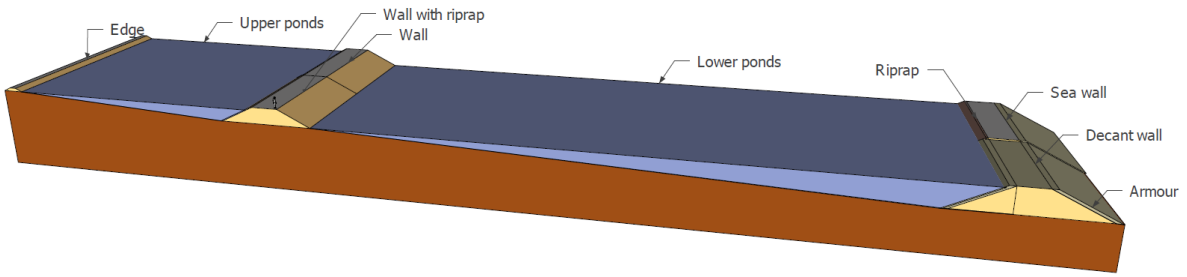


Figure 1-8: Typical embankment sections

1.4.4 Bitterns

Bitterns recovery ponds and some bitterns management infrastructure (pipework) will be located on Mining Act tenure.

1.4.5 Pumps and Pipes

A network of polyethylene pipes will be used to transport brine to ponds, between ponds, and to the process plant. Brine pipelines will utilise industry-standard materials to minimise the chance of leaks and will be fitted with leak detection if they leave the process area. Most transfers are internal to the development footprint (i.e., spillage will report to ponds) and will not require spill protection. Spill protection will be provided at the gas pipeline crossing as agreed with Santos.

Power for pumps will initially come from local diesel generators and/or reticulated power. Hybrid renewable energy will be developed for the ongoing operation.

1.4.6 Surface Water Drainage and Diversion

Surface Water Solutions (SWS) undertook a hydrologic assessment of the Project and modelled storm surge and potential flood flows from inland catchments (2025). O2 Metocean (a subsidiary of O2 Marine) developed a tidal inundation model of the Project (2023) and provided an assessment of sedimentation rates in the intertidal area downstream of the ponds and the consequent impact on Benthic Communities and Habitat (BCH). Information from these studies can be found in Section 4.6.

O2 Metocean (2023) simulated flow patterns of tidal inundations. The simulation period (24 March – 8 April 2021) encompassing some of the largest tidal ranges (in the measured data) was developed to allow for the comparison of tidal inundation processes during the full range of tides experienced at the site. The period was adopted for the inundation simulations based upon the availability of high-quality validation data concurrently gathered at oceanographic data collection sites (UNS05, NCP05 and ERA05) and creeks (STR02, and SIC02)

Flow patterns under cyclonic conditions were also simulated and main channels identified for typical tidal astronomical range near Cape Preston. SWS (2025) analysed available data to calculate storm surge and extreme water levels for the Project. The outcomes from that study indicated the following return period guidance:

- 100-year still water sea level is on average 3.19 m above MSL; and
- 10-year sea level is on average 2.69 m above MSL.

Several creeks and drainage features flow through the Project area. To protect the salt ponds and other project infrastructure, and to ensure impacts on mangroves, algal mats and fringing riparian vegetation are minimised, the Project design will incorporate drainage channels and stormwater diversion systems to mitigate obstructions by the mine infrastructure to inland drainage. The stormwater system is designed so that the water is diverted east/west of the operations.

Drainage and diversion structure design has been substantially finalised and there shall be no channels routed through ponds.

Drainage

The Project includes a number of levees, channels and culverts designed to ensure catchment flows are managed. These works will prevent extreme flows resulting from tropical cyclones and storms from flooding into the salt ponds or causing damage to pond walls and other Project infrastructure.

Flood control diversions are established within the Devil Creek and McKay Creek catchments. No overland flows will be directed down the Reindeer gas pipeline corridor, to ensure the integrity of the pipeline.

Any drainage control structures will be designed with key stakeholders to accommodate agreed Annual Exceedance Probability (AEP) values, and may consist of the following:

- Armoured bunding along either side of the McKay Creek watercourse where it abuts the ponds; and
- Diversion channels along the southern edge of the ponds, westward into McKay Creek and eastward into Devil Creek.

A floodway will be installed for the site access road where it crosses McKay Creek. The floodway will pass up to a 10% AEP flood event underneath the road through culverts.

Post-Development Hydraulic Model

Leichhardt's planned post-mining land use is to reinstate the pre-mining land use. This includes pastoral, customary and recreational activities. Surface hydrology general flow patterns will restore surface water flows to and from the marine environment to achieve the planned post-mining land use. Modelling will be undertaken pre-closure to identify measures that will return the Project site functionally to pre-development drainage conditions.

1.4.7 NON-PROCESS INFRASTRUCTURE

The following NPI will be installed:

- Access road from North West Coastal Highway (NWCH);
- Product haulage road to the Cape Preston access road;
- Emergency response and training centre;
- Administration building (not included in MCP);
- Workshop and store facilities;
- Vehicle washdown facility with an oil/water separation facility;
- Amenities, crib and pre-start buildings;
- "Go-line" area for the large mobile plant;
- Helicopter landing area for emergency evacuations;
- Diesel fuel storage and dispensing area;
- Port area diesel fuel storage and dispensing, including Trans-Shipment Vessel (TSV) fuelling;
- Laboratory facilities;
- Sewage treatment facilities at hub;
- Power generation and distribution facilities;
- Potable water supply from on-site desalination plant;
- Communication facilities;

- Layout, pedestrian ways and parking provisions; and
- Borrow pits and material stockpiles for civil repairs.

Leichhardt Access Road

A site access road is required from Karratha via the Great Northern Coastal Highway to facilitate construction of the site and to provide ongoing access to the site for operations and maintenance.

Haul and Service Roads

There will be heavy vehicle haul roads from the crystallisers to the wash plant. Other roads will be a minimum of 4 m lane width for one-way traffic.

Workshop and Store Facilities

A workshop and vehicle parking area will be constructed in the vicinity of the wash plant site. Based on the preliminary study, the workshop area may include the following amenities:

- Heavy vehicle maintenance workshop for the servicing of salt harvest, load and haul vehicles;
- Light vehicle maintenance for repairs of all light vehicles (servicing likely within Karratha);
- General maintenance workshop for the maintenance of installed equipment (i.e. pumps, drives, valves, etc.);
- Electrical and instruments workshop;
- Washdown facilities for light and heavy vehicles;
- Oil separation facility to remove washdown water from all maintenance workshops and to separate and store oil for disposal offsite;
- Enclosed storage facility for spare parts; and
- Uncovered storage area.

Electrical Power Supply

Power for the salt production facilities will commence with diesel powered generators and is intended to ultimately be generated in a hybrid power station with both Liquefied Natural Gas (LNG) generating engines and a solar farm area.

Re-fuelling Facilities

For Project operation, diesel fuel storage and dispensing facilities will be provided at the salt hub and port to service the respective mobile equipment.

Laboratory

A chemical and biological laboratory will be supplied to enable adequate monitoring of the salt production process.

Potable Water

A packaged desalination plant at the production hub will utilise seawater to produce potable water with brine returned to the salt process.

Groundwater abstraction is not proposed as part of this Project.

1.5 APPROVALS AND AGREEMENTS

1.5.1 PART IV OF THE *ENVIRONMENTAL PROTECTION ACT 1986*

The Project is currently undergoing environmental impact assessment under Part IV of the EP Act and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). The Project was referred under Section 38 of the EP Act on 28 June 2020. The Environmental Protection Authority (EPA) released its decision to assess the Project as a Public Environmental Review (s. 40(2) (b) and s. 40(4)) on 6 September 2021. A proponent-prepared Environmental Scoping Document (ESD) was then submitted to the EPA and formally approved on 22 December 2022. An application to amend the Project was approved under Section 43A of the EP Act in June 2023. An ERD has been prepared to align with the scope of the amended Project.

1.5.2 PART V OF THE *ENVIRONMENTAL PROTECTION ACT 1986*

At a suitable juncture, Leichhardt will then apply for several secondary approvals, such as a Works Approval and Licence under Part V of the EP Act, however these approvals will not be in place during the closure phase.

1.5.3 SECTION 87 OF THE *ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999*

The Project was referred to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) on 13 September 2021 (EPBC 2021/9027). DCCEEW determined that the Project was a 'controlled action' and required assessment and approval under the EPBC Act, due to the potential impacts on the following relevant controlling provisions:

- Listed threatened species and communities (sections 18 & 18A);
- Listed migratory species (sections 20 & 20A); and
- Commonwealth marine areas (sections 23 & 24A).

DCCEEW provided comment and input into the content of the ESD.

The Project will be assessed as an 'accredited assessment' under Part IV of the EP Act. Section 87 of the EPBC Act makes provisions for the EPA to undertake this accredited assessment of the potential impacts to Matters of National Environmental Significance (MNES) on behalf of DCCEEW.

An application to amend the Project was approved under Section 156A of the EPBC Act in July 2023.

1.5.4 ABORIGINAL HERITAGE AND CULTURAL VALUES

Native Title/Traditional Owners

Native Title rights and interests comprise either the exclusive right to possession, occupation, use and enjoyment of the relevant land or a set of non-exclusive rights which include, among others, the right to maintain and protect places of significance.

The Mardudhunera People are the Traditional Owners and determined Native Title holders for the land that underlies the Project. The Native Title Determination Area covers an area of 9,927 km² (Figure 1-9). The Wirrawandi Aboriginal Corporation Registered Native Title Bodies Corporate (WAC, RNTBC) is the registered prescribed body corporate that holds on trust the Native Title rights and interests for the Mardudhunera People. The Project is located 55 km west of Karratha, which is where many of the Traditional Owners currently reside.

Aboriginal Heritage

The Aboriginal Heritage values within the development envelopes have been identified through cultural heritage surveys with Mardudhunera People and ongoing consultation with the WAC. Approximately 15,500 ha (almost all of the development envelopes), has been surveyed for previously unknown and unrecorded Aboriginal Heritage sites and other areas of potential cultural interest (Figure 1-10). Leichhardt has agreed with WAC to survey the unsurveyed areas prior to any development. This commitment is contained within the Social, Cultural Heritage Management Plan (SCHMP). The extensive heritage survey work has allowed Leichhardt to gain a thorough understanding of the cultural landscape, Aboriginal Heritage sites and their importance to the Traditional Owners.

Prior to the completion of the cultural heritage surveys, Leichhardt commissioned a desktop study from Horizon Heritage Management, WAC's heritage consultant (2018). The key finding of this report was that there had been no Aboriginal Heritage surveys previously undertaken within the Survey Area, which is generally aligned with the boundaries of the Ponds and Infrastructure Development Envelope (PIDE). One registered site, Noorea Soak (ID 11871), was identified within the Survey Area through the Aboriginal Heritage Inquiry System (AHIS). This site was recorded in 1975 as a freshwater soak with an engraving. The six other sites listed on the AHIS within the Survey Area have either been assessed by the Aboriginal Cultural Material Committee as being sites to which section 5 of the *Aboriginal Heritage Act 1972* (AH Act) does not apply, or the sites are in fact outside of the Survey Area.

Eight surveys were conducted over 58 survey days between September 2021 and September 2023, with 76 Mardudhunera People participating in the surveys. A total of 304 new Aboriginal sites were identified. A breakdown of the site types is provided in Table 1-2and depicted in Figure 1-11.

Table 1-2: Newly recorded site types in the Survey Areas

Site Type	Number recorded	Percentage (%) of total
Grinding Patches	80	27
Artefacts inc. Quarries and Camps	188	62
Rock Engravings	22	7
Fish Traps	7	2
Stone Arrangements	4	1
Freshwater Soaks	1	<1
Mythological (Water Pool)	2	<1
Total	**304**	**100**

The key finding from the surveys is that there are pockets of land in the Survey Areas rich in Aboriginal cultural heritage sites and areas of cultural interest. The Mardudhunera People have noted that the area within the Survey Areas used to be a 'food bowl' due to the proximity to the ocean, rich in food types and close to freshwater creeks. The granite and dolerite rock outcrops that occur throughout the Survey Areas have been used for grinding seeds and carving rock engravings. Some of the engraving figures depict domestic messages such as the presence of native fauna and some engravings have been described by the Mardudhunera People during the surveys as depicting ceremonies. The Mardudhunera People attribute a particular significance to these types of rock engravings and have requested that Leichhardt avoid these places and ensure access is maintained.

The predominant site type present in the Survey Areas is artefact/camp/grinding stones sites representing 188 sites (62% of the total). These sites include portable grinding stones, artefact scatters, quarries, and camping areas. The grinding patch sites have also been found in high numbers accounting for 80 sites (27%). These sites are found on the large dolerite rock outcrops and granite domes.

It should be noted that many sites contain more than one cultural feature. For example, many of the grinding sites also included artefacts. The large grinding sites are in proximity to the several freshwater creeks including Eramurra Creek, McKay Creek and Devil Creek. These creeks feed numerous ephemeral creek lines throughout the PIDE. These environmental factors created a bountiful food production area during the wet season when water and native grass seed were available. The area of land is also a transitional zone between the inland hills and the coastal zone. The presence of the large number of grinding sites indicates the intensive use of the area by generations of Mardudhunera People.

There are 22 new rock engraving sites that have been identified in the Survey Areas representing 7% of the new sites recorded. The engravings feature both religious depictions of Aboriginal culture and more mundane motifs indicating the presence of animals. Most of the rock engravings are situated on large rock outcrops. The rock engravings were assessed by the Mardudhunera People and WAC as being highly significant in Aboriginal tradition.

Fish traps and stone arrangements were identified during the heritage surveys in the coastal tidal flats. These cultural features are considered rare and highly significant by the Mardudhunera People. The Mardudhunera People requested that these features be preserved for future generations.

Devil's Pool was identified as a mythological place associated with a Dreamtime story. The pool is significant because of these mythical associations and WAC has requested that the pool remain undisturbed, and access maintained.

The numerous artefact sites including camps and quarries confirms the intensive use of the area by generations of Aboriginal people. The cultural features of these sites range from a few artefacts in a location to hundreds of artefacts indicating intensive quarrying of suitable stone resources for different purposes.

Engagement with the Mardudhunera People

Leichhardt finalised the negotiation of a Heritage Protection Agreement with the determined native title holders the Mardudhunera People through WAC in May 2021 and a SCHMP in April 2023.

Leichhardt is finalising a Land Access Agreement for the Project which Leichhardt has been negotiating with WAC since 2019. The agreement sets out Leichhardt's obligations in relation to the identification, protection, and management of the social environment where the Project is located. These obligations require Leichhardt to conduct its operations in a way that avoids or minimises disturbance to cultural values and respects Mardudhunera cultural heritage.

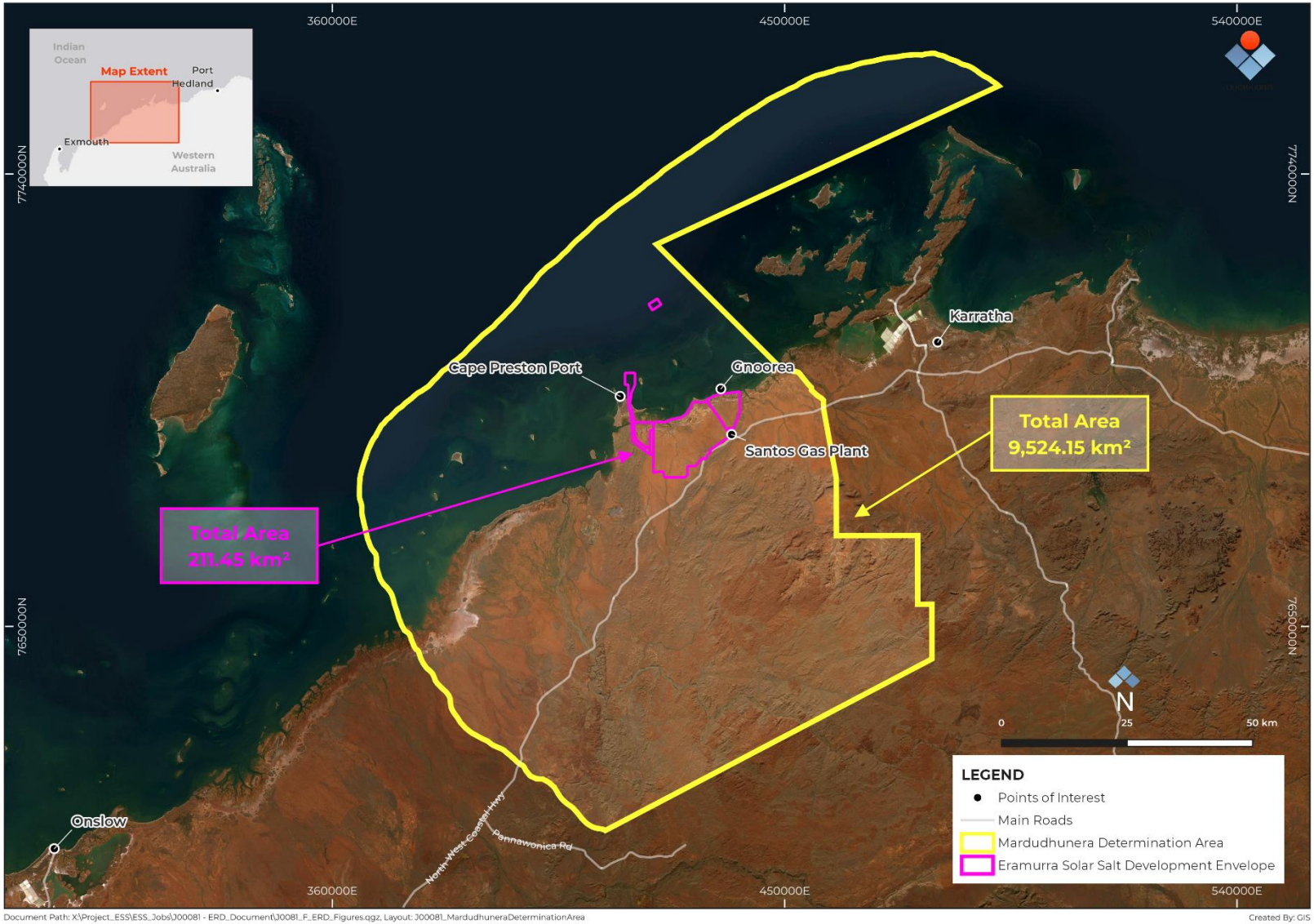


Figure 1-9: Mardudhunera Native Title Area and Leichhardt Project Area

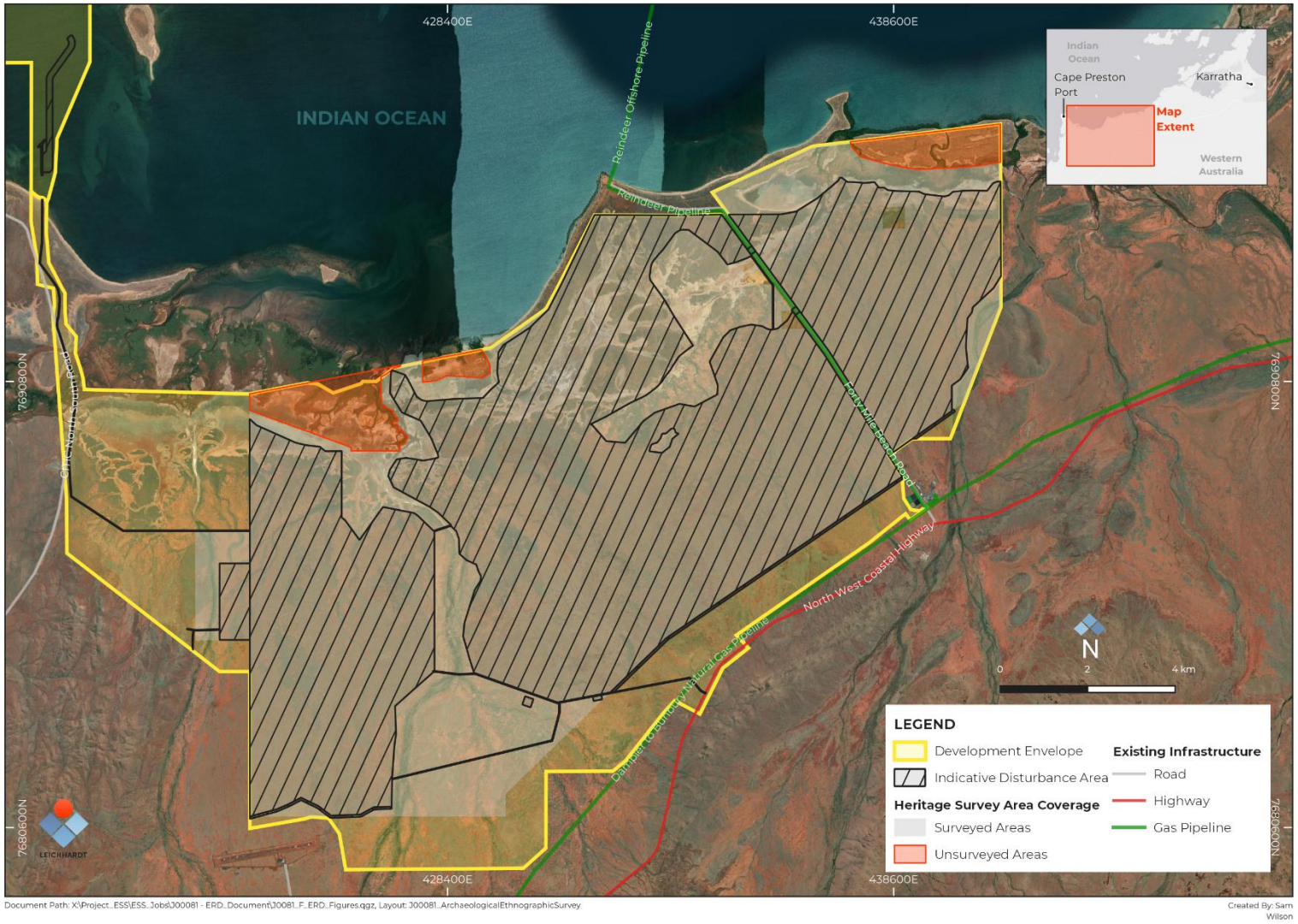


Figure 1-10: Archaeological and ethnographic survey coverage

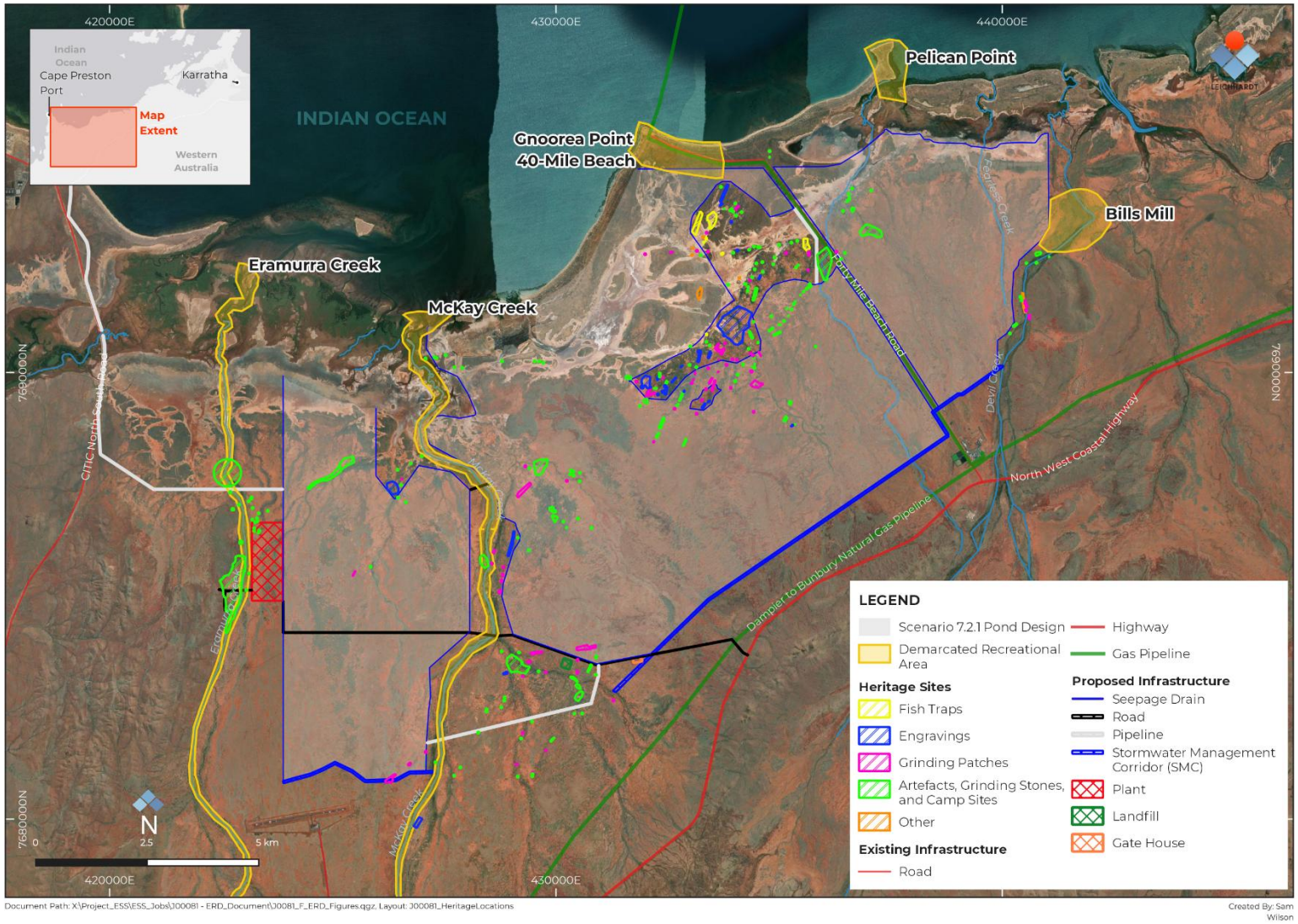


Figure 1-11: Recorded sites in survey areas

2 IDENTIFICATION OF CLOSURE OBLIGATIONS AND COMMITMENTS

Leichhardt recognises its legal responsibilities as described in statutory documentation, including regulations generally applicable to closure of the Project. Leichhardt currently has two mining lease applications pending and as a result, there are no current legal obligations relevant to closure of the Project (Table 2-1. M47/1622 and M47/1623 will have conditions, and as approvals are lodged, tenement conditions will be updated to include new conditions under the Mining Act.

Closure obligations may also be imposed on the Project from other approvals that have not yet been initiated. These will be included as the operations are planned and approved. Potential sources of closure related obligations include:

- Native Title Agreement(s);
- Agreements with underlying or adjacent tenure holders (e.g., Local Government, Santos, MRWA);
- Approval conditions (EP Act, EPBC Act);
- *Contaminated Sites Act 2003* (CS Act); and
- Lease or Licence conditions associated with non-Mining Act tenure.

Table 2-1: Legal compliance register

Relevant DEMIRS Tenement Condition		
Tenement	**Condition No.**	**Closure Conditions**
M47/1622	N/A	Mining lease currently pending.
M47/1623	N/A	Mining lease currently pending.
Ministerial Statement		
Condition	**Date**	**Closure Condition**
-	N/A	MS not yet granted
EP Act Part V Works Approval		
Condition	**Aspect related to closure**	
-	Licence not yet granted	
EP Act Part V Licence		
Condition	**Aspect related to closure**	
-	Licences not yet issued	
Mining Proposal		
Section No.	Closure commitment	
-	Mining Proposal not yet submitted and approved	

3 STAKEHOLDER ENGAGEMENT

3.1 DEVELOPING A STAKEHOLDER ENGAGEMENT STRATEGY

The primary objectives of the Project Stakeholder Engagement Strategy adopted are to identify relevant external stakeholders during the early stages of the Project, engage with them to determine their concerns, identify appropriate mitigation strategies, and determine mutually acceptable environmental outcomes. Stakeholder feedback has been considered in the development of the Project Risk Register.

Leichhardt developed the Project Stakeholder Engagement Strategy by identifying environmental receptors potentially interacting with the Project. Individuals, organisations and other parties that may value the qualities of those receptors and be affected by impacts on those receptors were then designated as potential stakeholders. Engagement processes are inclusive, and as potential stakeholders are identified, processes will be applied according to the nature of the stakeholder and the degree to which they would likely be affected by the Project.

The objective of Leichhardt's engagement strategy is to give stakeholders the opportunity to engage, through an iterative process, in the development of environmental outcomes to ensure the identified environmental receptors are protected. Leichhardt's stakeholder engagement strategy has been prepared, resourced and implemented such that all stakeholders have been identified and are being effectively engaged.

3.1.1 PRINCIPLES OF STAKEHOLDER ENGAGEMENT

Leichhardt aims to at all times be a 'good neighbour', including open, positive and respectful relationships with its neighbours. The principles of stakeholder engagement described by the Ministerial Council on Mineral and Petroleum Resources (2005) to formulate and implement a stakeholder engagement strategy have been adopted by Leichhardt, as recommended by DMIRS (2020b):

- Communication: Communication must be open, accessible, clearly defined, two-way and appropriate;
- Transparency: The process and outcomes of community and stakeholder engagement should, wherever possible, be made open and transparent, agreed upon and documented;
- Collaboration: A co-operative and collaborative approach to seek mutually-beneficial outcomes is considered key to effective engagement;
- Inclusiveness: Inclusiveness involves identifying and involving communities and stakeholders early and throughout the process, in an appropriate manner; and
- Integrity: Community and stakeholder engagement should establish and foster mutual trust and respect.

3.2 KEY STAKEHOLDERS

A register of historic stakeholder engagement related to the project is contained in Appendix 3.

3.2.1 Government Stakeholders

Commonwealth, State and Local Government authorities have been briefed on the Project to ensure any issues, concerns or suggestions are identified and, where appropriate, addressed or responded to by Leichhardt. The consultations have resulted in some changes to Project design; however, in most cases the purpose was to provide the Government stakeholders with relevant information.

The following Government stakeholders have been consulted:

- Commonwealth:
  - DCCEEW;
  - Minister for Finance;
  - Minister for the Environment;
  - Northern Australia Infrastructure Facility (NAIF);
  - Regional Development Association Pilbara;
  - Assistant Minister for Regional Development and Territories; and
- Honourable Melissa Price MP – Member for Durack.State:
  - Department of Water and Environmental Regulation (DWER);
  - Department of Jobs, Tourism, Science and Innovation (DJTSI);
  - DEMIRS;
  - Department of Biodiversity, Conservation and Attractions (DBCA);
  - Department of Primary Industries and Regional Development (DPIRD);
  - Department of Transport (DoT);
  - PPA;
  - EPA;
  - Minister for Mines and Petroleum, Energy and Industrial Relations;
  - Minister for Regional Development; and
  - Mr Kevin Michel MLA – Member for the Pilbara.
- Local:
  - City of Karratha

3.2.2 Corporate and Community Stakeholders

Leichhardt recognises that individuals, companies, and communities may also be interested in the impacts of the Project. The following corporate and community stakeholders were deemed to be relevant to this Project:

- CITIC Pacific Mining;
- City of Karratha;
- Hampton Harbour Boat and Sailing Club;
- King Bay Sporting Fishing Club;
- Nickol Bay Sporting Fishing Club;
- Pastoral Management Pty Ltd;
- Recfishwest;
- SANTOS Limited;
- WA Fishing Industry Council (WAFIC);
- WA Marine Science Institute (WAMSI);
- WAC (and WAC Registered Native Title Body Corporate); and

- Yaburara and Coastal Mardudhunera Aboriginal Corporation (YACMAC).

3.2.3 Internal Stakeholders

Internal Stakeholders have yet to be formally identified. These stakeholders shall be updated with later revisions of this mine closure plan. They are likely to include:

- Mine manager;
- Mine planners;
- Engineers;
- Environmental advisor / specialist; and
- Other relevant staff involved in mine planning and technical/operational decision making.

3.3 Stakeholder Engagement Strategy

Leichhardt has a Consultation Strategy which identifies key external stakeholders and determines how they will be impacted by the Project and what influence they have over its implementation. The aim of such extensive consultation is to develop productive relationships that ensure the Project is underwritten by sustainable agreements and necessary statutory approvals. The Consultation Strategy has also been developed to secure the approvals necessary for the construction and operation of the Project, which will require consultation with the following stakeholders:

- Local Government;
- State Government;
- Commonwealth Government;
- Aboriginal groups with a connection to the Project lands; and
- Corporate, industry and community stakeholders.

3.4 Stakeholder Management

Due to the ongoing mining status of the Eramurra Operation, a formal stakeholder consultation program that specifically addresses closure has not been developed, although engagement on closure will be conducted as appropriate through the operation's Stakeholder Engagement Plan (SEP), which is currently being developed.

Consultation will be undertaken in accordance with the Eramurra Community Policy; in particular:

'Engaging early, openly, honestly, and regularly with communities impacted by our operations and considering their views in our decision-making to minimise social impacts'.

The internal Eramurra Communication and Consultation Standard also provides guidance to engagement and consultation with contracting partners to improve alignment on HSECQ activities and initiatives. This will be reviewed and integrated as the site progresses towards closure execution.

These documents are reviewed regularly and updated as required and will also form the basis of developing a closure specific stakeholder strategy, when required in the future.

Once a closure timeframe has been identified, the stakeholder management processes will be updated to include consultation and strategies regarding closure as appropriate to the timeframe to closure.

Formal stakeholder consultation specific to closure will be undertaken by Eramurra when a LOM is identified at the operation. A closure-specific engagement plan will be developed, and the objective of the engagement will be to:

- Communicate potential closure outcomes or scenarios with relevant stakeholders;
- Receive feedback and input on closure-related outcomes;
- Maintain communication with stakeholders so they are well informed about the potential effects of closure; and
- Ensuring that stakeholder priorities at the time of closure inform the evaluation of potential closure outcomes.

General stakeholder engagement will continue throughout the life of the operation. A SEP is being developed by Eramurra to guide engagement with community groups and other stakeholders. The SEP will include strategies for engagement with stakeholders on specific matters including closure planning. General stakeholder engagement meetings will be held by Eramurra and include:

- Periodic meetings with the JTSI, and meetings with other regulators and Government departments as required;
- Meetings with the PPA, Australian Maritime Safety Authority, Australian Customs, the Karratha Local Emergency Management Action Committee, and the City of Karratha as required;
- Meetings with the City of Karratha, Chambers of Commerce as well as local business owners and other interested parties; and
- Meetings with Indigenous organisations including the WAC and the Mardudhunera People.

Closure planning will be discussed in these regular stakeholder meetings as appropriate.

3.5 Employee Information, Communication and Consultation

A Human Resources Strategy will be developed to address workforce and industrial relations issues associated with closure within an appropriate timeframe if a decision is made to close the operation.

3.6 PLANNED CLOSURE ENGAGEMENT

The Project will continue operational stakeholder engagement and over time, introduce and develop rehabilitation and closure concept awareness as the site progresses towards closure. Proposed closure engagement is outlined in Table 3-1.

Stakeholder engagement outcomes will be detailed in future submission of the Annual Environmental Report (AER) and the MCP.

Table 3-1: Planned Closure Engagement

Stakeholder	Planned Engagement Topic	Methods
Indigenous owners	• MCP updates (including post closure land use, closure objectives and completion criteria, identification and management of closure risks, closure implementation strategies, residual assets).	Quarterly meetings to commence five years prior to closure.
Adjacent pastoralists	• Post closure land use. • Residual assets. • Access to Site domains.	Yearly meetings to commence five years prior to closure.
DEMIRS	• MCP updates (including post closure land use, closure objectives and completion criteria, identification and management of closure risks, and closure implementation strategies. • Residual assets.	MCP updates and AER.
JTSI	• MCP updates. • Residual assets.	Meetings as required to discuss Site changes.
DWER	• Remediation and management of contaminated sites • MCP updates. • Residual assets.	Meetings as required to discuss Site changes.
DPLH	• MCP updates. • Aspects involving Aboriginal affairs. • Residual assets.	Meetings as required to discuss Site changes.
Local government	• Post closure land use. • Residual assets. • Access to Site domains.	Yearly meetings to commence five years prior to closure.
Relevant tenement holders	• Post closure land use. • Residual assets. • Access to Site domains.	Yearly meetings to commence five years prior to closure.
Local community groups	• Post closure land use. • Residual assets. • Access to Site domains. • Business opportunities	Yearly meetings to commence five years prior to closure.

4 BASELINE AND CLOSURE DATA AND ANALYSIS

4.1 CLIMATE

The Pilbara bioregion has an arid to tropical climate with average maximum temperatures over 40°C from November to February and an average maximum of 25°C during the winter months (Leighton, 2004; McKenzie et al., 2009). Annual rainfall across the broader Pilbara region averages approximately 290 mm and is most prevalent over the summer months in association with cyclonic activity to the north and northwest, though annual rainfall is highly variable (McKenzie et al., 2009). The climate of the Roebourne subregion is described as arid (semi-desert) tropical with highly variable rainfall, falling mainly in summer. Cyclonic activity is significant, with several systems affecting the coast and hinterland annually (Kendrick and Stanley, 2001).

The nearest Bureau of Meteorology (BoM) weather station with comprehensive data collection and recent historic climate data is Mardie (Site number 005008), located 44 km southwest of Cape Preston. Mardie records its highest maximum mean monthly temperature (37.9°C) in January and lowest (27.8°C) in July, with its highest minimum mean (25.4°C) in February and lowest (11.9°C) in July. Average annual rainfall is 276.3 mm, with highest monthly average rainfall recorded in February (62.4 mm) (BoM, 2022) (Figure 4-1).

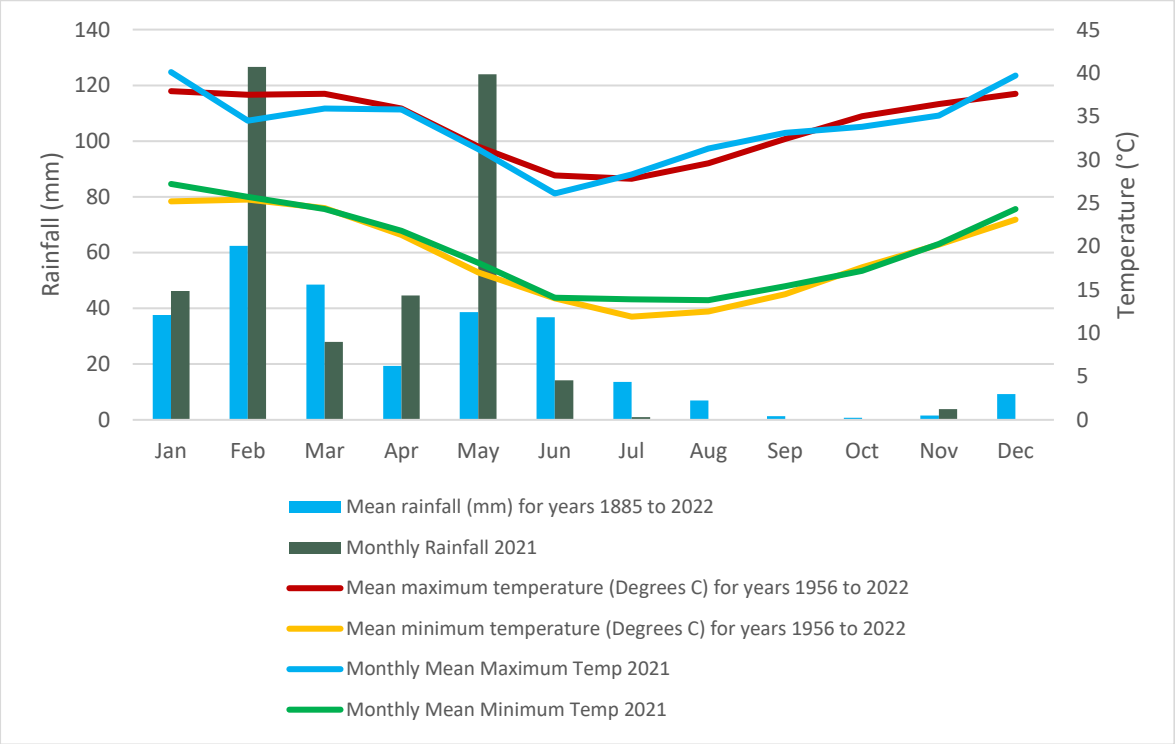


Figure 4-1: Mardie climate data derived from nearest BoM weather station (site number 005008)

4.2 LANDSCAPE

The Eramurra Solar Salt Project is located approximately 55 km southwest of Karratha, between the towns of Onslow and Dampier on the Pilbara coast, in the north-west of WA (Figure 1-1). The main mining feature, being concentration ponds, will be constructed on mudflats and flat plains on the landward side of the coastal mangroves.

The central and eastern parts of the Project coastline is comprised of a line of coastal beach ridges, dunes and cheniers forming a coastal barrier rising locally to over 12 m AHD along the crest of the main dune. This coastal barrier has allowed a backwater (salt flat) to have formed which becomes inundated on the highest tides, storm surges and flooding events. Several small (high tide) islands, often displaying orientation with ridges of higher ground orientated with the contemporary coastline, are scattered across the backwater area (CMW Geosciences (CMW), 2020).

This backwater area is very flat, and playa deposits have accumulated in the low energy depositional environment fed with sediment laden tidal water through numerous gaps in the coastal barrier where creeks have cut through. In the west, the elevated coastal barrier becomes highly fragmented and is completely absent in the western-most quarter of the Project coastline, where mangroves fringe a poorly defined coastline (CMW, 2020).

Inland of inter and supra-tidal flats is an area of alluvial outwash. The land falls at a gradient of about 1:300 from the southeast towards the northwest. Several minor drainages dissect this alluvial outwash plain. The creeks (see Section 4.6) are generally small as the catchments are not large. A relatively significant stream along the eastern edge of the site called Devil Creek drains a larger inland area, as does Eramurra Creek that follows the western side the Project area. The most significant stream affecting the Project site is McKay Creek. McKay Creek is locally incised approximately 1 m in the creek bed and features a ≈ 200 m wide floodplain (CMW, 2020).

The playa deposits are referred to as lagoonal deposits, with the backwater landform referred to as inter-tidal and supra-tidal flats. Inter-tidal flats are inundated on normal spring tides, while supra-tidal flats are those areas above the level of normal monthly tides, and which may only experience inundation very intermittently during astronomical highwaters or during meteorologically induced high waters. This could include extreme low barometric pressure, storm surges or seiche effects (CMW, 2020).

4.2.1 Interim Biogeographical Regionalisation of Australia

The study area is located entirely within Roebourne (PIL4) subregion of the Pilbara bioregion. The Roebourne subregion is described by Kendrick (2001) as:

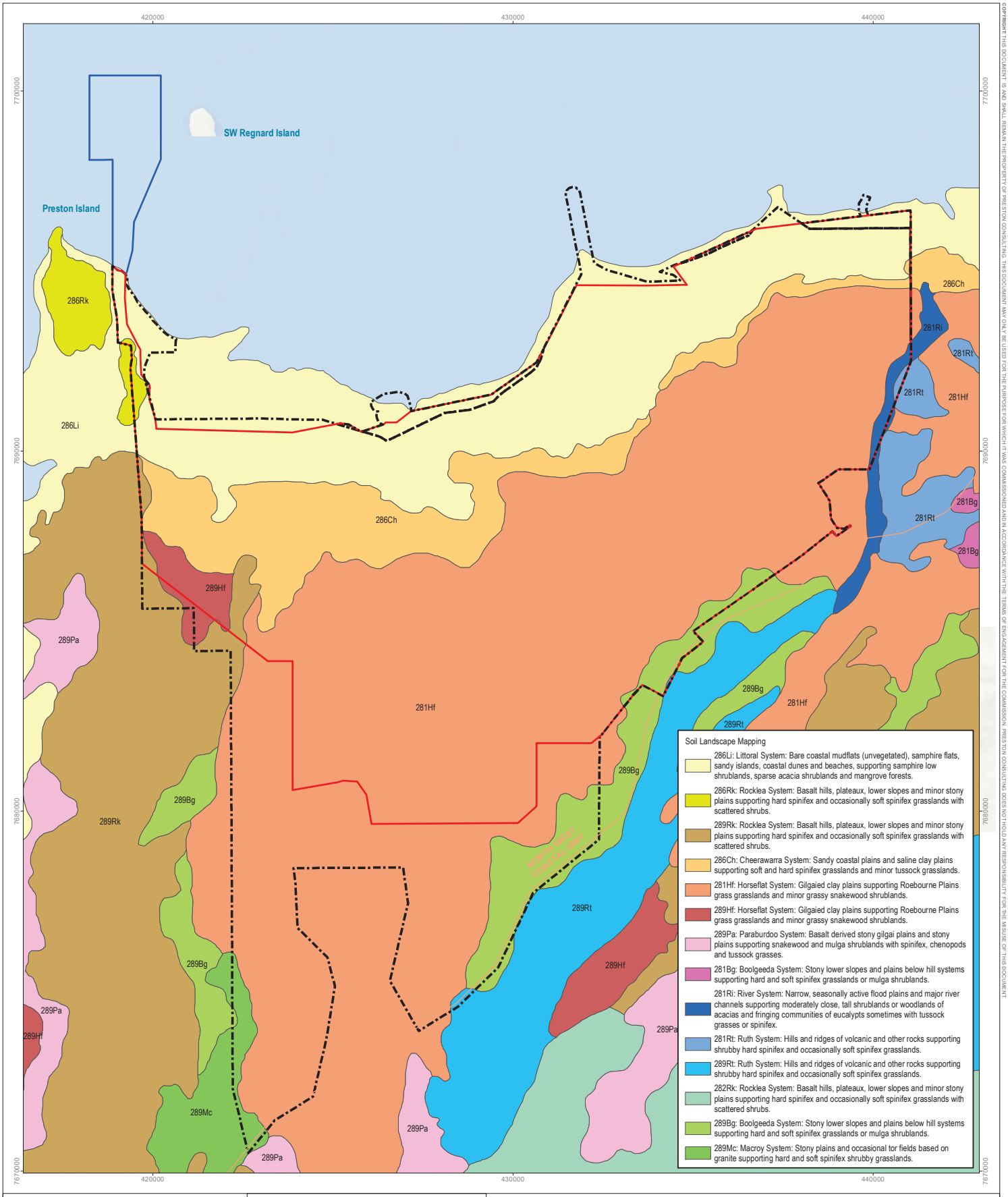
> Quaternary alluvial and older colluvial coastal and subcoastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub-steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *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. Islands are either Quaternary sand accumulations, or composed of basalt or limestone, or combinations of any of these three. The subregion experiences an arid (semi-desert) tropical climate with highly variable rainfall, often influenced by cyclonic activity in the northwest of WA and falling during summer.

4.2.2 Land Systems

The Project intersects eight land systems, as mapped by the Department of Agriculture and Food Western Australia (Table 4-1; Figure 4-2). The Horseflat system is the dominant land system of the study area occupying approximately 62.8%, followed by the Littoral system (20.1%).

Table 4-1: Description of Land Systems Intersecting the Study Area

Land System	Land system description	Area (ha)	% of Study Area
Horseflat	Gilgaied clay plains supporting Roebourne Plains grass grasslands and minor grassy snakewood shrublands.	16,610.6	62.8%
Littoral	Bare coastal mudflats (unvegetated), samphire flats, sandy islands, coastal dunes and beaches, supporting samphire low shrublands, sparse Acacia shrublands and mangrove forests.	5,321.0	20.1%
Cheerawarra	Sandy coastal plains and saline clay plains supporting soft and hard spinifex grasslands and minor tussock grasslands.	2,754.3	10.4%
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands	925.0	3.5%
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs	407.3	1.5%
Macroy	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands	194.5	0.7%
River	Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	88.9	0.3%
Ruth	Hills and ridges of volcanic and other rocks supporting shrubby hard spinifex and occasionally soft spinifex grasslands.	39.3	0.1%
N/A	No land systems description available. Occur in locations considered to be inundated with ocean.	108.1	0.4%
	Total Area represented by Land Systems	26,340.8	99.6%



Preston Consulting

CREATED BY	JOB	DATE	REVISION
ENVIRONMAPS	PC2900212	27/04/2023	0

Leichhardt Salt Pty Ltd

0 0.75 1.5 3 km

Scale: 1:100,000 @ A3

N

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY

Legend

- Marine Development Envelope
- Pond and Infrastructure Development Envelope
- Flora and Vegetation Study Area

ENVIRONMAPS | 0406 590 006 | Environmental Mapping Solutions | www.environmaps.com.au

C:\GIS\Jobs\Preston Consulting\PC2900212 - ERD Project Management - Leichhardt Industrials\Figures\PC2900212_Land Systems_230427.mxd

Figure 4-2: Land systems

4.2.3 Conservation Reserves and Environmentally Sensitive Areas

WA Conservation Reserves

No conservation reserves or other Environmentally Sensitive Areas, as defined under section 51B of the EP Act, are located within the development envelopes. The closest conservation reserves are the numerous offshore islands within the Passage Island Archipelago, associated with the Great Sandy Island Nature Reserve (Class B). These islands are managed by DBCA for the conservation of flora and fauna and are vested with the Conservation Commission of WA. There is also a proposed Marine Conservation Reserve where the Project is located, spanning from Mary Anne Islands to Cape Keraudren (Figure 4-3). Marine areas are outside the Mining lease. Therefore, current and proposed conservation reserves and Commonwealth Marine Parks are not included in the scope of this MCP.

Other conservation reserves in the area include:

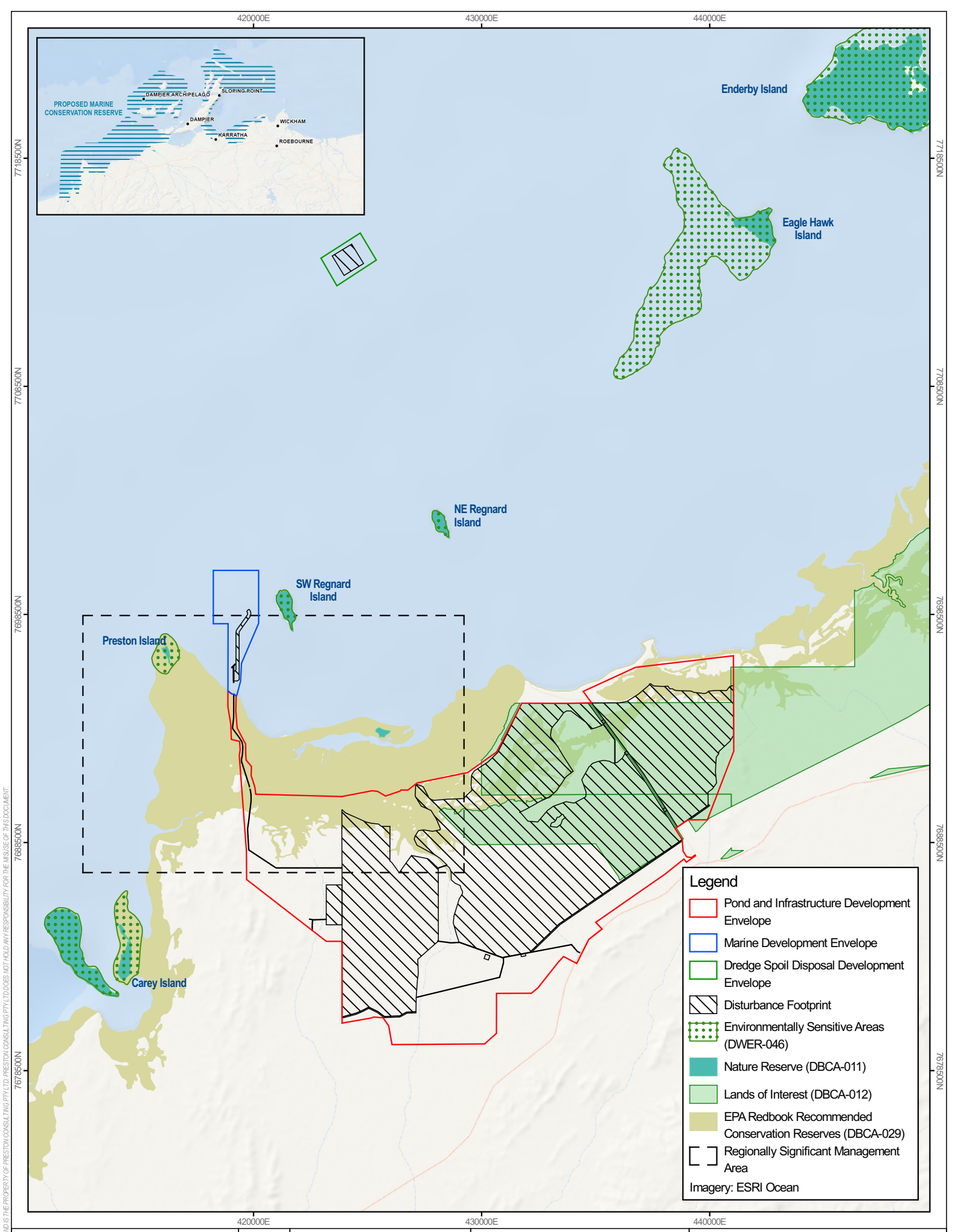
- Dampier Archipelago Nature Reserves, located 50 km northeast;
- Murujuga National Park, located 60 km northeast;
- Dolphin Island Nature Reserve, located 70 km northeast;
- Barrow Island Marine Management Area, located 80 km northwest;
- Barrow Island Nature Reserve (Class A), located 90 km northwest; and
- Montebello Islands Conservation Reserve, located 90 km northwest.

EPA Management Areas

EPA Guidance Statement No. 1 for protection of tropical arid zone mangroves along the Pilbara coastline (EPA, 2001) has identified that mangroves are an important component of the coastal ecosystem. Consistent with this statement, the EPA has identified several areas along the Pilbara coastline containing regionally significant mangroves. The Cape Preston Mangrove Management Area (CPMMA) overlaps the northern portion of the Ponds and Infrastructure Development Envelope (Figure 4-3). The Fortescue River Delta Mangrove Management Area (FRDMMA) lies approximately 20 km southwest of the Project.

Important Wetlands

The Project does not overlap any listed or proposed wetlands of national or international importance. The closest important wetland to the Project is Exmouth Gulf East (Wetland of National Importance), located 190 km southwest of the Project.



0 3 6 km

GDA2020 / MGA zone 50

1:200,000

Project: LEI_0535_016
Date: 30/04/2025
Size: A4
Author: ASmithers (Preston Consulting Pty Ltd)

LEICHHARDT

Preston Consulting

Figure 4-3: Environmental Assets in proximity to the Proposal

4.3 MATERIALS CHARACTERISATION

The materials characterisation work completed is consistent with the Project being a salt project, with the largest excavations and constructions being the pond embankments.

4.3.1 GEOLOGY

The Pilbara coast is one of the most geologically and geomorphologically diverse and complex arid coasts in the world (Semeniuk, 1996). The region harbours a major tidal estuary which contains tidal creeks of various forms and sizes. The tidal creeks contain extensive areas of subtidal and intertidal flats, fringing and estuarine mangroves. The coastline immediately seawards of the proposed ponds is about 18 km long, and contains a variety of coastal morphologies, inferred sediment transport regimes and sediment transport pathways. At the eastern margin of the ponds are a number of tidal creeks. Further east are the wave-dominated deltas of some relatively small rivers, the Yanyare and Maitland, beyond which is the complex array of islands of the Dampier Archipelago.

The regional bedrock geology and boreholes from Cape Preston (Table 4-2) indicate that the Cape Preston promontory is underlain by igneous and similar hard basement rocks, and the nearby islands are probably cemented limestones. Across almost the entire PIDE, these sediments overlie granitic rock belonging to the Dampier Granitoid Complex present in creek beds and encountered in boreholes. This granite was encountered at elevations around 0 m AHD immediately south of the 40-Mile Beach foredune and at shallow levels in test pits further south along the Santos pipeline route out towards the NWCH. At the proposed jetty area, basement rocks are finer-grained and metamorphosed igneous rocks.

Table 4-2: Generalised coastal stratigraphy, based on boreholes at Cape Preston (SKM, 2013)

Lithology	Depth range to top of layer (m)	Layer thickness range (m)	Strength range	Typical description
Coastal sand deposit	-	0.5 to 6.0	Very loose to medium dense, Standard Penetration Test (SPT) number ranges from 1 - 20.	Fine to coarse grained, well graded, sub-rounded, dark brown and grey, with silt and sub-angular gravels, shells, corals and rootlets. Encountered in all the boreholes.
Calcrete	0.5 - 6.0	Absent to 4.0	Strength variable; highly fractured in some areas.	Fine, off-white, distinctly weathered. Encountered in all the boreholes.
Ferricrete	0.5 - 5.0	0.5 to 9.0	Extremely low to high strength.	Fine, yellow brown, massive, distinctly weathered. Encountered in all the boreholes.
Dacite	6.0 - 9.0	Absent to base of borehole	Highly variable, extremely low to high strength.	Fine, much quartz, off-white, extremely weathered to fresh. Encountered in BH 05 to BH 10.
Basalt	4.0 - 12.0	Base of borehole	Medium to very high strength, highly fractured in some areas.	Fine, grey, massive, distinctly weathered to fresh. Encountered in all the boreholes except BH 05 and BH 07.

CMW (2020) describe the main surface units as:

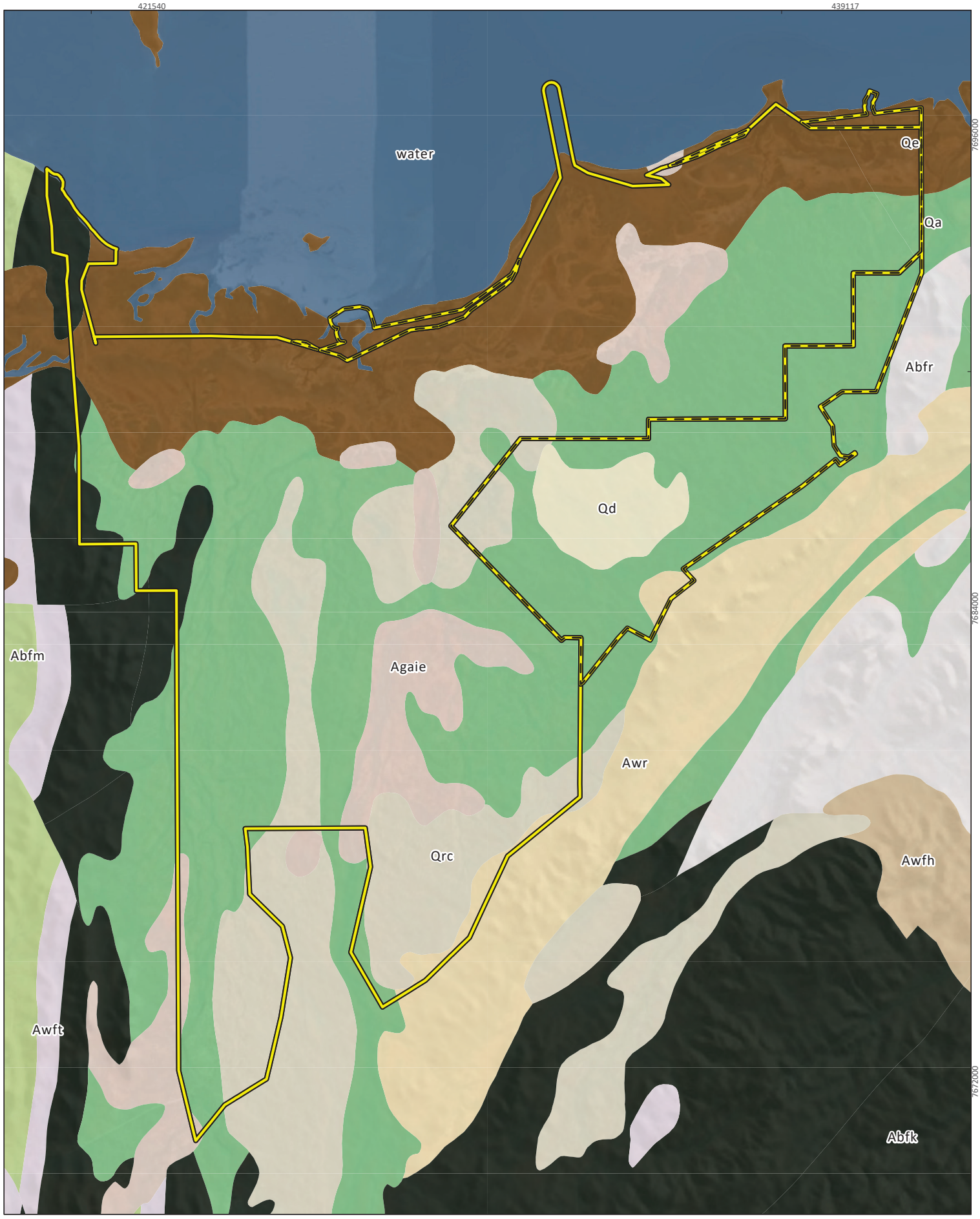
- Mangrove and marine "muds" fringing the coast but about 1 km wide in the west;
- Shelly sand in coastal dunes and old beach deposits;
- Coastal limestone, lime-cemented shelly sand, dune sand and beach conglomerate;
- Silt and mud in supratidal and intertidal flats and a low lagoon landward of the tidal creek systems, including being 2 - 3 m thick at the Cape Preston Causeway; and
- Quartzo-feldspathic windblown sand with quartz and rock fragments – mostly occurring at the base of granitic outcrops.

The pond areas are located in a flat area, where the surface sediments are interpreted as Holocene and recent muds and sandy muds The pattern of sea-level change for the last 7,000 - 8,000 years indicates that there will be little modern sediment on the upper tidal flats and supratidal coastal plain.

According to the Surface Geology of Australia 1:1,000,000 scale, Western Australia database (Stewart et al., 2008) the study area intersects nine geological formations (Table 4-3; Figure 4-4). Two-thirds of the study area (67.9%) is composed of either alluvial or estuarine sediments.

Table 4-3: Published Geological Units of the Project Area

Geological Unit	Abbreviation	Description	Area (ha)	% of study area
Alluvium 38485	Qa	alluvial sediment	12,292.8	46.5
Estuarine and delta deposits 38489	Qe	Estuarine sediment	5,659.0	21.4
Colluvium 38491	Qrc	Colluvial sediment	4,348.6	16.4
Eramurra Monzogranite	Agaie	monzogranite	2,270.0	8.6
Dune 38496	Qd	Sand – aeolian, sand-residual	829.1	3.1
Kylena Formation	Abfk	Basalt, andesite, rhyolite, dacite, dolerite	589.5	2.2
Roebourne Group	Awr	Basalt, komatiite, metaperidotite, chert, banded iron formation (BIF)	299.5	1.1
Water	water		155.7	0.6
Mount Roe Basalt	Abfr	Mafic volcanic, sandstone, limestone, dolerite	4.8	<0.12
		Total	**26,448.9**	**100.0**



Leichhardt Industrial Pty Ltd
Eramurra Solar Salt Project

Project No	1319
Date	7/06/2022
Drawn by	BK
Map author	BL

0 2.5 5
Kilometers

1:123,800 (at A4) GDA 1994 MGA Zone 50

Study Area (Expanded)
Study Area (Original)

Surface geology

Abfk
Abfm
Abfr
Agaie
Awfh
Awft
Awr
Qa
Qd
Qe
Qrc
water

PHOENIX ENVIRONMENTAL SCIENCES

P:\GIS\Projects\Eramurra\Salt\1319-ESP-11-BDY\Mapping\MapDocuments\Figures\Figures.aprx

Figure 4-4: Surface geology in the study area

4.3.2 Soils

LWC was engaged by Leichhardt to undertake soil and sediment testing to inform the Baseline Soil and Sediment Assessment for the Project. A description of the geology encountered across the Project area has been documented by CMW (2022) based on the observations from test pit, Cone Penetration Testing (CPT) and surface sampling (across the algal mats) soil investigations in August/September 2021. The geological units have been grouped into the two main geographical areas where they are encountered. Unit names in italics below are the geomorphological units where the geological unit is commonly encountered:

- Units occurring within the *Alluvial Outwash/Residual Surface* north of the low-lying hills present immediately south of the NWCH, extending north through the crystalliser and concentration ponds to the southern margin of the *Inter- and Supra-tidal flats*; and
- Coastal Units occurring north of the *Alluvial Outwash/Residual Surface* within the Playa (*Inter and Supra tidal flats*) and heading north towards the coastal dunes and including the sand islands (*Fringing Dunes and Deflated Dunes, Sand Plains and Sandy Islands*) interspersed within the *Inter- and Supra-tidal Flats* and areas of *Mangrove* and associated mangrove muds both along the coastline and within tidal creeks.

Geological units within the Alluvial Outwash/Residual Surface are described as:

- Alluvial sheetwash – surface deposits of predominantly sand with gravel or gravelly sand with cobbles;
- Residual soil – located at the surface throughout the *Alluvial Outwash/ Residual Surface* area and beneath the thin veneer of Alluvial Outwash described above. Main soil types include sandy clay and clay with sand;
- Alluvium – potential alluvium deposits were encountered within the *Alluvial Outwash/ Residual Surface* are generally associated with (in the vicinity of) existing creek beds and are considered to represent former channel courses (paleochannels). Main soil types included sandy clay and sandy gravel;
- Granite (Extremely Weathered) - this unit was encountered directly beneath the Residual Soil and although the parent rock has been weathered to such an extent that it is a soil, the mass structure, texture and fabric of the parent rock can be observed. The predominant soil types comprised coarse through to fine grained clay-sand-gravel mixtures;
- Dolerite (Extremely Weathered) - this unit was encountered directly beneath the Residual Soil. Weathering has produced a similar range of clay-sand-gravel mixtures as the Granite formation;
- Granite (Moderately Weathered) - the Archaean-age Dampier Granitoid Complex is present under most of the site and is exposed in outcrops as follows:
    - In the banks of incised creek bed channels and particularly towards the mouth of the creeks where they discharge into the Playa (Inter- and Supra-tidal flats);
    - At the southern margins of the Playa (Inter and Supra-tidal flats) sometimes as a coastal wave cut platform (shoreline surface);
    - As low relief, shallow outcrops across the Alluvial Outwash/Residual Soil surface area; and
- Metasediment (Highly to Moderately Weathered) - encountered along the western edge of the crystalliser ponds area close to the western boundary of the study area. The material was encountered below Residual Soil typically from around 1.00 to 1.50 m depth and recovered from the pit as a sandy gravel.

Geological units within the Coastal Units are described as:

- Eolian Sand - these occur immediate north and north-east of the Intertidal and Supra-tidal Flats along the coast behind the beach areas. The material typically comprises orange silty sand;
- Residual Soil - description as above, encountered beneath the Eolian Sand at the southern edge of the Sand Plains. The material comprised sandy clay or clayey sand;
- Granite (Extremely Weathered) - description as above, encountered beneath the Eolian Sand at the southern edge of the *Sand Plains* adjoining the northern margin of the *Inter- and Supratidal Flats*;
- Dolerite (Extremely Weathered) - description as above, encountered beneath the Eolian Sand at the southern edge of the *Sand Plains* adjoining the northern margin of the *Alluvial Outwash/Residual Surface* and in the east of the sandy islands;
- Calcarenite (Extremely Weathered) - encountered beneath the Residual Soil beneath the majority of the *Deflated Dunes* and *Sand Plains* extending north from the margins of the *Alluvial Outwash/Residual Surface* and below the *Fringing Dunes*. The unit typically comprised sandy gravel and clayey gravelly sand;
- Calcarenite (Highly to Moderately Weathered) - encountered in the following geological settings:
    - Former coastal rock ledges exposed at the margins of the sandy islands and along the southern margin of the *Inter- and Supra-tidal Flats*; and
    - Occasional cemented dune sands i.e., calcarenites exposed immediately to the south of the *Fringing Dunes* or around the edges of sand islands;
- Lagoonal Muds (Sediments) - soft sediments encountered in the Inter- and Supra-tidal Flats. These sediments occurred within the following geological settings:
    - Inter-tidal flats and creeks;
    - Within area of scattered mangrove; and
    - Within area of Supra-tidal flats;
- The lagoonal muds comprised Inter-laminated layers of clay, silt, sand and sandy clay (very soft to stiff) and clayey sand and sandy clay.

It is noted that some of the soil investigation locations completed by LWC/Leichhardt were outside of the mapped geology overlay prepared by CMW. The surficial soils encountered at these locations are described further in Section 4.5 of the Baseline Soil and Sediment Testing report (LWC, 2022; Appendix 1).

Soil bores logs for the samples collected by CMW are not presented here, however, details from these logs which describe the samples collected are appended to the Soil and Sediment Testing report (LWC, 2022; Appendix 1).

Surface soils and sediments were assessed for their Al, Fe and Mn content. The highest Fe content (65 000 mg/kg) was reported in the alluvial soils in the central portion of the site (MBH006). This did not correlate with other attributes of the sample such as Mn or Electrical Conductivity (EC), and thus it is likely that the distribution of Fe relates to the source rock of the alluvial material rather than any in situ weathering process or to surface water quality.

For Mn, the highest concentrations (maximum 2300 mg/kg) were reported in the surface sediments of the coastal units. This is unsurprising given the common association of Mn with estuarine and coastal sediments.

Aluminium, Al highest concentrations are found in the clay materials, particularly those in the coastal units. Clays are aluminium silicates, and thus the association with Al is expected.

Acid Sulfate Soils

In order to select the number of sampling locations, a combination of targeted and grid-based sampling methods was adopted as detailed below:

- CMW investigated the western ponds area and algal mats along the coastal aspect of the Project, resulting in 464 test pit samples, 54 CPT samples and 63 surface samples in 2021;
- LWC investigated the following locations in March 2022;
    - Perimeter outside pond footprint, collecting 14 samples;
    - Access route area in northwestern corner of the Project, collecting four samples;
    - Monitoring well locations, collecting 11 samples;
    - Surface water sampling locations, collecting 14 samples; and
    - Infill sampling, collecting three samples;

All assessments were conducted in accordance with the 2015 *Guidelines for Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DWER, 2015).

The coastal soils at the site are described as possessing a high risk, moderate and low risk of containing acid sulfate soil (ASS) within 3 m of current ground surface, each risk ranking is dependent on the soil/sediment type and depth to groundwater. The following criteria are used to interpret the field screening results:

- $pH_f \leq 3$;
- $pH_f - pH_{fox} = 3$ or more; and
- Strong to extreme reaction rating (values of 4 or above).

As per DWER (2015) Identification and investigation of ASS and acidic landscapes, high Potential ASS (PASS) risk rating was assigned if the samples displayed all three criteria. Moderate PASS risk is assigned if two positive criteria are reported. Low PASS risk is assigned if one criterion is positive and Actual ASS were considered to be those with a pH_f of less than or equal to 4.5.

The samples collected in 2021 were submitted for PASS screening analysis. Out of the 437 samples, 436 were given a low-risk rating (i.e., one or none of the three risk criteria were met).

In 2022, LWC undertook a baseline soil assessment of the PIDE including physical (i.e., particle size) and chemical (i.e., metals and hydrocarbons) characteristics.

ASS are unlikely to be present in the majority of the PIDE in the weathered residual soils and alluvial outwash. The soils outside of the coastal region are residual weathered soils derived from igneous rocks. Sulfides were not reported in these soils. However, some soils and sediments in the coastal units may be ASS. The coastal units are described as occurring north of the alluvial outwash/residual surface within the playa (inter- and supra-tidal flats) and heading north towards the coastal dunes and including the sand islands (fringing dunes and deflated dunes, sand plains and sandy islands) interspersed within the inter- and supra-tidal flats and areas of mangrove and associated mangrove muds both along the coastline and within tidal creeks.

pH and Electrical Conductivity

Table 4-4 provides a summary of the pH and EC results reported across the Project Area.

Table 4-4: Summary of pH and electrical conductivity results

Parameter	pH (1:5 Aqueous extract) (pH units)	Electrical Conductivity (µS/cm)
Number of Samples analysed	134.0	134.0
Number of Detections	134.0	133.0
Minimum value detected	6.9	20.0
Maximum value detected	9.9	25,000.0
Median value detected	8.6	3,500.0
Mean value detected	8.5	5,699.7
Standard deviation of detected values	0.5	6,125.6
Comment	Reported pH across the Site indicates that the soil profile is generally more alkaline than acidic. Only two samples reported pH less than 7 (SS/MBH06 and SS208 both reported pH of 6.9) and both were in close proximity to surface water features. In general, slightly lower pH (but still alkaline) were reported nearer the coastline.	Reported EC was observed to be highest near the coast, within the algal mat areas and within the Lagoonal Muds/ Eolian Sand coverage. As demonstrated on the bubble plots, EC throughout this area predominantly ranged from 7,500 to 25,00. The highest reported concentrations were: • SSA058_0-50 located within the central northern portion of the Project Area within the Lagoonal Muds coverage – 25,000 µS/cm It is noted that the underlying sample SSA058_100-150 reported a lower EC of 4500 µS/cm • SSA065_100 also located within the central northern portion of the Project Area within the Lagoonal Muds coverage – 18,000 µS/cm For the remainder of the project area (i.e., not within or adjacent the mapped algal mat areas), EC was generally less than 3,500 µS/cm with the majority of samples reporting EC less than 1,000 µS/cm.

Sulfate and Chloride

Table 4-5 provides a summary of the sulfate and chloride results reported across the Project Area.

Table 4-5: Summary of sulfate and chloride results

Parameter	pH (1:5 Aqueous extract) (pH units)	Electrical Conductivity (µS/cm)
Number of Samples analysed	134.0	134.0
Number of Detections	95.0	108.0
Minimum detected concentration	10.0	9.4
Maximum detected concentration	11,000.0	50,000.0
Median detected concentration	1,600.0	7,850.0
Mean detected concentration	2,221.4	13,584.7
Standard deviation of detected concentrations	2,427.1	14,491.6
Comment	Around 30% of the samples submitted for analysis reported concentrations of	20% of samples reported chloride below laboratory detection limits.

Parameter	pH (1:5 Aqueous extract) (pH units)	Electrical Conductivity (µS/cm)
	sulfate below laboratory detection limits. Similar EC, reported sulfate was observed to be highest near the coast, within the algal mat areas and within the Lagoonal Muds/ Eolian Sand coverage. The highest reported concentrations were as follows: • SS/SW12 located at the surface within the water course near surface water sample location SW12, within the western portion of the Project Area in the Alluvial Soils coverage near the edge of the algal mat area – 11,000 mg/kg • SSA071_100 located in the north eastern portion of the project area near the coast – 11,000 mg/kg • SSA072_50 located near SSA071 – 10,000 mg/kg Whilst there is no mapped geological coverage for the area targeted by SSA071 and SSA-07 it is likely that these were collected from Lagoonal Mud/ Eolian Sand. For the remainder of the Site (i.e. not within/ adjacent the coastal algal mat area), concentrations of sulfate were generally less than 500 mg/kg.	Chloride concentrations generally correlate with sulfate and EC distribution in the soils. Highest concentrations are within the algal mat areas and within the Lagoonal Muds/ Eolian Sand coverage. The highest concentration of 50 000 mg/kg was reported in sample location SSA57 and SSA84.

Chloride:sulfate ratio (by mass) in soil water extracts can be used in concert with ASS field screening results to provide an indication of the presence of ASS (DWER, 2015). Thus, this ratio was calculated for all samples where chloride and sulfate contents were above the limit of reporting.

Chloride:sulfate in seawater is typically around 7, and thus a decrease from this value indicates an additional source of sulfate. Ratios of chloride and sulfate in evaporites will typically not be the same as the solution they precipitated from, however, DWER (2015) recommend that if a decrease in the ratio is combined with a positive field test result such as a strong reaction with peroxide and a drop in pH, the additional sulfate present could be from the oxidation of sulfides within the soil (DWER, 2015).

Chloride:sulfate at Eramurra ranged from 0.06 to 107.7. Values <7 were recorded in 40 out of the 95 samples where a ratio could be calculated.

Ratios can be grouped:

- Test pit surface clays/sandy clay chloride:sulfate ranged from 0.06 to 3.8,
- Surface sediments – sandy clays/clayey sands and sands chloride:sulfate were generally between 4.85-24.62.
- Surface sediments – silts chloride:sulfate ranged from 30.23-107.7

The test pit clays and sandy clays did not record a risk of ASS in the field screening with the only positive indicator being the reaction rating where effervescence was noted. This is interpreted as being caused by carbonates and organic matter reacting with the peroxide solution, not a reaction with sulfides. The low chloride:sulfate is caused by the low concentration of chloride in the soils, which would be expected in an environment where rainwater was the primary water source. The sulfate in these soils may be residual gypsum which has a lower solubility than any chlorides, the gypsum forms a crust on the surface of the soils preventing erosion. The gypsum likely forms from evaporation of rainwater and surface water flows rather than from oxidation and neutralisation reactions of sulfides.

Surface sediments sandy clays/clayey sands and sands were the units where PASS was identified, the low ratios in these soils may therefore be an additional indication of PASS, however the pH of all extracts was above 6.9, therefore it is unlikely that the insitu sulfide has oxidised. If any oxidation has occurred, the neutral pH measured is evidence that there is sufficient buffering capacity present to manage this acid source or that the acid has been removed from the system (tidal flushing). Further, it is also possible that a portion of the sulfate in these sediments is sourced from the gypsum present in the alluvial outwash and residual soils surface.

The very high ratios measured in the surface sediment silts are likely due to evaporation an area which is not regularly flushed with water which has led to relatively elevated chloride values. This is typical of an area where the chloride is derived from freshwater and cyclical wetting and drying events occur; the chloride concentrates in the brine as minerals containing the other major ions such as sodium precipitate. Once the system reaches dryness there is an excess of chloride in the evaporites.

Nitrogen

Table 4-6 below provides a summary of the Total Nitrogen (TN), nitrate and nitrite and Kjeldahl nitrogen concentrations reported across the Project Area.

Table 4-6: Total nitrogen, nitrate, nitrite and Kjeldahl nitrogen results

Parameter	Total Nitrogen as N (mg/kg)	Nitrate and Nitrite as N (mg/kg)	Kjeldahl Nitrogen as N (mg/kg)
Number of Samples analysed	134.0	134.0	134.0
Number of Detections	131.0	56.0	131.0
Minimum detected concentration	13.0	1.1	13.0
Maximum detected concentration	1,100.0	39.0	1,100.0
Median detected concentration	220.0	4.6	220.0
Mean detected concentration	280.2	7.5	280.2
Standard deviation of detected concentrations	227.3	7.9	227.3
Comment	Concentrations of TN were variable across the Project Area and across areas of differing algal activity.	Concentrations of the sum of nitrate and nitrite were generally	Based on the data presented in this table the majority of nitrogen

Parameter	Total Nitrogen as N (mg/kg)	Nitrate and Nitrite as N (mg/kg)	Kjeldahl Nitrogen as N (mg/kg)
	The highest reported concentrations were as follows: • SS/SW12 located at the surface within the water course near surface water sample location SW12, within the western portion of the Project Area in the Alluvial Soils coverage near the edge of the algal mat area – 1,100 mg/kg • TP58_0 located at the surface in the western portion of the Project Area within the Alluvial Soils coverage – 1,039 mg/kg • SSA001_50-100 located in the central northern portion of the Project Area within the Lagoonal Muds/ Limited Algal Activity coverage – 950 mg/kg	below 5 mg/kg, with 60% of samples reporting concentrations below the limits of laboratory detection. The highest reported concentration of 39 mg/kg was in TP058 at surface (0-0.5m).	in the soils is Kjeldahl nitrogen which is associated with organic nitrogen. The concentrations of Kjeldahl nitrogen therefore directly correlate to TN concentrations and distribution.

Total organic carbon, total phosphorus

Table 4-7 below provides a summary of the Total Organic Carbon (TOC) and Total Phosphorus (TP) concentrations reported across the Project Area.

Table 4-7: Summary of Total Organic Carbon and Total Phosphorus Results (mg/kg)

Parameter	Total Organic Carbon (mg/kg)	Total Phosphorus (mg/kg)
Number of Samples analysed	134.0	134.0
Number of Detections	123.0	126.0
Minimum detected concentration	0.1	9.3
Maximum detected concentration	10.0	1,900.0
Median detected concentration	0.5	155.0
Mean detected concentration	0.9	179.5
Standard deviation of detected concentrations	1.2	184.1
Comment	Concentrations of TOC were variable across the Project Area and across areas of differing algal activity. The highest reported concentrations were as follows: • SSA200_50 located at the outlet of Eramurra Creek in the western portion of the Project Area (no geological coverage) – 10 % • TP151_0 located at the surface in the central portion of the Site within the Residual Soil coverage – 5.6 %	The maximum concentration of phosphorus measured appears to be anomalously high as it is double the concentration of the next highest value 660 mg/kg. The presence of phosphorus correlates to organic matter (TOC) where concentrations of TOC are greater than 3

Parameter	Total Organic Carbon (mg/kg)	Total Phosphorus (mg/kg)
	• SSA15_100-150 located within the north eastern portion of the Site (no geological coverage) – 4.2 % • SSA058_100-150 located within the central northern portion of the Project Area within the Lagoonal Muds coverage – 4% It is noted that the overlying sample (SSA058_0-50 reported TOC of only 0.9%)	times the laboratory detection level of 0.1%

Cation exchange capacity and exchangeable cations

Table 4-8 provides a summary of the cation exchange capacity (CEC) and exchangeable cation concentrations reported across the Project Area.

Table 4-8: Summary of CEC and Exchangeable Cation Results

Parameter	Cation exchange capacity (mq/100g)	Exchangeable cations (mq/100g)			
		Ca	Mg	K	Na
Number of Samples analysed	134.0	52.0	52.0	52.0	52.0
Number of Detections	134.0	52.0	52.0	47.0	25.0
Minimum detected concentration	3.0	1.7	0.6	0.2	0.2
Maximum detected concentration	190.0	34.0	47.0	4.4	64.0
Median detected concentration	34.0	18.0	3.3	0.7	1.2
Mean detected concentration	36.2	16.9	5.4	1.0	9.0
Standard deviation of detected concentrations	23.6	9.2	8.0	0.9	16.2
Comment	CEC was observed to be variable across the project area. The highest reported CEC was reported at: • SSA071_100 located in the north-eastern portion of the project area near the coast–190 meq/100g • SSA072_50 located near SSA071–130 meq/100g Whilst there is no mapped geological coverage for this area, it is likely that these were collected from Lagoonal Mud/ Eolian Sand. The cation exchanging in these soils and sediments is predominantly Ca given the higher median concentration. However, it is noted that similar maximum concentrations were reported for Ca, Mg and Na. Thus, other cations are contributing to CEC at the site. The data is too sparse at present to make a definitive association however, the higher CEC was always found in the silty clay soils (where soil type was recorded).				

Particle size distribution

Particle size distribution analysis was undertaken across the project area as summarised in Table 4-9 below. These data were collected to:

1. Allow for comparison of material type to chemical parameter concentrations; and
2. To assist with the hydrogeological conceptualisation of the site and seepage assessment given the relationship of grain size and the hydraulic conductivity of soils and sediments.

The full laboratory results are presented in Appendix B of the soil and sediment report (LWC, 2022).

Table 4-9: Summary of Particle Size Distribution Results (Surface Soils)

Sample	Location in the Project Area	Mapped Geology	Interpreted Predominant Soil Type
SS/MBH001	Adjacent west of pipeline	Residual Soil	Clayey Sandy Silt with minor gravels
SS/MBH003	Northern portion of the Project Area near coast	Eolian sand	Silty sand with clay fines
SS/MBH008	Northern central portion of the Project Area along coast	Eolian sand	Sand with clay and silt fines
SS/MBH017	Adjacent east of pipeline	No mapped geology	Sandy clayey silt with minor gravels
SS/MBH019	Eastern portion of Project Area near algal mats	No mapped geology	Clayey silty sand with gravels
SS/MBH020	Eastern boundary of Development Envelope	No mapped geology	Clayey sandy silt with minor gravels
SS/MBH06	Central portion of Project Area	Alluvial Soils (this veneer of sheetwash gravels over residual soil)	Silty sandy clay with minor gravels
SS/SW03	Southern portion of Project Area within McKay Creek	No mapped geology	Gravelly sand with trace clay and silt fines
SS/SW04	Within McKay Creek	Predominantly granitoid rocks	Gravelly sand with silt and clay fines
SS/SW05	Within McKay Creek	Predominantly granitoid rocks	Gravelly sand with trace silt and clay fines
SS/SW07	Tributary of McKay Creek in south central portion of Project Area	No mapped geology but expected to be Predominantly granitoid rocks	Gravelly sand with trace silt and clay fines
SS/SW08	Tributary of McKay Creek in south central portion of Project Area	No mapped geology but expected to be Residual soil	Silty sand with gravels and clay fines
SS/SW09	Devil Creek upgradient of Development Envelope	No mapped geology	Gravelly sand with trace silt and clay fines
SS/SW12	Western portion of the Project Area in creek line/near Algal Mat area	Alluvial Soil (braided channel)	Clayey silt with minor sand and gravels
SS101	Western Portion of Project Area	No mapped geology	Sandy silt with clay fines
SS102	Western portion of Project Area	No mapped geology	Sandy Silt with clay fines and minor gravels
SS103	Western portion of Project Area	No mapped geology	Silty sand with gravels and clay fines
SS104	Western portion of Project Area	No mapped geology	Silty sand with gravels and clay fines
SS105	Western portion of Project Area	No mapped geology	Clayey silt/silty clay with sand and gravel
SS106	Western portion of Project Area within Eramurra Creek	No mapped geology	Sandy silt with gravels and clay fines

Sample	Location in the Project Area	Mapped Geology	Interpreted Predominant Soil Type
SS107	Western portion of Project Area	Residual Soil	Clayey silt/silty clay with sand and gravel
SS108	Western portion of Project Area	Alluvial Soils (braided channel)	Gravelly silt with clay fines and minor sand
SS109	Western portion of Project Area	Residual Soil	Clayey silt/silty clay with sand and gravel
SS110	Western boundary of Development Envelope	Residual Soil	Clayey silt/silty clay with sand and gravel
SS111	South-western boundary of development envelope	No mapped geology Expected to be residual soil	Clayey silt/silty clay with sand and gravel
SS112	Western portion of Project Area within Eramurra Creek	No mapped geology	Silty sand with clay fines and minor gravels
SS113	South-eastern portion of Project Area	Residual Soil	Clayey silt/silty clay with sand and gravel
SS114	Within McKay Creek	No mapped geology	Silty sand with gravels and clay fines
SS115	South-western portion of Project Area	No mapped geology	Silty sand with gravels and clay fines
SS116	Central portion of Project Area	Alluvial Soil (thin veneer of sheetwash gravel over residual soils)	Silty sand with gravels and clay fines
SS117	Southern boundary of Development Envelope	No mapped geology	Silty sand with gravels and clay fines
SS118	Southern boundary of Development Envelope	No mapped geology	Sandy silt with gravels and clay fines
SS119	Western portion of Project Area adjacent creek bed	Alluvial Soils	Sand with clay and silt fines and gravels
SS120	Central portion of Project Area	Predominantly granitoid rocks	Silty sand with gravels and clay fines
SS121	Central portion of Project Area	Predominantly granitoid rocks near Residual Soil	Gravelly sand with clay and silt fines
SS201	Adjacent east of pipeline	No mapped geology	Clayey silt/silty clay with sand and gravel
SS202	Adjacent east of pipeline	No mapped geology	Silty clay with sand and gravel
SS203	Adjacent east of pipeline	No mapped geology	Clayey silt/silty clay with sand and gravel
SS204	Eastern portion of Project Area near coast	No mapped geology	Clayey silt/silty clay with sand and gravel
SS205	Eastern portion of Project Area	No mapped geology	Clayey silt/silty clay with sand and gravel
SS206	Eastern portion of Project Area near Devil Creek	No mapped geology	Silty sand with gravels and clay fines
SS207	Eastern boundary of Development Envelope	No mapped geology	Sandy silt with gravels and clay fines
SS208	Eastern boundary of Development Envelope	No mapped geology	Sandy gravel with clay and silt fines
SS209	East of pipeline	No mapped geology	Silty clay with sand and gravel

Sample	Location in the Project Area	Mapped Geology	Interpreted Predominant Soil Type
SS210	Eastern portion of Project Area near Devil creek	No mapped geology	Clayey silt/silty clay with sand and minor gravel
SS211	South-eastern corner of development envelope, adjacent east of pipeline	No mapped geology	Clayey silt/silty clay with sand and gravel
SS212	South-eastern corner of development envelope, adjacent east of pipeline	No mapped geology	Clayey silt/silty clay with sand and gravel
SS213	Within Devil Creek	No mapped geology	Clayey silt with clay fines and gravels
SS214	Eastern portion of Project Area	No mapped geology	Clayey silt/silty clay with sand and gravel
SS215	Adjacent east of pipeline	No mapped geology	Clayey silt/silty clay with sand and gravel
SS216	Adjacent west of pipeline	Residual soils	Clayey silt/silty clay with sand and gravel
SS217	Eastern portion of Project Area near coast	No mapped geology but expected to be Lagoonal Mud or Eolian Sand	Clayey Silt/ Silty Clay with sand and gravel

Sub Surface Soils assessment

Twenty-two (22) sub surface soils were collected during the groundwater monitoring well drilling program completed by LWC in December 2021. The soils were submitted to Microanalysis for assessment of their crystalline mineral content via x-ray diffraction (XRD) to assist with the geological description of these materials. Samples were collected above and below the water table with samples also collected within the screened interval of installed wells. Location denoted MBH were drill locations where water was not encountered, those denoted MW are the sampled locations where a well was installed. Locations are in numerical order irrespective of whether they are MW or MBH.

These data are included here to assist in understanding the variability of the sub-surface soil profile. Generally, the sub-surface soils consist of a highly weathered residual soil. The majority of the samples consisted of clays kaolinite, palygorskite, illite and montmorillonite indicating the weathered nature of the materials sampled. The primary minerals remaining from the parent rock were silicates: quartz, feldspars (albite and microcline), amphibole, muscovite and chlorite (clinochlore), carbonates (dolomite and calcite) and iron oxides (hematite) with occasional sulfates (gypsum). Sulfides were not reported. The mineralogy is consistent with the geological description: residual soil.

The water table could not be distinguished based on the mineralogy, despite there being a distinct colour change from brown to cream or pale green at times. This colour change is likely due to leaching of iron from the surface of the minerals present, a process that can occur without altering the mineral crystal form.

The mineralogy and the weathered nature of the materials sampled suggests that no significant risk of acid formation from the sub-surface materials is present. Clays will produce acidic pH (pH below 5) when in contact with water through the release of hydrogen ions from clay hydrolysis. This is considered to be the natural background soil pH in the sub-surface of the majority of the site.

4.4 FLORA AND VEGETATION

A desktop review and numerous field surveys have been conducted by Phoenix Environmental Sciences (Phoenix) (2025) to inform this section.

4.4.1 VEGETATION

Vegetation Condition

The condition of vegetation in the Study Area ranged from Completely Degraded to Excellent (Figure 4-5; Table 4-10) with the majority (76.8%) in Excellent condition. All areas rated as Completely Degraded comprised cleared areas only. Excellent condition ranks the vegetation as pristine or nearly so with no signs of damage caused by human activities since European settlement. Areas recorded as Good to Degraded were due to disturbances such as grazing and/or aggressive weeds. Weed species were a dominant factor within several vegetation types. Completely cleared areas (e.g., roads, tracks, paddocks) were excluded from condition ratings and mapped as 'cleared'.

Table 4-10: Vegetation condition in the Study Area

Condition rating	Area (ha)	% of Study Area
Excellent	20,307.8	76.8
Very Good	1,253.8	4.7
Good	1,714.9	6.5
Poor	118.5	0.4
Degraded	3.7	<0.1
Completely Degraded	148.0	0.6

Vegetation Associations

Six vegetation associations are located within Study Area based on regional vegetation mapping by Shepherd et al., (2002) and Beard et al., (2013) (Table 4-11; Figure 4-6). All vegetation associations are extensively represented in the Roebourne subregion and currently have over 84% pre-European extent remaining, and therefore have the status of 'Least Concern' (DPIRD, 2018). It is noted that the Mardie Project is currently under construction, which includes native vegetation disturbance within 7,720 ha of the same vegetation associations. These values have been added to Table 4-4 for reference.

Table 4-11: Vegetation associations within the development envelope

Vegetation association and description	Pre-European extent (ha)	Current extent (ha)	% Remaining	% of Study Area
43: Low Forest; mangroves (Kimberley) or thicket; mangroves (Pilbara)	217,449.3	183,250.1	84.3	1.3
93: Hummock grasslands, shrub steppe; kanji over soft spinifex	3,044,309.5	3,040,641.0	99.9	7.4
117: Hummock grasslands, grass steppe; soft spinifex	919,517.0	886,005.8 (38 ha to be cleared at the Mardie Project)	96.4 (inclusive of clearing at Mardie Project)	4.6
127: Bare areas; mudflats	737,724.0	697,871.4 (7,682 ha to be cleared at the Mardie Project)	93.6(inclusive of clearing at Mardie Project)	16.3
175: Short bunch grassland - savanna/grass plain (Pilbara)	526,957.9	524,640.2	99.6	70.3
587: Mosaic Hummock grasslands, open low tree-steppe; snappy gum over *Triodia wiseana*/Hummock grasslands, shrub-steppe; kanji over *Triodia pungens*	580,728.6	580,697.0	100.0	0.1%

Vegetation Types

Seventeen vegetation types were mapped within the Study Area (Figure 4-7 - Figure 4-10). These vegetation types can be generalised into the following seven broad vegetation groups:

- Low isolated forbs over closed tussock grassland;
- *Acacia* shrubland over hummock grassland;
- *Acacia* shrubland over tussock grassland;
- Low open *Tecticornia* shrubland, occasionally over sparse tussock grassland;
- Low sparse to open shrubland of *Aerva javanica* over *Cenchrus* spp. grassland;
- Drainage woodlands, variably composed of *Eucalyptus camaldulensis*, *E. victrix* and *Corymbia hamersleyana*; and
- Exposed granite areas containing isolated shrubs and forbs.

Vegetation type Ex is the dominant vegetation type, covering 44.3% of the Study Area. This vegetation type is described as low isolated forbs of *Sida fibulifera*, *Rhynchosia minima*, and *Indigofera trita*, over low tussock grassland to closed tussock grassland of *Eragrostis xerophila, Dichanthium sericeum* subsp. *Humilius,* and *Sorghum plumosum*.

Vegetation type AbTw is the second largest covering 15.9% of the Study Area. This vegetation type is described as mid sparse to open shrubland of *Acacia bivenosa*, with occasional *A. stellaticeps* and *A. coriacea* (s.l.), over low hummock grassland of *Triodia wiseana*.

The remaining fifteen vegetation types mapped cover 26.8% of the Study Area, 1.5% was mapped as mosaic or complex vegetation types, and 10% was mapped as devoid of vegetation, either described as cleared or mudflats.

Four vegetation types (EcAcTe, EvScSv, HscIlCc and MmTsppSv) were noted as being restricted vegetation, each occupying less than 0.1% of the Study Area.

Threatened and Priority Ecological Communities

No Threatened Ecological Communities (TEC) listed under the *Biodiversity and Conservation Act 2016* (BC Act) or EPBC Act were recorded within the Study Area, however two Priority Ecological Communities (PEC) were recorded (Figure 4-11):

- Horseflat PEC (Priority 3), occupying 11,720.6 ha of the Study Area. This PEC is represented by vegetation type Ex; and
- Coastal Dune PEC (Priority 3), occupying 117.9 ha of the Study Area. This PEC is represented by vegetation type TeWa.

A minor proportion of the mapped vegetation consisted of a mosaic of complex vegetation types. Areas where the vegetation type (Ex) occurs as an element of the mosaic are considered as significant vegetation as a precaution.

Significant Vegetation

Thirteen vegetation types have been identified as being locally significant as they had restricted distributions within the Study Area and/or represented a refuge for flora species not recorded elsewhere in the Study Area. These vegetation codes and descriptions are listed in Table 4-12 and shown in Figure 4-12 and Figure 4-13. Table 4-12 also describes why each vegetation type was considered locally significant.

Vegetation type Tspp was originally identified by Phoenix as being locally significant as it represented habitat for sterile, and therefore potentially novel, *Tecticornia* sp. As none of the *Tecticornia* sp. were identified as being restricted to the development envelopes (Shepherd and Žerdoner Čalasan, 2024) this vegetation is no longer considered locally significant.

Vegetation type AbTw was not identified by Phoenix as being locally significant but has been included in Figure 4-12 and Table 4-12 as it represents habitat for Priority species *Goodenia pallida.* This species was not recorded by Phoenix but has previously been recorded in the Study Area.

Table 4-12: Locally significant vegetation types within the Study Area

Vegetation type	Significance	Level of significance	Extent within Study Area (ha)
Ex	Represents the Horseflat PEC and habitat for: • *Dolichocarpa* sp. Hamersley Station (P3)); and • *Polygala* aff. *galeocephala* (sp. nov.).	Regionally and locally significant	11,720.6
TeWa	Represents the Coastal Dune PEC.	Regionally and locally significant	117.9
AxEx/Ex	Half of the mosaic represents the Horseflat PEC.	Locally significant	300.9
HscIlCc/Ex	Half of the mosaic represents the Horseflat PEC.	Locally significant	4.0
AcAjTe	Represents habitat for *Scaevola* aff. *pulchella* (sp. nov.).	Locally significant	246.9
AiElTw	Represents habitat for *Eremophila forrestii* subsp. *viridis* (P3).	Locally significant	100.0
EvAcCf	• Represents habitat for *Rostellularia adscendens* var. *latifolia* (P3); and • Potential GDE.	Locally significant	54.6
AbTw	Represents habitat for *Goodenia pallida* (P1).	Locally significant	4,196.4

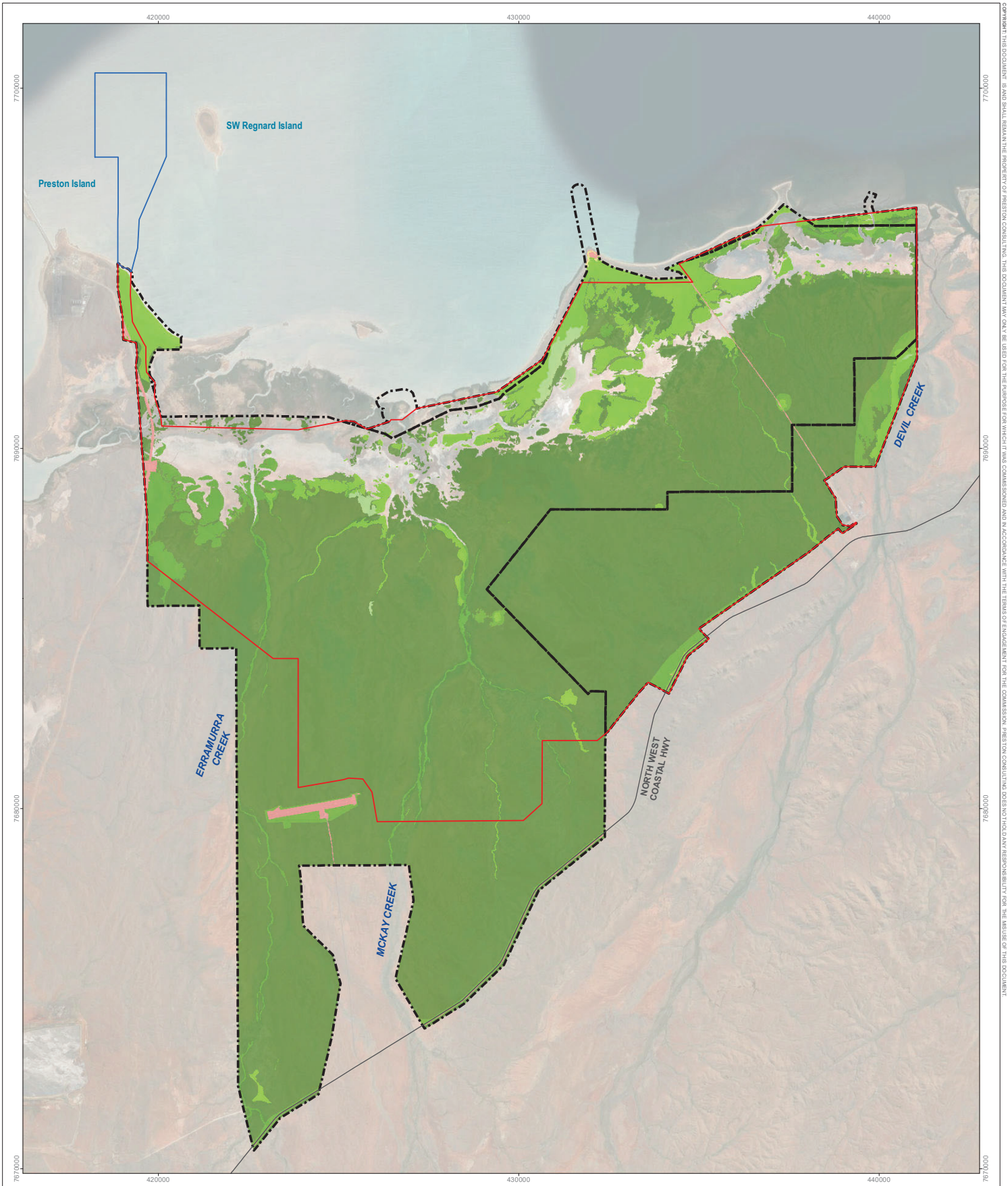
Vegetation type	Significance	Level of significance	Extent within Study Area (ha)
EvScSv	• Represents restricted vegetation community; and • Potential GDE.	Locally significant	7.7
HscIlCc	• Represents restricted vegetation community; and • Represents habitat for *Bonamia* aff. *media.*	Locally significant	6.4
MmTsppSv	Represents restricted vegetation community.	Locally significant	3.8
EcAcCs	Potential GDE.	Locally significant	176.0
EcAcTe	Potential GDE.	Locally significant	25.7

Groundwater Dependent Ecosystems

There were four vegetation types within the Study Area that may represent GDE's due to the presence of either *Eucalyptus camaldulensis* or *E. victrix* that were associated with creek systems (Table 4-12; Figure 4-13) (Phoenix, 2025). The four vegetation types include EcAcCs, EvAcCf, EcAcTe and EvScSv. Combined, the four vegetation types represent only 1.1% of the Study Area.

Groundwater drilling completed between November 2023 and December 2024 (CDM Smith, 2024), found depth to water adjacent to many of the site drainages ranges between 10 and 12 m which is within the rooting depth of these species. Based on the interpreted groundwater levels for the site it is possible this vegetation accesses groundwater, however, the rooting depths and specific water use patterns of the local eucalypt species is not currently understood. This vegetation, in particular *Eucalypt* species, is known to be resilient to changes in water availability and utilise multiple water sources. Ev vegetation types consist of *E. vitrix* and/or *E. camaldulensis* and *E. vitrix* with occasional *E. camaldulensis*. However, *E. vitrix* is potentially a facultative GDE which may not always depend on groundwater and may be weakly phreatophytic or a vadophyte (independent of groundwater), as demonstrated by the University of WA (by Pauline Grierson and other researchers over multiple years throughout the Hamersley Range in the Pilbara for Rio Tinto).

It is also understood the presence of saline groundwater will limit its use for this vegetation.



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0 0.75 1.5 3
km

Scale: 1:100,000 @ A3

N

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY

Legend

- Marine Development Envelope
- Pond and Infrastructure Development Envelope
- Flora and Vegetation Study Area

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

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Figure 4-5: Vegetation Condition

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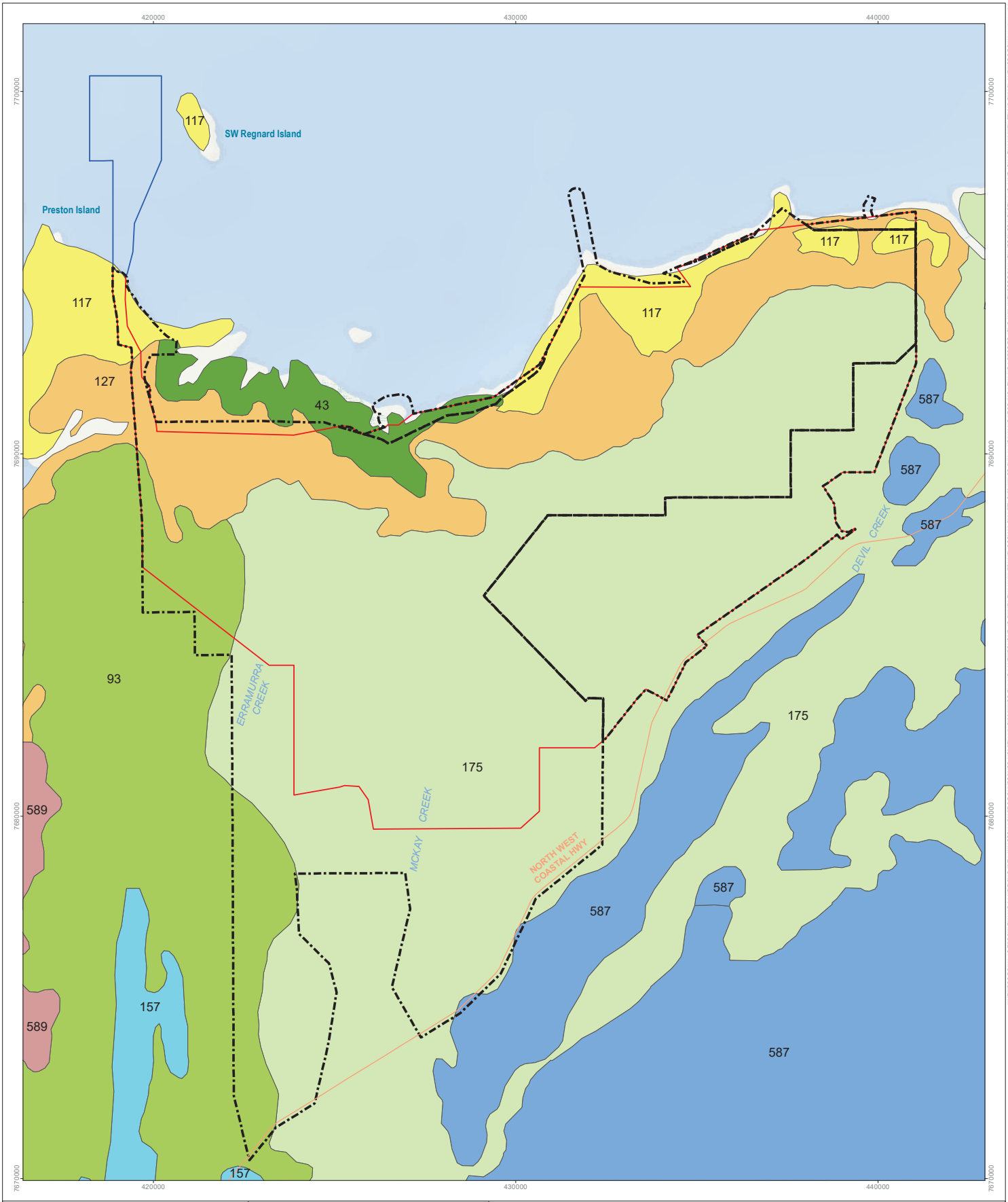

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ENVIRONMAPS	PC2900212	11/04/2023	0

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Figure 4-6: Vegetation Associations

0 0.75 1.5 3 km

Scale: 1:100,000 @ A3

N

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

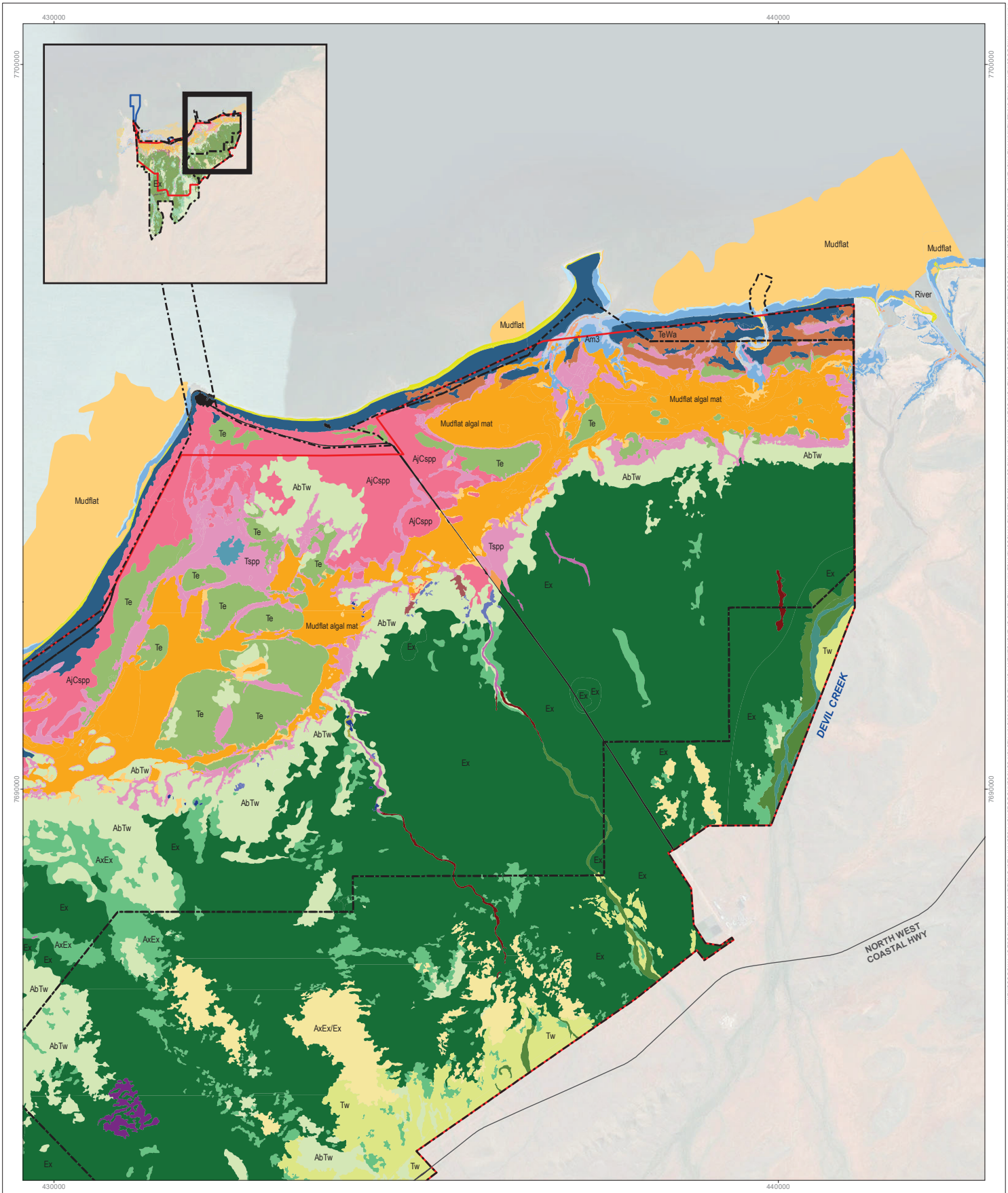
LOCALITY

Legend

- Marine Development Envelope
- Pond and Infrastructure Development Envelope
- Flora and Vegetation Study Area

Vegetation Association

- 43: Mangroves
- 117: Grass-steppe
- 127: Tidal mud flat
- 93: Shrub-steppe
- 589: Short bunch-grass savanna / Grass-steppe
- 157: Grass-steppe
- 175: Grasslands, short bunch-grass savanna
- 587: Sparse low tree-steppe / Sparse shrub-steppe



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ENVIRONMAPS	PC2900212	11/04/2023	0

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Figure 4-7: Site vegetation types (northeast)

0 0.5 1 2 km

Scale: 1:50,000 @ A3

N

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY

Legend

- Marine Development Envelope
- Pond and Infrastructure Development Envelope
- Flora and Vegetation Study

Vegetation Type

- AbTw
- AbTw/AxEx
- AbTw/Mudflat
- AbTw/Tspp
- AcAjTe
- AiElTw
- AjCspp
- AssCc
- AxEx
- AxEx/Ex
- EcAcCs
- EcAcTe
- EvAcCf
- EvScSv
- Ex
- HscllCc
- HscllCc/AbTw
- HscllCc/EcAcCs
- HscllCc/Ex
- HscllCc/Mudflat
- HscllCc/Tspp
- MmTsppSv
- Mudflat
- Te
- Te/Tspp
- TeWa
- Tspp
- Tw
- Cleared

Intertidal BCH

- Am/Ca
- Am1
- Am2
- Am3
- Beach
- Ca
- Mudflat algal mat
- Rs1
- Rs2
- Sand

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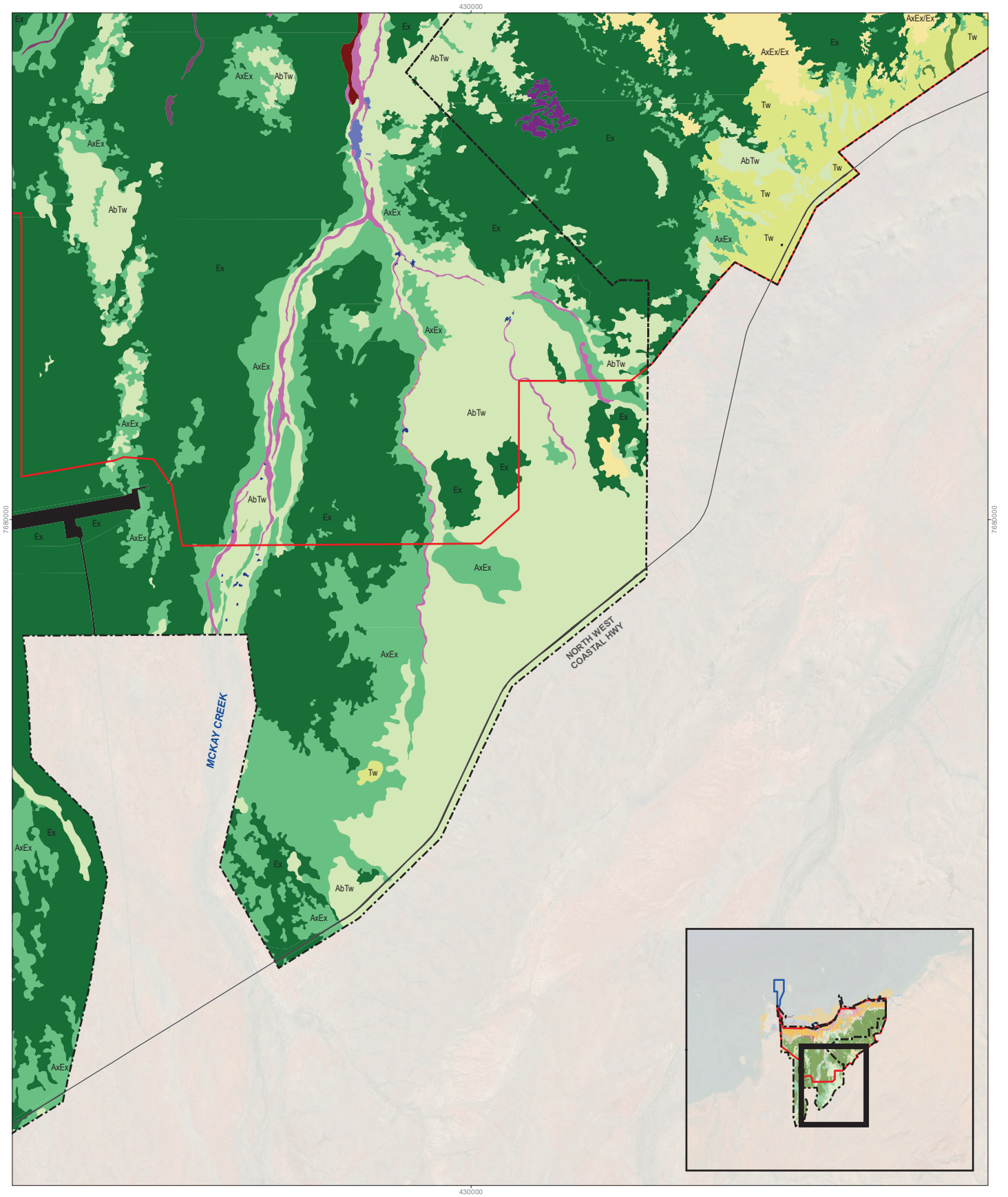

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Figure 4-8: Site vegetation types (southeast)

0 0.5 1 2 km

Scale: 1:50,000 @ A3

N

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY

Legend

- Marine Development Envelope
- Pond and Infrastructure Development Envelope
- Flora and Vegetation Study

Vegetation Type

- AbTw
- AbTw/AxEx
- AbTw/Mudflat
- AbTw/Tspp
- AcAjTe
- AiElTw
- AjCspp
- AssCc
- AxEx
- AxEx/Ex
- EcAcCs
- EcAcTe
- EvAcCf
- EvScSv
- Ex
- HscllCc
- HscllCc/AbTw
- HscllCc/EcAcCs
- HscllCc/Ex
- HscllCc/Mudflat
- HscllCc/Tspp
- MmTsppSv
- Mudflat
- Te
- Te/Tspp
- TeWa
- Tspp
- Tw
- Cleared
- Intertidal BCH
- Am/Ca
- Am1
- Am2
- Am3
- Beach
- Ca
- Mudflat algal mat
- Rs1
- Rs2
- Sand

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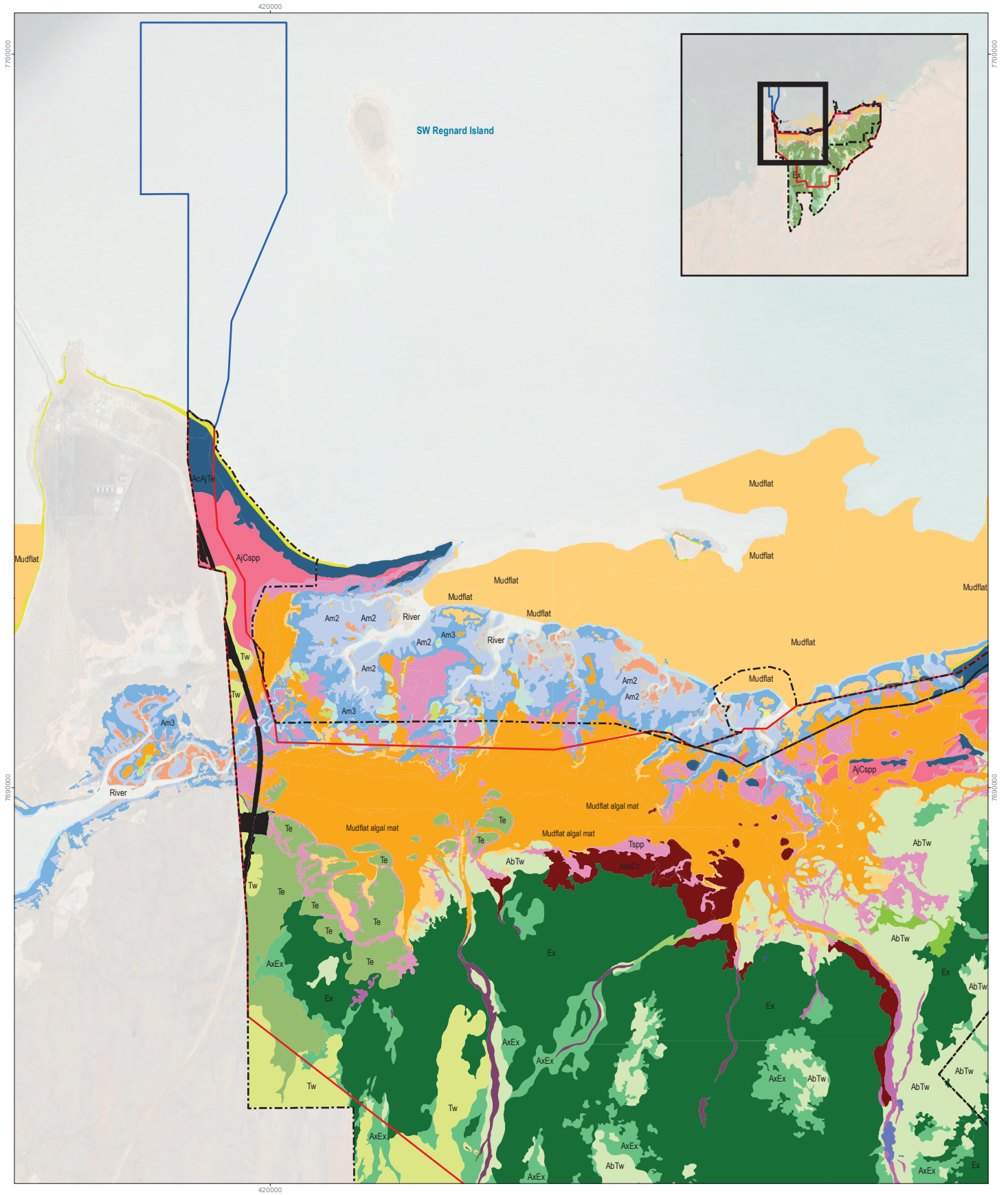

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ENVIRONMAPS	PC2900212	11/04/2023	0

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Figure 4-9: Site vegetation types (northwest)

0 0.5 1 2 km

Scale: 1:50,000 @ A3

N

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY

Legend

- Marine Development Envelope
- Pond and Infrastructure Development Envelope
- Flora and Vegetation Study

Vegetation Type

- AbTw
- AbTw/AxEx
- AbTw/Mudflat
- AbTw/Tspp
- AcAjTe
- AiElTw
- AjCspp
- AssCc
- AxEx
- AxEx/Ex
- EcAcCs
- EcAcTe
- EvAcCf
- EvScSv
- Ex
- HscllCc
- HscllCc/AbTw
- HscllCc/EcAcCs
- HscllCc/Ex
- HscllCc/Mudflat
- HscllCc/Tspp
- MmTsppSv
- Mudflat
- Te
- Te/Tspp
- TeWa
- Tspp
- Tw
- Cleared

Intertidal BCH

- Am/Ca
- Am1
- Am2
- Am3
- Beach
- Ca
- Mudflat algal mat
- Rs1
- Rs2
- Sand

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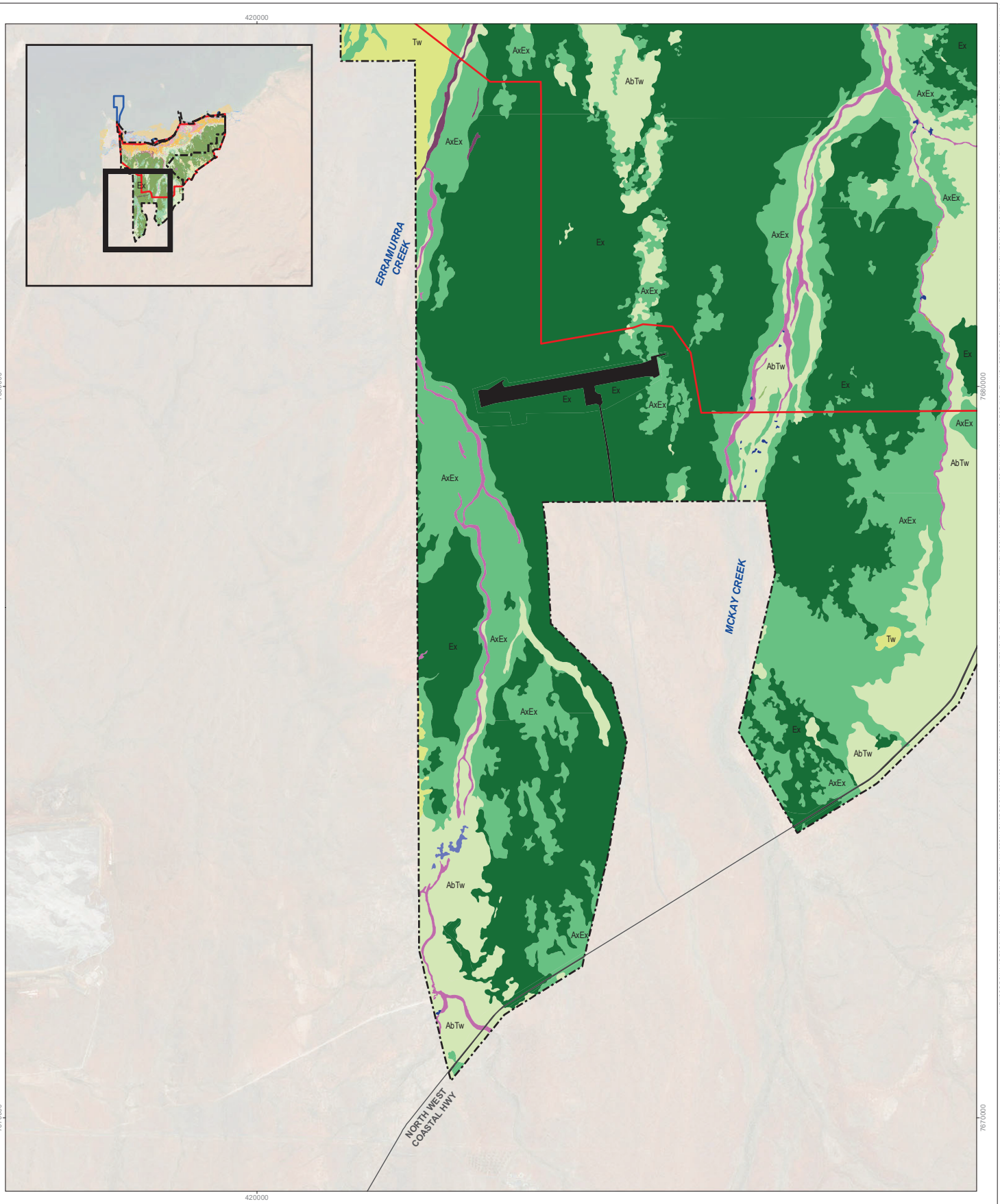

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ENVIRONMAPS	PC2900212	11/04/2023	0

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Figure 4-10: Site vegetation types (southwest)

0 0.5 1 2 km

Scale: 1:50,000 @ A3

N

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY

Legend

- Marine Development Envelope
- Pond and Infrastructure Development Envelope
- Flora and Vegetation Study

Vegetation Type

- AbTw
- AbTw/AxEx
- AbTw/Mudflat
- AbTw/Tspp
- AcAjTe
- AiElTw
- AjCspp
- AssCc
- AxEx
- AxEx/Ex
- EcAcCs
- EcAcTe
- EvAcCf
- EvScSv
- Ex
- HscllCc
- HscllCc/AbTw
- HscllCc/EcAcCs
- HscllCc/Ex
- HscllCc/Mudflat
- HscllCc/Tspp
- MmTsppSv
- Mudflat
- Te
- Te/Tspp
- TeWa
- Tspp
- Tw
- Cleared

Intertidal BCH

- Am/Ca
- Am1
- Am2
- Am3
- Beach
- Ca
- Mudflat algal mat
- Rs1
- Rs2
- Sand

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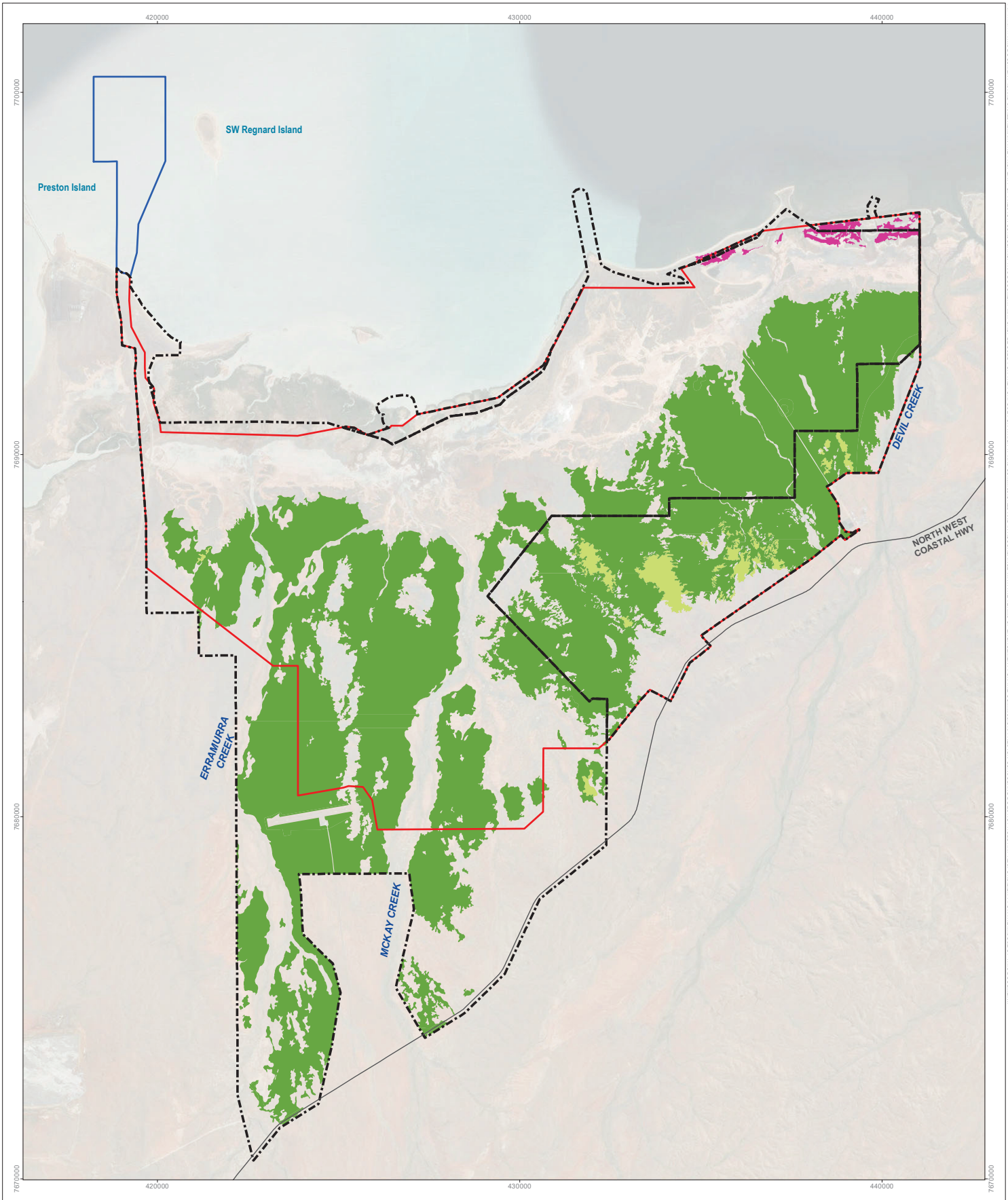

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Figure 4-11: PECs identified within the Study Area

0 0.75 1.5 3 km

Scale: 1:100,000 @ A3

N

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY

Legend

- Marine Development Envelope
- Pond and Infrastructure Development Envelope
- Flora and Vegetation Study Area

Threatened and Priority Ecological Communities

- Priority 3: Coastal dune native tussock grassland dominated by *Whiteochloa airoides*
- Priority 3: Horseflat land system of the Roebourne Plains
- Priority 3: (PARTIALLY) Horseflat land system of the Roebourne Plains

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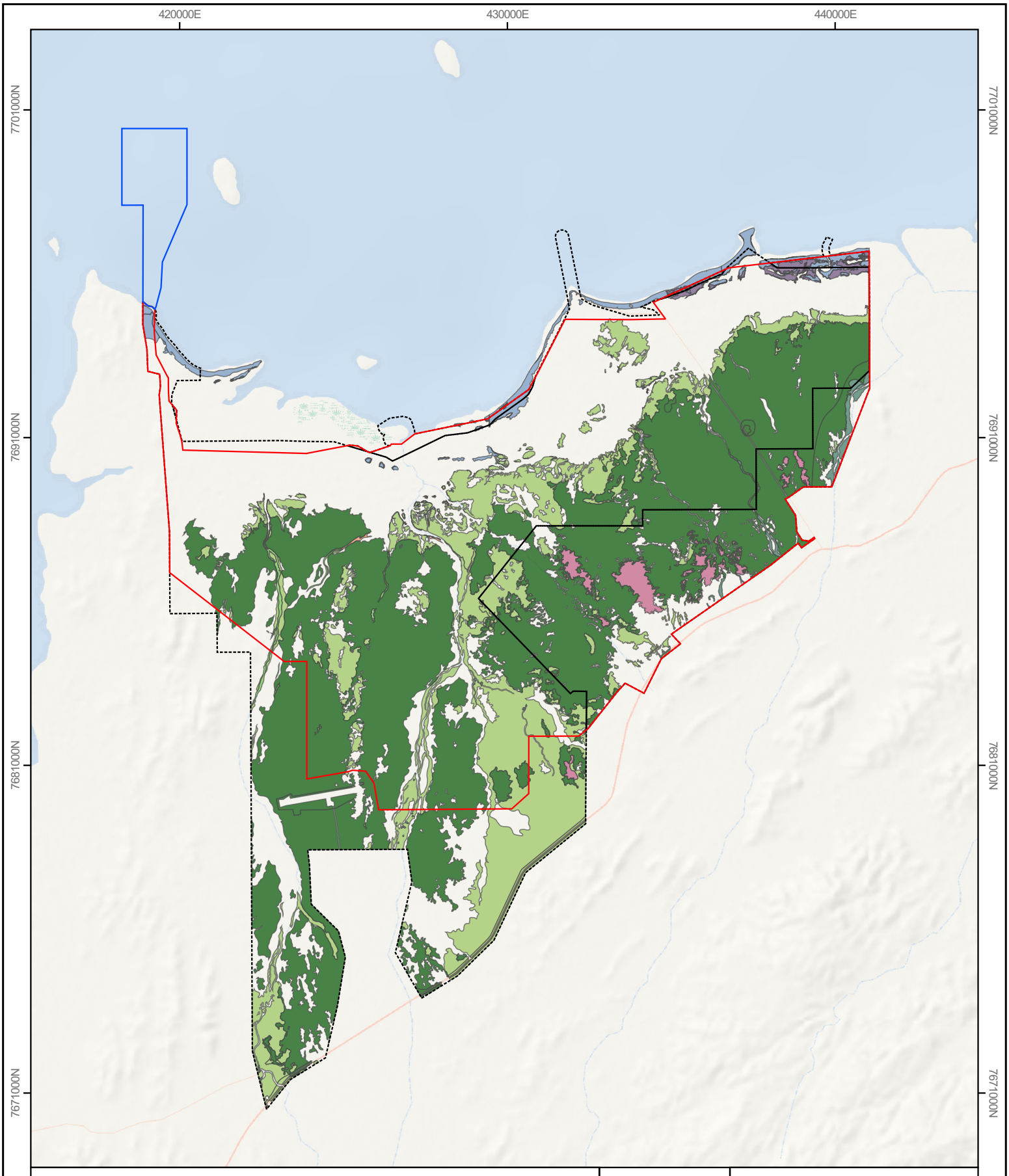
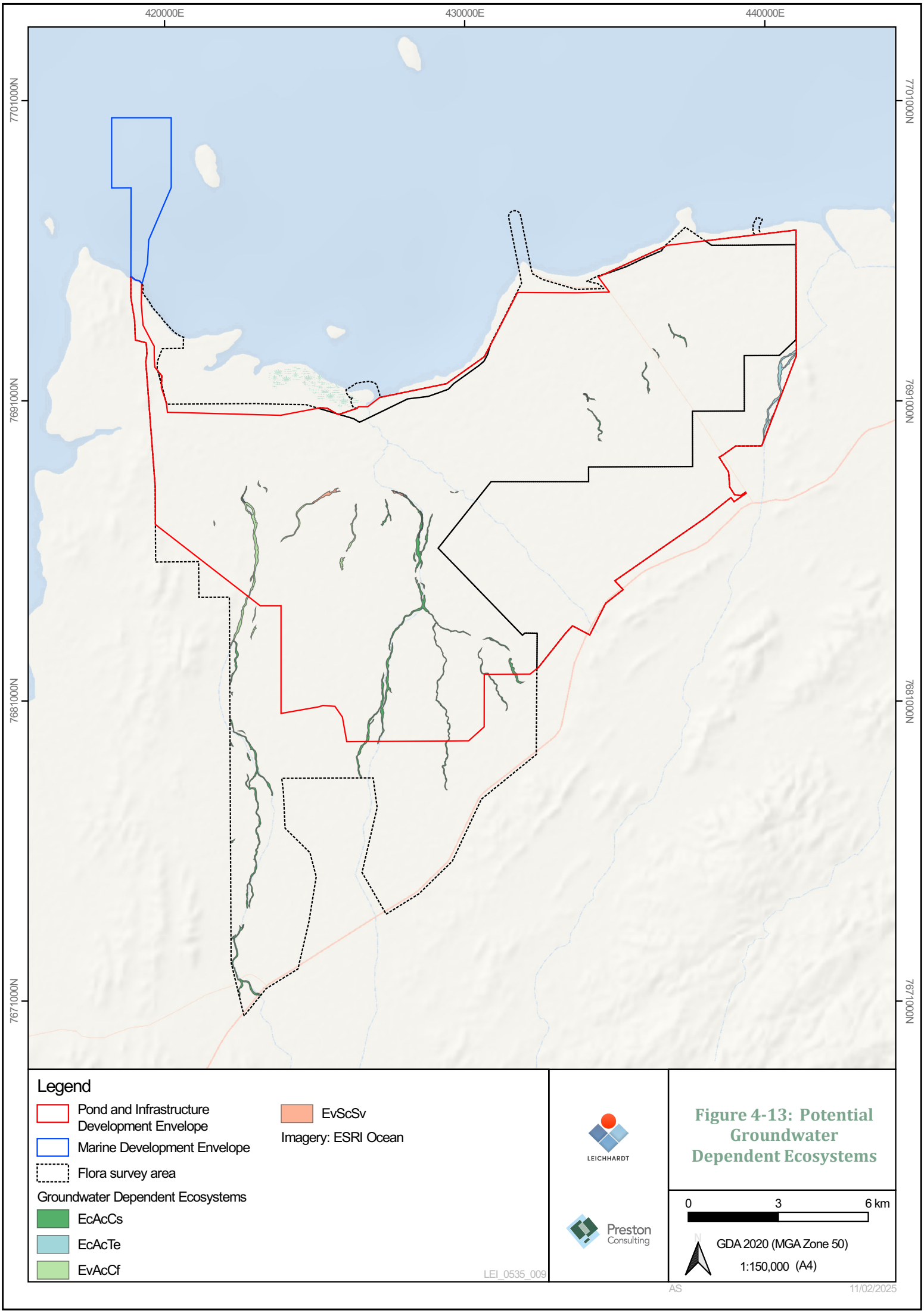


Figure 4-12: Locally significant vegetation types (excluding vegetation significant only as a GDE)


420000E
430000E
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7701000N
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Legend
Pond and Infrastructure Development Envelope
Marine Development Envelope
Flora survey area
Groundwater Dependent Ecosystems
EcAcCs
EcAcTe
EvAcCf
EvScSv
Imagery: ESRI Ocean
LEICHHARDT
Preston Consulting
Figure 4-13: Potential Groundwater Dependent Ecosystems
0
3
6 km
N
GDA 2020 (MGA Zone 50)
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4.4.2 FLORA

The field surveys recorded, and identified to species level, a total of 356 flora taxa, representing 51 families and 165 genera. Species richness between quadrats ranged from 6 - 75 species. The assemblage included 344 native species and 12 introduced species, including 253 perennial species, 93 annual or short-lived species and ten species that are considered both. The most prominent families recorded were Fabaceae (69 taxa), Poaceae (50 taxa), and Chenopodiaceae (38 taxa).

Phoenix (2025) reported that the number of species recorded in the current Study Area compares favourably to other surveys within close proximity to the Project.

Threatened and Priority Flora

Twenty-one significant flora species were identified in the desktop review as potentially occurring in or around the Study Area; 20 Priority flora listed under the BC Act and one novel species. One Priority flora species identified, *Minuria tridens,* is also listed as Threatened under the EPBC Act but has since been shown not to occur in WA. These records were visited by Phoenix and were not located. Pers. comms. with Professor Stephen van Leeuwen has identified that there is no suitable habitat for *Cucumis* sp. Barrow Island (D.W. Goodall 1264) as this species grows on limestone habitats on Barrow Island and Cape Range only. Therefore, the two historical records at Cape Preston East are likely to have been incorrectly identified and have not been considered further.

Targeted searches of the Study Area were undertaken for significant flora species identified in the desktop review. The searches focused on habitats considered likely to support such flora, in addition to previously recorded locations of significant plants or populations in proximity to the Study Area.

No Threatened flora under the BC Act or EPBC Act were recorded during the field surveys. Three Priority 3 flora were recorded during the field survey; *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479) (Priority 3), *Eremophila forrestii* subsp*. viridis* (Priority 3) and *Rostellularia adscendens* var*. latifolia* (Priority 3) (Figure 4-14). Leichhardt notes that *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479) and *Eremophila forrestii* subsp*. viridis* remain taxonomically uncertain and their Priority flora status may change pending further taxonomic information.

Nine other Priority flora species were identified by Phoenix (2025) as possibly occurring within the Study Area, following a conservative habitat assessment:

- *Minuria tridens* (P1);
- *Atriplex lindleyi* subsp. *conduplicate* (P3);
- *Euphorbia australis* var. *glabra* (P3);
- *Gomphrena cucullate* (P3);
- *Gomphrena leptophylla* (P3);
- *Gymnanthera cunninghamii* (P3);
- *Stackhousia clementii* (P3);
- *Terminalia supranitifolia* (P3); and
- *Goodenia nuda* (P4).

As above, it is now known that *Minuria tridens* does not occur in WA. Professor S. van Leeuwen (pers. comm., 2023) also noted that *Stackhousia clementii* (P3) and *Terminalia supranitifolia* (P3) were unlikely to occur based on a lack of suitable habitat. Table 4-13 lists the other Priority Flora that were assessed and considered unlikely to be present within the Study Area.

Table 4-13: Likelihood of occurrence for significant flora in the Study Area (Phoenix, 2025)

Species	Status	Likelihood of occurrence
Gomphrena axillaris (R.W.Davis and J.Palmer) formally known as *Gomphrena* sp. Martins Well (K.F. Kenneally 6116)	P1	Unlikely Study Area outside of typical range. Closest record 31.1 km from Study Area.
Corchorus congener	P3	Unlikely. Study Area unlikely to contain typical habitat of offshore islands.
Goodenia sp. East Pilbara	P3	Unlikely Study Area outside of typical distribution and lack of suitable habitat. Closest Florabase record is 205.7 km however, it was recorded within several km (<5 km) from Study Area in Biota and Trudgen and Associates (2001).
Owenia acidula	P3	Unlikely. Study Area within typical range. Suitable habitat within the Study Area, however due the ease of detectability in the field and area of habitat searched, unlikely present. Closest record is 30.8 km from the Study Area.
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	Unlikely Study Area outside of typical distribution and lack of suitable habitat present. Closest record is 36.3 km from the Study Area.
Triodia pisoliticola	P3	Unlikely. Study Area outside of typical distribution. Closest record is 28.6 km from Study Area.
Vigna triodiophila	P3	Unlikely. Study Area outside of typical distribution. Closest record is 39.7 km from Study Area.
Rhynchosia bungarensis	P4	Unlikely. Suitable habitat does not occur within the Study Area. Closest record is 1.2 km from the Study Area.

Potentially Significant Unidentified or Undescribed Flora

Additional significant flora taxa identified during the survey (Figure 4-14) include 12 unidentified /unknown species which include:

- *Polygala* aff. *galeocephala;*
- *Bonamia* aff. *media;*
- *Scaevola* aff. *pulchella*;
- *Tecticornia halocnemoides* 'ovate seed aggregate';
- *Tecticornia* sp. sterile 1;
- *Tecticornia* sp. sterile 2;
- *Tecticornia* sp. sterile 3;
- *Tecticornia* sp. sterile 4;
- *Tecticornia* sp. sterile 5;
- *Tecticornia* sp. sterile 6;

- *Tecticornia* sp. sterile 7; and
- *Tecticornia* sp. sterile 8.

The nine sterile *Tecticornia* species collected by Phoenix (2025) have unresolved taxonomy due to a lack of material.

While samphires (*Tecticornia* species) are easily recognised as a single vegetation type at the landscape level, ironically individual plants are extremely difficult to identify to species (Shepherd & Žerdoner Čalasan, 2024). This is due to their reduced morphology as they do not have true leaves (only succulent, bead-like stems), the flowers are tiny, and non-descriptive, and the seeds are very small (usually less than 1.5 mm long) A detailed study of samphire seeds using Electron Microscopy (Shepherd et al. 2005), determined that the shape, colour, and ornamentation of seeds are useful diagnostic characters and, in some cases, also the only reliable character for species identification, particularly among closely related taxa (species or subspecies). However, as samphire seeds are so small, these fine details are not as readily observed with the naked eye. Unfortunately, seed is also held only on some species with 'soft-fruits' for a period of weeks or months post-flowering before fruits fall, rendering them sterile and essentially unidentifiable for most of the year.

Samphires pose further taxonomic challenges due to the presence of unresolved species complexes with morphological intergrades, and potential hybrids among sympatric (co-occurring) species (Shepherd & Žerdoner Čalasan, 2024). Polyploids (taxa with multiple sets of chromosomes) have also been documented within some species of the genus and even among species in the same population.

Dr Kelly Shepherd from the WA Herbarium and Dr Anže Žerdoner Čalasan from the Ludwig Maximilian University of Munich were engaged to complete a taxonomic analysis of the *Tecticornia* species (Shepherd & Žerdoner Čalasan, 2024; Appendix 1). The results demonstrate that none of the currently known species of *Tecticornia* are restricted to the study area, confirming that all known species present within the Indicative Disturbance Footprint, also occur elsewhere. The large numbers of samples of the potentially new undescribed taxon *T.* sp. nov. 'large ovate seed' sequenced in this study confirm that this taxon is present at both the Project and elsewhere, having a widespread distribution along the coast from Carnarvon to Derby. Similarly, the genetically divergent subclade of *Tecticornia pterygosperma* subsp. *denticulata* includes a sample from the Project, which is genetically similar to samples with a widespread distribution from near Carnarvon to Point Sampson. If further research supports this subclade as morphologically distinct and warrants taxonomic recognition, it represents another potentially new, undescribed *Tecticornia*, which is present at both the Project and elsewhere.

Other Unidentified or Undescribed Species

A total of 11 other taxa could not be identified to a species level (Table 4-14), mainly as a result of insufficient taxonomic characters, as plants were sterile or reproductive structures were too old/dry or damaged to be useful. The majority of the species possessed characters indicating that they were likely common species but lacked sufficient characters for confirmation of identity. Seven of the 11 unidentified flora have been ruled out as potential Priority species (Phoenix, 2025).

Table 4-14: Unidentified taxa recorded during the field survey

Taxon	Comments
Boerhavia sp.	Sterile. No Priority *Boerhavia* are known in the Pilbara region.
Frankenia sp.	Sterile. No Priority *Frankenia* are known in the Pilbara region.
Goodeniaceae sp.	Sterile.
Hibiscus sp.	Damaged reproductive structures. No Priority *Hibiscus* are known in the Roebourne subregion.
Indeterminate	Damaged reproductive structures.
Lamiaceae sp.	Sterile. No Priority *Lamiaceae* are known in the Roebourne subregion.
Poaceae sp.	Inflorescence old and dry.
Sclerolaena sp.	Damaged reproductive structures. No Priority *Sclerolaena* are known in the Pilbara region.
Sida sp.	Old dry material, incomplete. One Priority *Sida* (sp. Barlee Range (S. van Leeuwen 1642)) known in the Roebourne subregion, but not known within the local region and Study Area lacks suitable habitat.
Tephrosia sp. (E043)	Sterile. One Priority *Tephrosia* (*rosea* var. Port Hedland (A.S. George 1114)) known in the Roebourne subregion, but not known within the local region.
Triodia ?epactia	Inflorescence old and dry.

Range Extensions

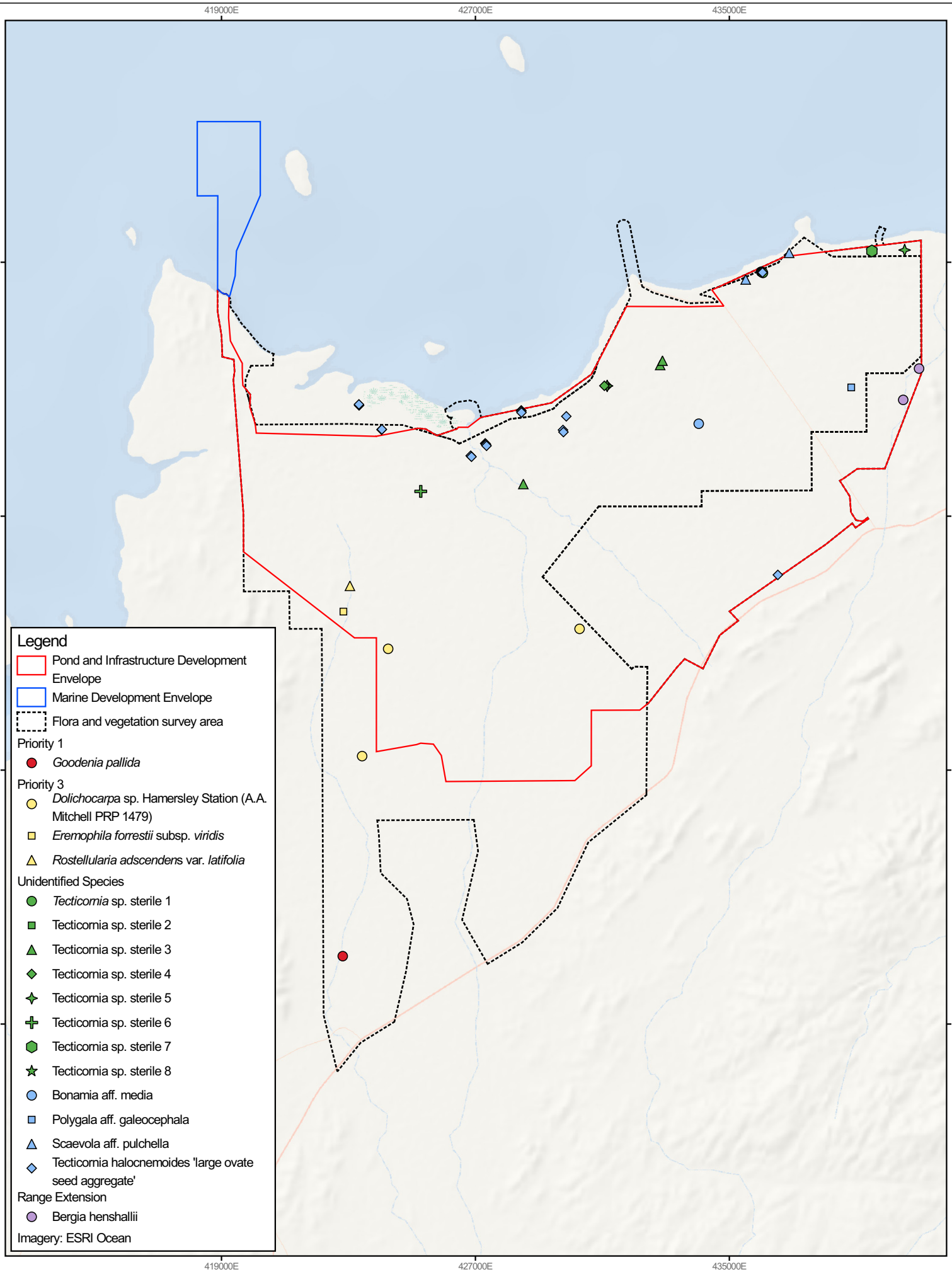
Two of the three Priority 3 species recorded within the Study Area are deemed range extensions, *Eremophila forrestii* subsp. *viridis* and *Rostellularia adscendens* var. latifolia. One additional species was also deemed as significant range extension. Details of flora species with significant range extensions are detailed in Table 4-15.

Table 4-15 Details of flora species recorded during the field survey with range extensions

Species	Status	Distribution and ecology
Eremophila forrestii subsp. *viridis*	P3 (DBCA) ~147 km range extension	Recorded across the Carnarvon, Great Sandy Desert, Pilbara Bioregions and Roebourne subregion. Shrubland over hummock grassland, flats and hardpan. Rocky gullies. Five records in Florabase (WA Herbarium, 1998-). Further taxonomic work may be required to accurately determine distribution.
Rostellularia adscendens var. *latifolia*	P3 (DBCA) ~130 km range extension	Recorded across the Pilbara bioregion on ironstone soils near creeks and rocky hills. Florabase has 40 records with populations ranging from a few individuals to 50 plants (WA Herbarium, 1998-).
Bergia henshallii	~239.8 km range extension	Recorded across the Dampierland, Gibson Desert, Great Sandy Desert, Ord Victorian Plain, Tanami, and Pilbara Bioregions, including the Roebourne subregion. Red clay, sand. Flats and dunes. 24 records in Florabase (WA Herbarium, 1998-).

Introduced Flora

Twelve introduced flora species were recorded during the survey. One of these species, *Prosopis glandulosa x velutina,* is listed as both a WoNS and Declared Pest. This species was recorded within one quadrat. This introduced species is allocated to the category 2 - eradication category (DPIRD, 2021). This identifies organisms which should be eradicated from part or all of WA, at the state-wide scale.



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Project: LEI_0535_026
Date: 30/04/2025
Size: A4
Author: ASmithers (Preston Consulting Pty Ltd)

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Preston Consulting

Figure 4-14: Location of significant flora

4.5 TERRESTRIAL FAUNA

A desktop review and numerous field surveys have been conducted by Phoenix (2023) to inform this section.

4.5.1 FAUNA HABITAT

A total of 16 fauna habitat types were identified in the Terrestrial Fauna Study Area (TFSA) which can be classified into eight broad groupings based on vegetation and landform:

- Tussock grasslands on beaches and dunes;
- Mangal forests;
- Eucalypt forests and woodlands (typically on drainage lines);
- Samphire shrublands (tidal and inland) which are indistinguishable floristically;
- Tussock grasslands, with varying degrees of shrub cover/dominance;
- Spinifex grasslands;
- Tidal creeks and ocean; and
- Mudflats and salt flats.

Descriptions and mapped extent of the habitats are provided in Table 4-16.

Table 4-16: Fauna habitats of the TFSA

Habitat	Mapped extent within TFSA (ha)	Percentage of TFSA
Beach	16.4	0.1
Cleared	142.1	0.5
Forest of *Eucalyptus* spp. over tall shrubland over grassland	54.6	0.2
Mangal community	285.1	1.1
Mudflat or salt flat	2,419.7	9.1
Samphire shrubland (tidal)	593.7	2.2
Samphire shrubland (inland)	295.1	1.1
Shrubland over spinifex grassland	5,326.5	20.1
Shrubland over tussock grassland	3,805.2	14.4
Shrubland over spinifex grassland on drainage	100.0	0.4
Spinifex grassland	120.5	0.5
Tidal channel and ocean	155.9	0.6
Tussock grassland	12,914.6	48.8
Tussock grassland on beach and dune	0.03	<0.1
Tussock grassland on granite outcrop	9.5	<0.1
Upright outcrop - shrubland over spinifex grassland	0.5	<0.1
Woodland of Eucalyptus spp. over tussock grassland on drainage	209.4	0.8
TOTAL	**26,448.8**	**100.0%**

Tussock Grasslands

Tussock grasslands is the most dominant fauna habitat within the TFSA comprising approximately 60% of the total area. Tussock grasslands recorded a single significant species, the North-Western Free-tailed Bat (P1). The record here is associated with a drainage line and is consistent with other survey records in the region (Phoenix, 2013 and 2020), where the species was recorded several kilometres inland from its coastal roosting sites.

Mangal Communities

Mangal communities support North-Western Free-tailed Bat which was recorded from four locations and occurs extensively within mangal communities of the region. This habitat also supports foraging and roosting of numerous migratory shorebirds, such as Whimbrel (Migratory; EPBC Act, BC Act), and the Shining Flycatcher which was recorded as a range extension.

Eucalypt forests and woodlands (typically on drainage lines)

A number of drainage lines carry water from the south and east towards the coast and these typically support narrow strips of riparian eucalypt open woodlands and woodlands. Here, where the inland alluvial, more porous soils meet the marine-deposited soils of the mudflats above the current tide line, fresher groundwater is forced to the surface over the denser marine groundwater and pools. Further, if granite outcropping occurs, surface water persistence is often extended (mainly in the northeast). These habitats are typically heavily impacted by cattle and have likely suffered significant changes to the vegetation structure and composition. Despite the impacts, these habitat areas support Northern Quoll (EN; EPBC Act, BC Act) dispersal down the drainage lines from the hills to the south and shelter/denning opportunities where granite outcropping occurs. The occurrence of persistent surface water in this habitat is also an important water source for most species of bird and mammal through the dry season.

Samphire Shrublands

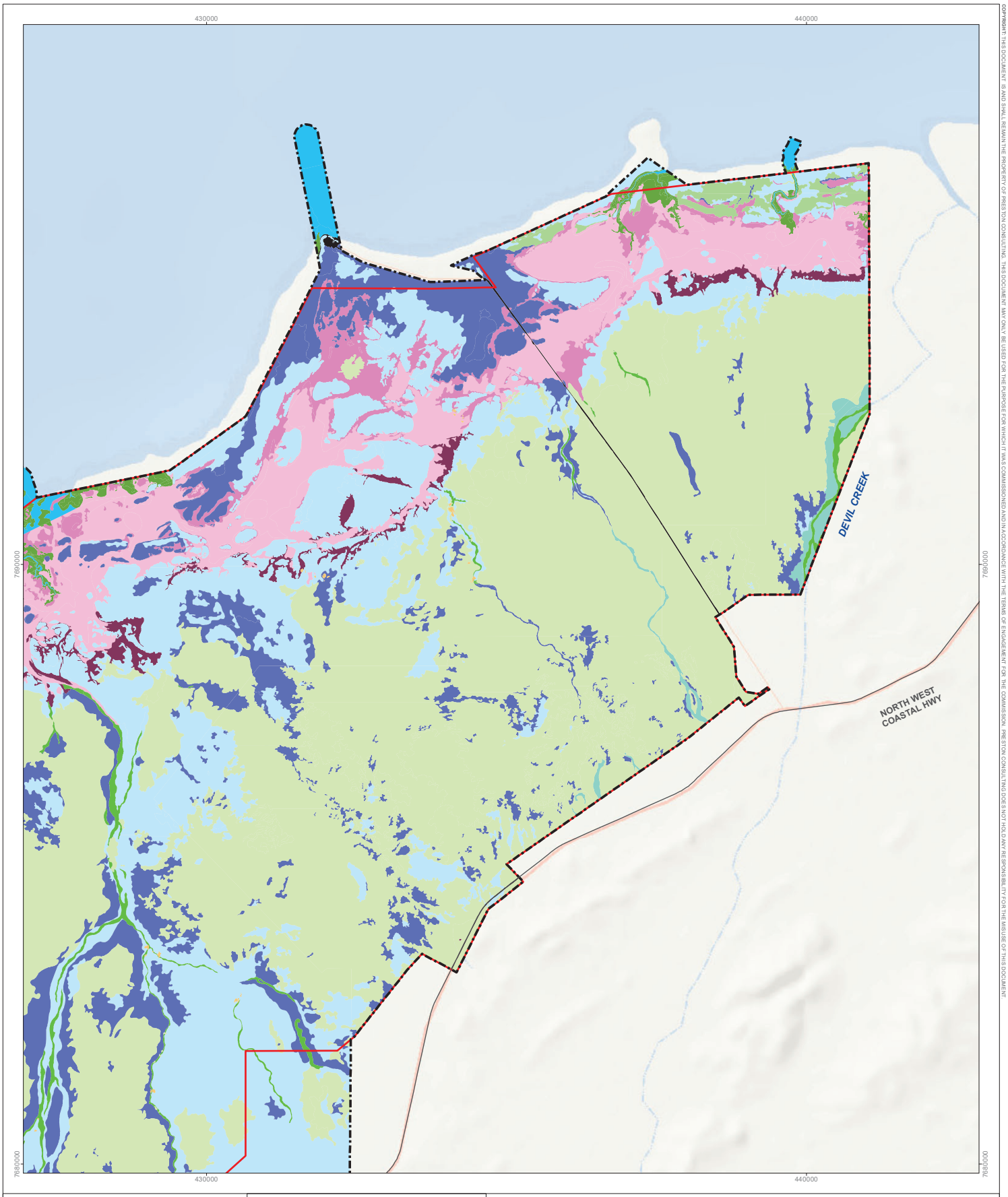
Within the tidal samphire habitat, 16 migratory bird species were recorded while conducting aerial shorebird transects. A Northern Quoll scat was also recorded in this habitat, just 790 m from the coast, and isolated from other Northern Quoll habitat features typically targeted when attempting to determine presence/absence of the species. Tidal samphire shrublands predominantly support foraging by the diverse and abundant shorebird assemblage recorded; of which 31 species were present (including six Threatened species) often in nationally significant numbers and occasionally in internationally significant numbers.

Spinifex Grasslands

Spinifex grasslands is the second most dominant fauna habitat within the TFSA comprising approximately 21% of the total area. Spinifex grassland habitats were found to directly support four significant species, the Grey Falcon (VU; BC Act), Northern Quoll, North-Western Free-tailed Bat, Pilbara Leaf-nosed Bat (VU; EPBC Act, BC Act) and the Lined Soil-crevice Skink (P4).

Mudflats and Salt flats

A total of 24 Migratory bird species were associated with mudflat and salt flat habitat while conducting aerial shorebird transects.



Preston Consulting

CREATED BY	JOB	DATE	REVISION
ENVIRONMAPS	PC2900212	27/04/2023	0

Leichhardt Salt Pty Ltd

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km

Scale: 1:60,000 @ A3

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- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY

Legend

- Marine Development Envelope
- Pond and Infrastructure Development Envelope
- Terrestrial Fauna Study Area

Fauna Habitat

- Beach
- Mangal community
- Tidal channel and ocean
- Mudflat or salt flat
- Samphire shrubland (tidal)
- Samphire shrubland (inland)
- Forest of Eucalyptus spp. over tall shrubland over grassland
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Spinifex grassland
- Tussock grassland on beach and dune
- Tussock grassland on granite outcrop
- Upright outcrop - shrubland over spinifex grassland
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Tussock grassland
- Cleared

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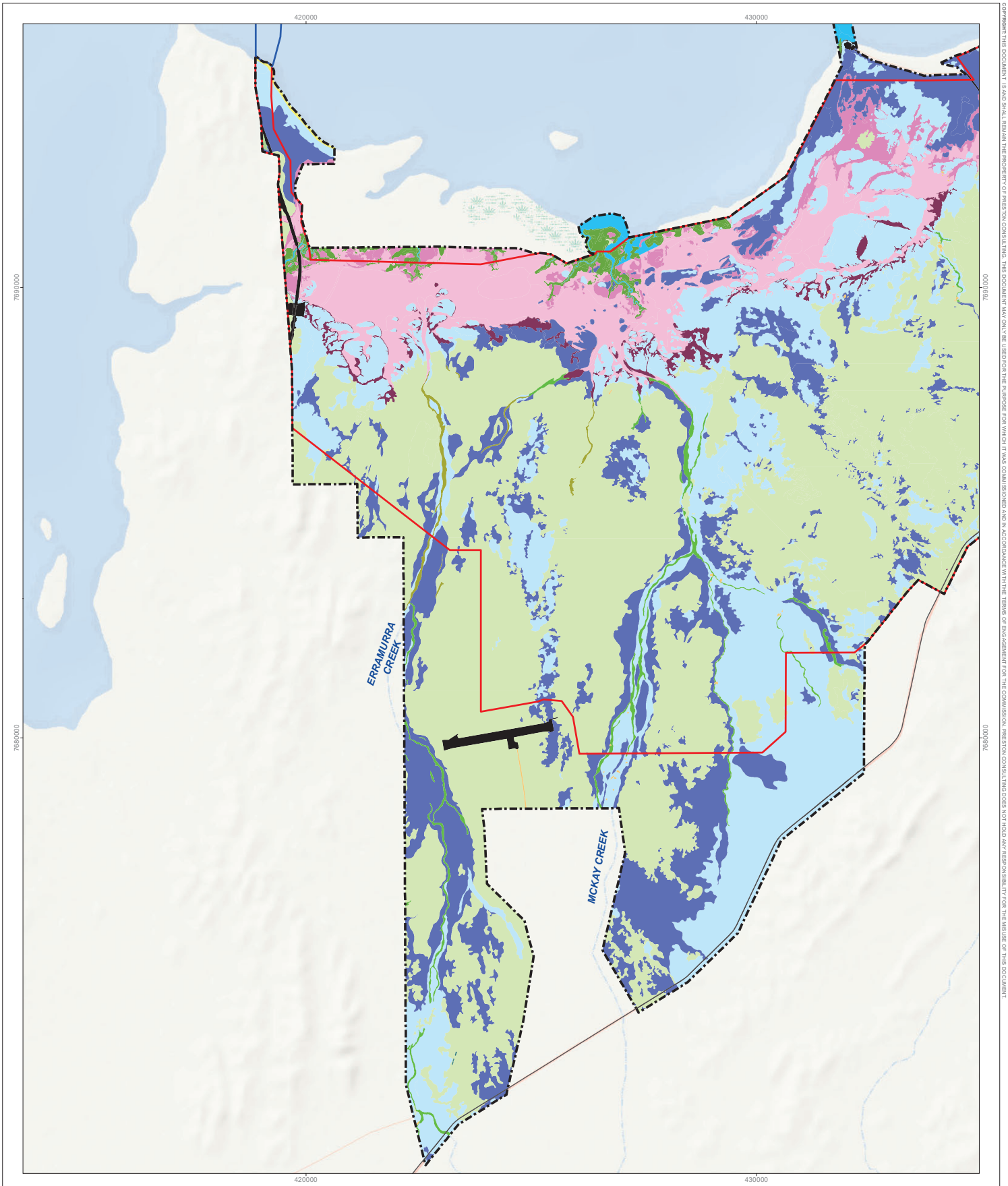
Figure 4-15: Fauna habitats recorded within the TFSA (East)



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ENVIRONMAPS	PC2900212	27/04/2023	0

Leichhardt Salt Pty Ltd

0 0.75 1.5 3 km

Scale: 1:80,000 @ A3

N

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY

Legend

- Marine Development Envelope
- Pond and Infrastructure Development Envelope
- Terrestrial Fauna Study Area

Fauna Habitat

- Beach
- Mangal community
- Tidal channel and ocean
- Mudflat or salt flat
- Samphire shrubland (tidal)
- Samphire shrubland (inland)
- Forest of Eucalyptus spp. over tall shrubland over grassland
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Spinifex grassland
- Tussock grassland on beach and dune
- Tussock grassland on granite outcrop
- Upright outcrop - shrubland over spinifex grassland
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Tussock grassland
- Cleared

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Figure 4-16: Fauna habitats recorded within the TFSA (West)

4.5.2 General Fauna

A total of 201 species were recorded in the TFSA and Migratory Shorebird Study Area (SBSA) during the field surveys undertaken between December 2019 and December 2021, including two amphibians, 48 reptiles, 128 birds and 23 mammals (20 native and three introduced). This represents 44% of the species that were identified as potentially occurring in the desktop review. In addition monitoring for Northern Quolls completed by Cowan (2024) identified the most widespread and frequently recorded species were red kangaroos, present in every habitat and at every camera location.

Birds were the most diverse Class of vertebrates recorded, which is consistent with the findings of the desktop review. This is to be expected where the largest proportion of the survey effort has focused on birds, principally migratory shorebirds.

4.5.3 Significant Fauna

For the purposes of this assessment the term 'significant fauna' refers to:

- Fauna species listed under the EPBC Act or BC Act that were recorded or considered likely to occur within the study areas, as well as the Night Parrot;
- Species with restricted distribution;
- Species with a degree of historical impact from threatening processes; and
- Species that provide an important function required to maintain the ecological integrity of a significant ecosystem.

A total of 60 significant terrestrial fauna (noting that turtles are excluded as they are considered marine fauna) were recorded or considered likely to occur within the survey areas, including seven mammals, two reptiles and 51 birds (Table 4-17).

The significant fauna species that were recorded during the field surveys are shown in Figure 4-17 and outlined in Table 4-17. Migratory shorebirds are excluded from Figure 4-17, which only displays bird species listed under the EPBA Act or BC Act. All recorded migratory shorebirds are discussed in further detail in the section below.

Table 4-17: Significant fauna recorded or considered likely or possible to occur within the study areas

Species	Common name	Conservation status	Likelihood of occurrence
Mammals			
Dasyurus hallucatus	Northern Quoll	EN (EPBC Act; BC Act)	Recorded
Macroderma gigas	Ghost Bat	VU (EPBC Act; BC Act)	Likely
Rhinonicteris aurantia (Pilbara)	Pilbara Leaf-nosed Bat	VU (EPBC Act; BC Act)	Recorded
Mormopterus cobourgianus	North-Western Free-tailed Bat	P1 (DBCA)	Recorded
Hydromys chrysogaster	Rakali, Water Rat	P4 (DBCA)	Likely
Leggadina lakedownensis	Northern Short-tailed Mouse	P4 (DBCA)	Likely
Pseudomys chapmani	Western Pebble-mound Mouse	P4 (DBCA)	Likely
Reptiles			

Species	Common name	Conservation status	Likelihood of occurrence
Notoscincus butleri	Lined Soil-crevice Skink	P4 (DBCA)	Recorded
Liasis olivaceus barroni	Pilbara Olive Python	VU (EPBC Act; BC Act)	Likely
Ctenotus angusticeps	Airlie Island *Ctenotus*	P2 (DBCA)	Possible
Birds			
Calidris ferruginea	Curlew Sandpiper	CR/Mig. (EPBC Act; BC Act)	Recorded
Calidris tenuirostris	Great Knot	CR/Mig. (EPBC Act; BC Act)	Recorded
Limosa lapponica menzbieri	Bar-tailed Godwit (northern Siberian)	CR/Mig. (EPBC Act; BC Act);	Recorded
Numenius madagascariensis	Eastern Curlew	CR/Mig. (EPBC Act; BC Act)	Recorded
Calidris canutus	Red Knot	EN/Mig. (EPBC Act; BC Act)	Recorded
Charadrius mongolus	Lesser Sand Plover	EN/Mig. (EPBC Act; BC Act)	Recorded
Puffinus huttoni	Hutton's Shearwater	EN (BC Act)	Likely
Charadrius leschenaultii	Greater Sand Plover	VU/Mig. (EPBC Act; BC Act)	Recorded
Sterna nereis nereis	Australian Fairy Tern	VU (BC Act)	Recorded
Falco hypoleucos	Grey Falcon	VU (EPBC Act; BC Act)	Likely
Oxyura australis	Blue-billed Duck	P4 DBCA	Likely
Tringa brevipes	Grey-tailed Tattler	P4 (DBCA) Mig. (EPBC Act; BC Act)	Recorded
Falco peregrinus	Peregrine Falcon	OS (BC Act)	Likely
Actitis hypoleucos	Common Sandpiper	Mig. (EPBC Act; BC Act)	Recorded
Arenaria interpres	Ruddy Turnstone	Mig. (EPBC Act; BC Act)	Recorded
Apus pacificus	Fork-tailed Swift	Mig. (EPBC Act; BC Act)	Recorded
Calidris acuminata	Sharp-tailed Sandpiper	Mig. (EPBC Act; BC Act)	Recorded
Calidris alba	Sanderling	Mig. (EPBC Act; BC Act)	Recorded
Calidris melanotos	Pectoral Sandpiper	Mig. (EPBC Act; BC Act)	Recorded
Calidris ruficollis	Red-necked Stint	Mig. (EPBC Act; BC Act)	Recorded
Charadrius veredus	Oriental Plover	Mig. (EPBC Act; BC Act)	Recorded
Chlidonias leucopterus	White-winged Black Tern	Mig. (EPBC Act; BC Act)	Recorded
Glareola maldivarum	Oriental Pratincole	Mig. (EPBC Act; BC Act)	Recorded
Limosa limosa	Black-tailed Godwit	Mig. (EPBC Act; BC Act)	Recorded
Numenius minutus	Little Curlew	Mig. (EPBC Act; BC Act)	Recorded
Numenius phaeopus	Whimbrel	Mig. (EPBC Act; BC Act)	Recorded
Pandion cristatus	Osprey	Mig. (EPBC Act; BC Act)	Recorded

Species	Common name	Conservation status	Likelihood of occurrence
Pluvialis fulva	Pacific Golden Plover	Mig. (EPBC Act; BC Act)	Recorded
Pluvialis squatarola	Grey Plover	Mig. (EPBC Act; BC Act)	Recorded
Sternula albifrons	White-shafted Little Tern, Little Tern	Mig. (EPBC Act; BC Act)	Recorded
Sterna bergii	Crested Tern	Mig. (EPBC Act; BC Act)	Recorded
Sterna caspia	Caspian Tern	Mig. (EPBC Act; BC Act)	Recorded
Sterna dougallii	Roseate Tern	Mig. (EPBC Act; BC Act)	Recorded
Sterna hirundo	Common Tern	Mig. (EPBC Act; BC Act)	Recorded
Sterna nilotica	Gull-billed Tern	Mig. (EPBC Act; BC Act)	Recorded
Tringa nebularia	Common Greenshank	Mig. (EPBC Act; BC Act)	Recorded
Xenus cinereus	Terek Sandpiper	Mig. (EPBC Act; BC Act)	Recorded
Ardenna pacifica	Wedge-tailed Shearwater	Mig. (EPBC Act; BC Act)	Likely
Calidris subminuta	Long-toed Stint	Mig. (EPBC Act; BC Act)	Likely
Fregata ariel	Lesser Frigatebird	Mig. (EPBC Act; BC Act)	Likely
Gallinago stenura	Pin-tailed snipe	Mig. (EPBC Act; BC Act)	Likely
Hirundo rustica	Barn Swallow	Mig. (EPBC Act; BC Act)	Likely
Limicola falcinellus	Broad-billed sandpiper	Mig. (EPBC Act; BC Act)	Likely
Oceanites oceanicus	Wilson's Storm Petrel	Mig. (EPBC Act; BC Act)	Likely
Plegadis falcinellus	Glossy Ibis	Mig. (EPBC Act; BC Act)	Likely
Sula leucogaster	Brown Booby	Mig. (EPBC Act; BC Act)	Likely
Tringa stagnatilis	Marsh Sandpiper	Mig. (EPBC Act; BC Act)	Likely
Tringa totanus	Common Redshank	Mig. (EPBC Act; BC Act)	Likely
Ardenna carneipes	Flesh-footed Shearwater	Mig. (EPBC Act; BC Act),VU (BC Act)	Possible
Calonectris leucomelas	Streaked Shearwater	Mig. (EPBC Act; BC Act)	Possible
Macronectes giganteus	Southern Giant Petrel	Endangered (EPBC Act) Mig. (EPBC Act; BC Act)	Possible
Limosa lapponica baueri	Bar-tailed Godwit (western Alaskan)	VU, Mig (EPBC and BC Act)	Possible
Phalaropus lobatus	Red-necked Phalarope	Mig. (EPBC Act; BC Act)	Possible
Tringa glareola	Wood Sandpiper	Mig. (EPBC Act; BC Act)	Possible
Motacilla flava	Yellow Wagtail	Mig. (EPBC Act; BC Act)	Possible

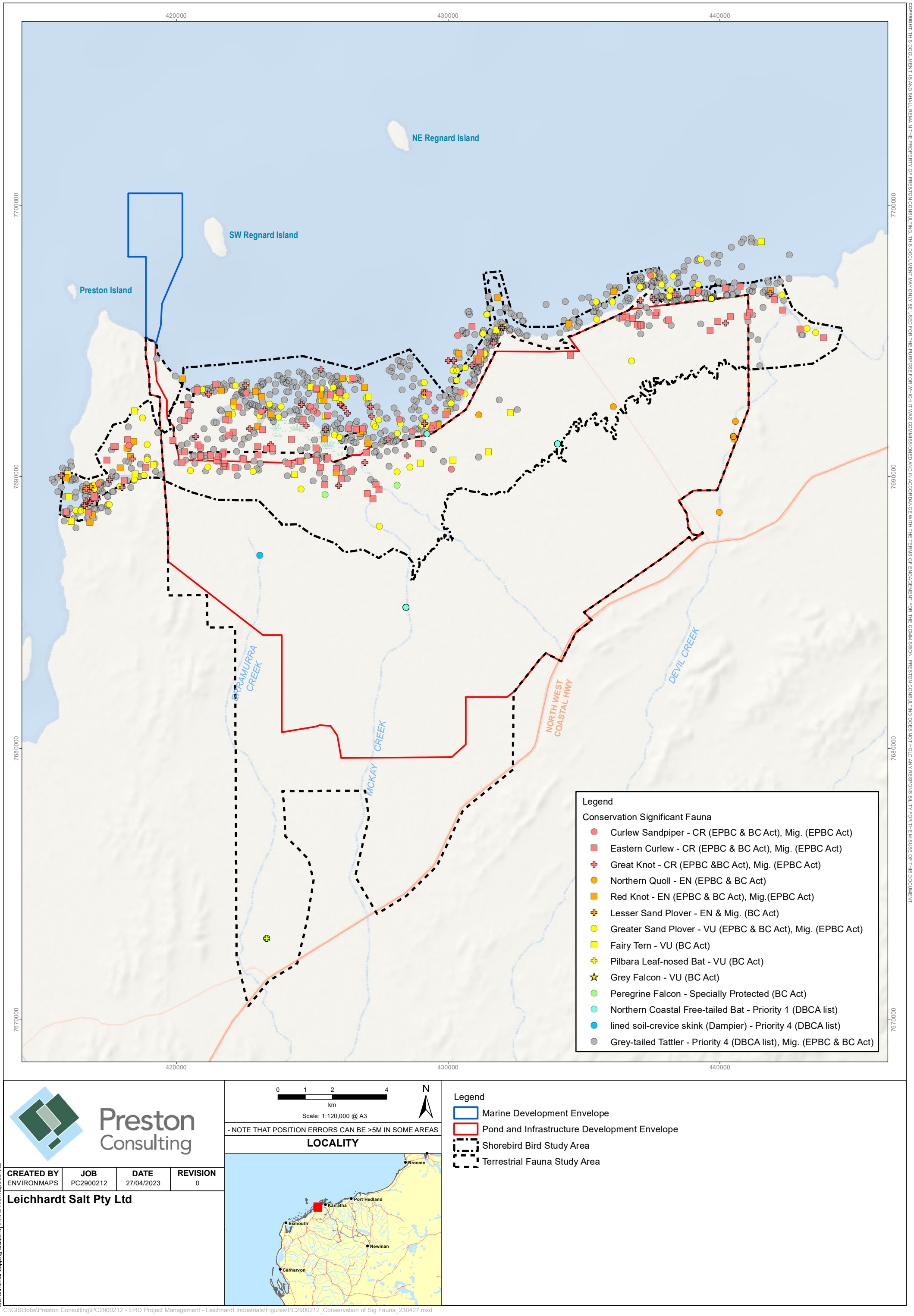


Figure 4-17: Significant fauna records (excluding shorebirds listed only as migratory)

Migratory Shorebirds

The field surveys identified 31 birds that are considered to be significant fauna species, and 11 additional significant bird species were identified during the desktop review as likely to occur within the TFSA (Table 4-17). The abundance of shorebirds is represented by heat maps, as shown from Figure 4-18 to Figure 4-21.

Recorded and Potential Species

The East Asian – Australasian Flyway (EAAF) migratory shorebird survey recorded 21 of the 37 species listed under EPBC Act Policy Statement 3.21 (Department of the Environment and Energy (DotEE), 2017). Of these, 14 were recorded in nationally and internationally significant numbers.

Habitat Assessment

Under the EPBC Act, 'important habitat' is a key concept for migratory species (DotEE, 2017). Important habitats in Australia for migratory shorebirds under the EPBC Act include those recognised as nationally or internationally important. The accepted and applied approach to identifying internationally important shorebird habitat has been through the use of criteria adopted under the Ramsar Convention on Wetlands (DotEE, 2017).

According to that approach, wetland habitat should be considered:

- Internationally important if it regularly supports:
  - 1% of the individuals in a population of one species or subspecies of waterbird; or
  - A total abundance of at least 20,000 waterbirds.
- Nationally important if it regularly supports:
  - 0.1% of the flyway population of a single species of Migratory shorebird;
  - A total abundance of at least 2,000 Migratory shorebirds; or
  - At least 15 Migratory shorebird species.

As assessment of the findings of the surveys within the SBSA against the above criteria is provided in Table 4-18.

Table 4-18: Assessment of migratory shorebird habitat within the SBSA

International Criteria	SBSA Characteristics
Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird	Likely to meet criterion. Three species were expected to meet this criterion once data was extrapolated across the SBSA: • Oriental Pratincole; • Ruddy Turnstone; and • Grey-tailed Tattler.
Regularly supports a total abundance of at least 20,000 waterbirds	Unlikely to meet criterion. The data does not suggest the SBSA supports more than 20,000 waterbirds.
National Criteria	**SBSA Characteristics**
Regularly supports 0.1% of the flyway population of a single species of migratory shorebird	Meets criterion. 14 species were recorded that meet this criterion: • Greater Sand Plover (also Vulnerable, EPBC Act); • Oriental Pratincole; • Ruddy Turnstone; • Sharp-tailed Sandpiper; • Sanderling; • Red Knot (also Critically Endangered, EPBC Act; Vulnerable, BC Act); • Curlew Sandpiper (also Critically Endangered, EPBC Act; Vulnerable, BC Act);

	• Red-necked Stint; • Bar-tailed Godwit; • Eastern Curlew (also Critically Endangered, EPBC Act; Vulnerable, BC Act); • Whimbrel; • Grey-tailed Tattler; • Common Greenshank; and • Terek Sandpiper.
Regularly supports a total abundance of at least 2,000 Migratory shorebirds	Meets criterion. More than 2,000 migratory shorebirds were regularly recorded in a single transect.
Regularly supports at least 15 Migratory shorebird species	Meets criterion. The surveys recorded 21 of the EAAF Migratory species.

Higher numbers of birds were observed in January and February compared to July. Abundance in summer was always greater for high tide events, suggesting more feeding opportunities are presented in the tidal samphire shrublands than on the exposed mudflats.

The area appears to be particularly important to the larger 'wetland species' (within the context of the Pilbara), Whimbrel, Curlew Sandpiper and Eastern Curlew, which is likely a reflection of the large extent of uninterrupted mangrove tidal creeks and associated intertidal samphire wetlands sitting immediately inland of large expanses of mudflats and sand banks that are exposed at low tides.

It is evident from the heat maps (Figure 4-18 to Figure 4-21) that on low tide when the intertidal mudflats are exposed the shorebirds move out of the SBSA and are highly concentrated in the bay and island immediately north of the Project, and in the 'delta' south of Cape Preston, to the west of the Project. At high tide when the mudflats are inundated, the birds move back into the SBSA to forage in the tidal samphire shrublands and mangroves, and on exposed sand bars in the tidal channels, but are more diffuse. However, important aggregations (roosting) still occur on high tide on the beaches west of 40-Mile Beach, on the unnamed island (407) offshore and also at the delta south of Cape Preston. The same pattern is evident in winter, but there are far fewer birds in the area at that time.

Figure 4-18: Summer low tide heat map for all birds recorded during shorebird transects

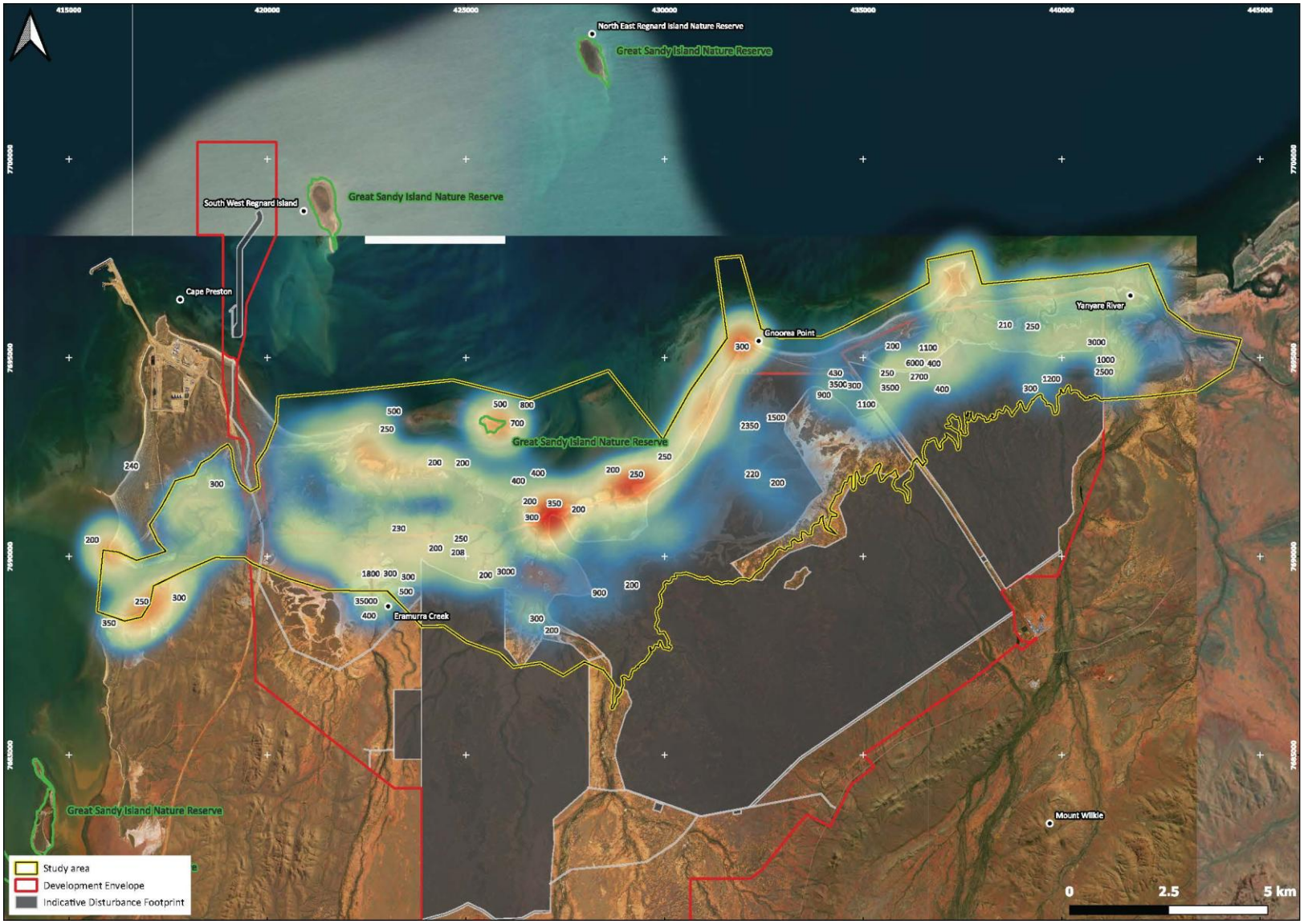


Figure 4-19: Summer high tide heat map for all birds recorded during shorebird transects

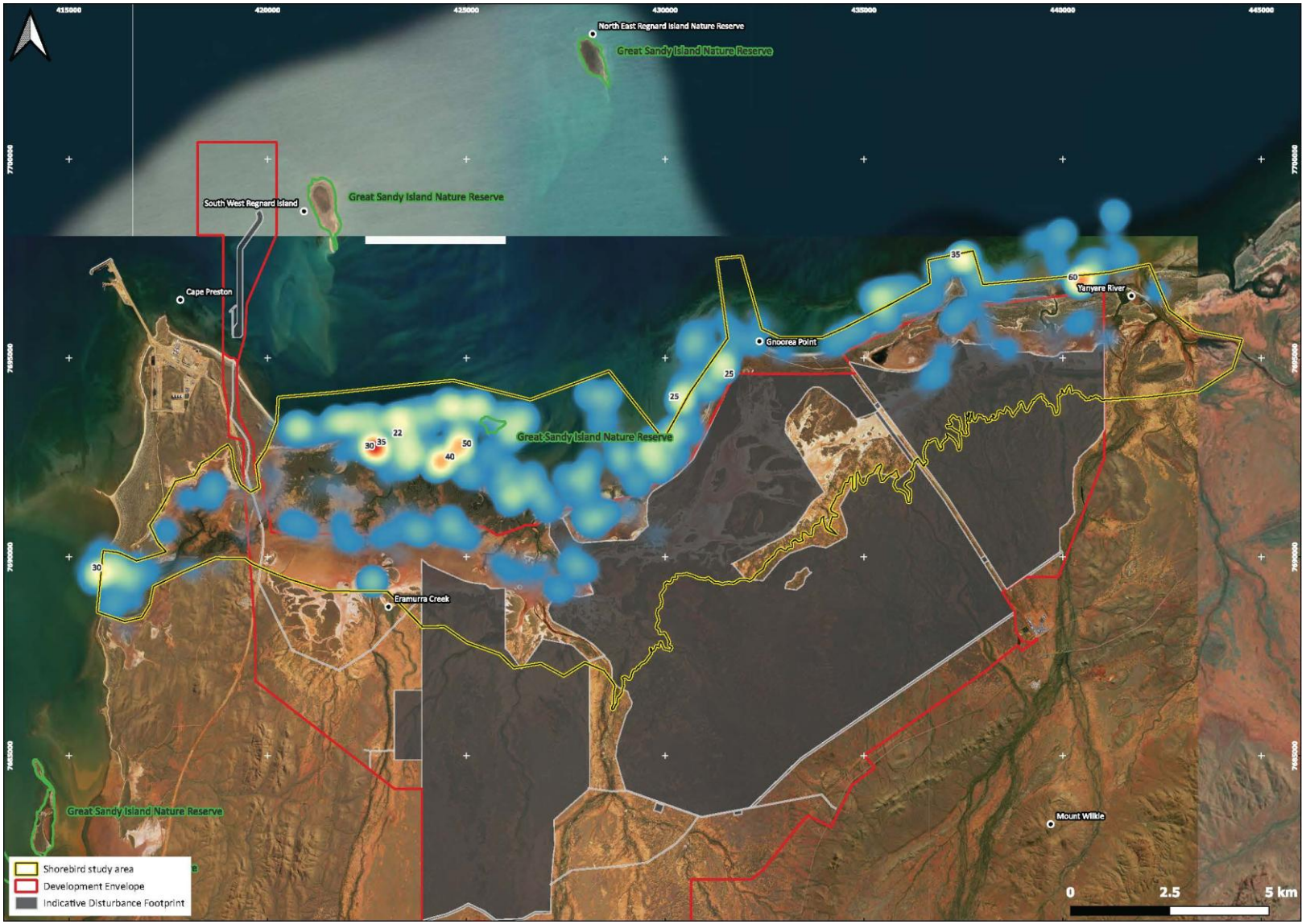


Figure 4-20: Winter low tide heat map for all birds recorded during shorebird transects

Figure 4-21: Winter high tide heat map for all birds recorded during shorebird transects

4.5.4 IMPORTANT HABITAT

A total of 16 fauna habitat types were identified in the TFSA which were classified into eight broad groupings based on vegetation and landforms, as described in Section 4.5.1. Table 4-19 outlines significant fauna recorded or identified as likely or possible to occur within the study areas and the important habitat associated with that species.

Table 4-19: Significant fauna and important habitat within the TFSA

Species	Status	Likelihood of occurrence	Terrestrial habitats						Intertidal habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Reptiles										
Ctenotus angusticeps Airlie Island *Ctenotus*	P3 (DBCA)	**Possible**, previous uncertain record in study area	✓	✓		✓	✓		✓	
Notoscincus butleri Lined Soil-crevice Skink	P4 (DBCA)	**Recorded**	✓	✓	✓					
Liasis olivaceus barroni Pilbara Olive Python	VU (EPBC Act, BC Act)	**Likely**, suitable habitat present	✓	✓	✓	✓				
Birds										
Oxyura australis Blue-billed Duck	P4 (DBCA)	**Likely** as occasional visitor			✓					
Oceanites oceanicus Wilson's Storm Petrel	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Ardenna carneipes Flesh-footed Shearwater	Mig (EPBC Act, BC Act), VU (BC Act)	**Possible** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Ardenna pacifica Wedge-tailed Shearwater	Mig (EPBC Act, BC Act)	**Likely occasional visitor,** but will not nest within the SBSA				✓			✓	✓
Calonectris leucomelas Streaked Shearwater	Mig (EPBC Act, BC Act)	**Possible** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Macronectes giganteus Southern Giant Petrel	EN (EPBC Act), Mig (EPBC Act, BC Act)	**Possible** as occasional visitor, but will not nest within the SBSA				✓			✓	✓

Species	Status	Likelihood of occurrence	Terrestrial habitats						Intertidal habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Puffinus huttoni Hutton's Shearwater	EN (BC Act)	**Likely** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Plegadis falcinellus Glossy Ibis	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor, but will not nest within the SBSA				✓	✓	✓	✓	✓
Fregata ariel Lesser Frigatebird	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Sula leucogaster Brown Booby	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Pandion cristatus Osprey	Mig (EPBC Act, BC Act)	**Recorded**, breeding resident				✓	✓	✓	✓	✓
Charadrius 84etanus84ultia Greater Sand Plover	VU, Mig (EPBC Act, BC Act)	**Recorded**, migrant				✓	✓	✓	✓	✓
Charadrius mongolus Lesser Sand Plover	EN, Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers** twice in February, migrant				✓	✓	✓	✓	✓
Charadrius veredus Oriental Plover	Mig (EPBC Act, BC Act)	**Recorded in internationally significant numbers**, migrant				✓	✓	✓	✓	✓
Pluvialis fulva Pacific Golden Plover	Mig (EPBC Act, BC Act)	**Recorded**, migrant				✓	✓	✓	✓	✓
Pluvialis squatarola Grey Plover	Mig (EPBC Act, BC Act)	**Recorded**, migrant				✓	✓	✓	✓	✓

Species	Status	Likelihood of occurrence	Terrestrial habitats						Intertidal habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Actitis hypoleucos Common Sandpiper	Mig (EPBC Act, BC Act)	**Recorded**, migrant				✓	✓	✓	✓	✓
Arenaria interpres Ruddy Turnstone	Mig (EPBC Act, BC Act)	**Recorded in internationally significant numbers** in January 2020, migrant				✓	✓	✓	✓	✓
Calidris acuminata Sharp-tailed Sandpiper	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers** in 30% of summer transects, migrant				✓	✓	✓	✓	✓
Calidris alba Sanderling	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers** once in December 2019, migrant				✓	✓	✓	✓	✓
Calidris canutus Red Knot	EN, Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers** once in February 2020, migrant				✓	✓	✓	✓	✓
Calidris ferruginea Curlew Sandpiper	CR, Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers** once in February 2020, migrant				✓	✓	✓	✓	✓
Calidris melanotos Pectoral Sandpiper	Mig (EPBC Act, BC Act)	**Recorded** (previously)				✓	✓	✓	✓	✓
Calidris ruficollis Red-necked Stint	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers** in 35% of summer transects				✓	✓	✓	✓	✓
Calidris subminuta Long-toed Stint	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor				✓	✓	✓	✓	✓
Calidris tenuirostris Great Knot	CR, Mig (EPBC Act, BC Act)	**Recorded**				✓	✓	✓	✓	✓

Species	Status	Likelihood of occurrence	Terrestrial habitats						Intertidal habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Gallinago stenura Pin-tailed Snipe	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor			✓					
Limicola falcinellus Broad-billed Sandpiper	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor				✓	✓			
Limosa lapponica baueri Bar-tailed Godwit (western Alaskan)	VU, Mig (EPBC Act, BC Act)	**Possible** as occasional visitor				✓	✓	✓	✓	✓
Limosa lapponica menzbieri Bar-tailed Godwit (northern Siberian)	CR, Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers** once in January and twice in February				✓	✓	✓	✓	✓
Limosa limosa Black-tailed Godwit	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓	✓	✓	✓
Numenius madagascariensis Eastern Curlew	CR, Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers** twice in February.				✓	✓	✓	✓	✓
Numenius minutus Little Curlew	Mig (EPBC Act, BC Act)	**Recorded** (previously)				✓	✓	✓	✓	✓
Numenius phaeopus Whimbrel	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers** in 53% of summer transects				✓	✓	✓	✓	✓
Phalaropus lobatus Red-necked Phalarope	Mig (EPBC Act, BC Act)	**Possible** as occasional visitor				✓	✓	✓	✓	✓

Species	Status	Likelihood of occurrence	Terrestrial habitats						Intertidal habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Tringa brevipes Grey-tailed Tattler	Mig (EPBC Act, BC Act), P4 (DBCA)	**Recorded in internationally significant numbers –** area supports a large number of this species throughout summer				✓	✓	✓	✓	✓
Tringa glareola Wood Sandpiper	Mig (EPBC Act, BC Act)	**Possible** occasional visitor			✓	✓	✓			
Tringa nebularia Common Greenshank	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers twice in December and twice in February**				✓	✓	✓	✓	✓
Tringa stagnatilis Marsh Sandpiper	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor				✓	✓	✓	✓	✓
Tringa totanus Common Redshank	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor in very small numbers				✓	✓	✓	✓	✓
Xenus cinereus Terek Sandpiper	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers twice in February**				✓	✓	✓	✓	✓
Glareola maldivarum Oriental Pratincole	Mig (EPBC Act, BC Act)	**Recorded in internationally significant numbers** – to 75,377 individuals recorded in the air, in a single transect in February 2020, which represents 2.6% of the world's population	✓	✓		✓	✓	✓	✓	✓
Chlidonias leucopterus White-winged Black Tern	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Sterna albifrons Little Tern (or *Sternula*)	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓

Species	Status	Likelihood of occurrence	Terrestrial habitats						Intertidal habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Sterna bergii Crested Tern	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Sterna caspia Caspian Tern	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Sterna dougallii Roseate Tern	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Sterna hirundo Common Tern	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Sterna nereis nereis Fairy Tern (or *Sternula*)	VU (BC Act)	**Recorded**				✓	✓		✓	✓
Sterna nilotica Gull-billed Tern (or *Gelochelidon*)	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Apus pacificus Fork-tailed Swift	Mig (EPBC Act, BC Act)	**Recorded**	✓	✓	✓	✓	✓	✓	✓	✓
Falco hypoleucos Grey Falcon	VU (EPBC Act, BC Act)	**Likely** (nest 6 km E)	✓	✓	✓	✓	✓	✓	✓	
Falco peregrinus Peregrine Falcon	OS (BC Act)	**Likely** as occasional visitor	✓	✓	✓	✓	✓	✓	✓	
Hirundo rustica Barn Swallow	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor	✓	✓	✓	✓	✓	✓	✓	

Species	Status	Likelihood of occurrence	Terrestrial habitats						Intertidal habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Motacilla flava Yellow Wagtail	Mig (EPBC Act, BC Act)	**Possible** as occasional visitor	✓	✓	✓	✓	✓	✓	✓	
Mammals										
Dasyurus hallucatus Northern Quoll	EN (EPBC and BC Acts)	**Recorded** – resident	✓	✓	✓	✓	✓		✓	
Macroderma gigas Ghost Bat	VU (EPBC and BC Acts)	**Likely** (foraging only, no roost sites present)	✓	✓	✓					
Rhinonicteris aurantia (Pilbara) Pilbara Leaf-nosed Bat	VU (EPBC and BC Acts)	**Recorded** – foraging only, no roost sites present	✓	✓	✓					
Mormopterus cobourgianus North-Western Free-tailed Bat	P1 (DBCA)	**Recorded -** roosting in mangroves, foraging elsewhere	✓	✓	✓	✓	✓	✓	✓	
Hydromys chrysogaster Rakali, Water-rat	P4 (DBCA)	**Likely**			✓		✓		✓	
Leggadina lakedownensis Northern Short-tailed Mouse	P4 (DBCA)	**Likely**	✓	✓	✓					
Pseudomys chapmani Western Pebble-mound Mouse	P4 (DBCA)	**Likely**		✓	✓					

4.5.5 SHORT-RANGE ENDEMIC FAUNA

A total of 40 taxa from SRE groups were collected from the field surveys of the TFSA and the regional targeted survey area to the east, comprising 20 taxa in the TFSA and 23 taxa from the regional targeted survey (three taxa species in both). The location of these records are identified in Figure 4-22 - Figure 4-25.

Within the TFSA 12 taxa are considered Potential SREs and eight are widespread species or indeterminate (Uncertain) taxa. The 12 Potential SRE taxa included five isopods, four scorpions and three mygalomorph spiders. The habitat within the TFSA is comprised entirely of low potential SRE habitats which extend beyond the TFSA and are dominated by three similar types comprised of landforms and vegetation types that are unlikely to restrict the dispersal of SRE fauna.

Generally, the SREs within the TFSA appear to have an affinity with the SRE fauna of nearby mainland coastal areas. Of significance, three taxa collected during the field surveys were previously known only from Barrow Island, which is located approximately 85 km to the west of the TFSA. These comprise one mygalomorph spider (*Aname* 'MYG593'), one scorpion (*Isometroides* 'SCO051/barrow'), and one isopod (*Buddelundia* '32'). These records have significantly increased the known range of these taxa. An additional two taxa are known from both Barrow Island and the mainland: one mygalomorph spider (*Synothele* 'MYG335') and one scorpion (*Lychas* 'SCO051/glauerti').

All but five of the 20 species recorded within the TFSA are already known from other areas indicating there is habitat connectivity outside the TFSA. Further to this, the paucity of systematic SRE surveys undertaken within general mainland coastal areas (as opposed to nearby islands of the Dampier Archipelago, and Barrow Island, which have been extensively surveyed for invertebrates, particularly land snails) is likely to be the reason these taxa have not been recorded before. The range extensions documented for three taxa previously known only from Barrow Island is further evidence that many species in the area are more widespread than currently known.

Of the five species currently known only from the TFSA, four were recorded in the field survey, and one is known from the desktop review. They comprise one mygalomorph spider, one scorpion, three isopods (slaters) and one land snail:

- Mygalomorph spider:
  - *Conothele* 'MYG726';
- Scorpion:
  - *Urodacus* 'erramurra';
- Isopods (slaters):
  - *Acanthodillo* sp. B (erramurra);
  - *Buddelundiinae* 'erramurra'; and
- Land snail:
  - *Rhagada* 'cape preston'.

Within the regional targeted survey 16 Potential SREs were recorded. These included five isopods, three pseudoscorpions, three land snails, three *Antichiropus* millipedes, two *Cryptops* centipedes, and one scorpion. The remaining seven taxa collected from the regional targeted survey are widespread species or indeterminate taxa.

None of the recorded potential SRE species were considered likely to be restricted to the TFSA:

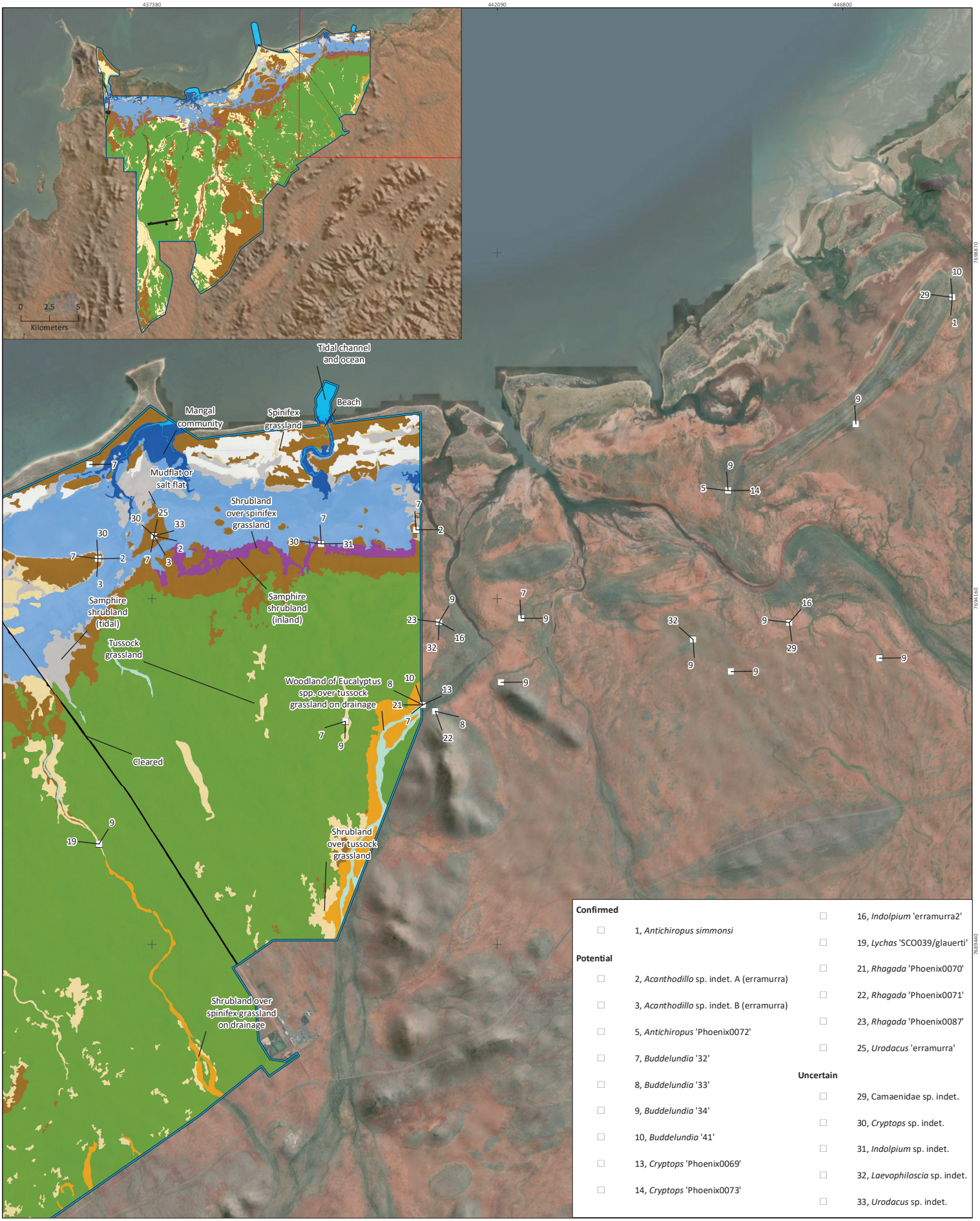
- *Conothele* 'MYG726' was sighted during SRE foraging at site FAU06 within the TFSA. This record was from the most widespread, unrestricted habitat within the TFSA, tussock grassland, and it is likely this species can occur throughout the coastal tussock grasslands;
- *Urodacus* 'erramurra' was collected in a wet pitfall trap at site SRE04 in shrubland over spinifex grassland habitat which is widespread in the TFSA and surrounds;
- *Acanthodillo* sp. *B* (erramurra) was collected from two sites (SRE003 and SRE04), both within shrubland over spinifex grassland habitat and approximately 800 m apart from each other. The *A.* sp. A (erramurra) specimens were collected from seven sites, including SRE003 and SRE004 from shrubland over tussock grassland and shrubland over spinifex grassland habitats respectively. *A.* sp. A (erramurra) and *A.* sp. B (erramurra) are considered likely to have similar broad distributions;
- *Buddelundiinae* 'erramurra' was represented by a single specimen collected from a wet pitfall trap from one site (SRE07), within the TFSA. This specimen was collected from the widely occurring shrubland over spinifex grassland habitat; and
- *Rhagada* 'cape preston' is a record from the desktop review, being collected from a previous survey in the area (circa 2007) (WA Museum (WAM), 2020). The collection site was in the widespread tussock grassland habitat. As no molecular information is available for this specimen, it is possible this species is synonymous with another undescribed taxon such as *R.* 'Phoenix0070', *R.* 'Phoenix0071', and *R.* 'Phoenix0087', all of which were recorded 21.5 km to the east (200 - 1,200 m apart from each other along a creekline) in the regional survey. These new records may represent specimens that have originated upstream or downstream rather than from the habitat they were recorded from.

Leichhardt commissioned a project with Curtin University and the WA Museum to undertake a review of the taxonomic status of the *Conothele* 'MYG726', *Urodacus* 'erramurra' and *Acanthodillo* sp. B specimens to determine the relationships to others recorded in the general vicinity of the Project. In addition, specimens of *Urodacus* 'erramurra' and *Acanthodillo* sp. B have been successfully sequenced for a molecular systematic review to determine if the species are likely to be conspecific with those collected elsewhere in the Pilbara. While too early to confirm whether they are conspecific, the *Urodacus* 'erramurra' specimen appears most closely related to a specimen collected south-southeast of Port Hedland, while the *Conothele* 'MYG726' does not appear to be conspecific with those collected elsewhere in the west Pilbara.

The lack of regional records of these species is considered an artefact of the paucity of regional detailed SRE surveys. The habitats within the TFSA are neither restricted, nor contain geographical features that would limit the dispersal of SREs and therefore, implementation of the Project would appear to present little risk to these four taxa (Phoenix, 2023).

4.5.6 Introduced Fauna

Evidence of introduced animal presence was common in the TFSA, including agricultural species (cattle) and pest species (feral cats and dogs). Over two thirds of land in the Roebourne subregion is used for grazing native vegetation. Both grazing pressure and the presence of feral cats and dogs as key introduced predator species, are likely to have substantively influenced the distribution and abundance of native fauna species in the TFSA.



Leichhardt Salt Pty Ltd
Eramurra Solar Salt Project

Project No	1320-ESP-LI-VER
Date	9/06/2022
Drawn by	IN
Map author	JC

0 1 2
Kilometers

1:47,000 (at A3) GDA 1994 MGA Zone 50

Terrestrial fauna study area

Fauna habitat

- Beach
- Mangal community
- Mudflat or salt flat
- Samphire shrubland (inland)
- Samphire shrubland (tidal)
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Spinifex grassland
- Tidal channel and ocean
- Tussock grassland
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Cleared

PHOENIX ENVIRONMENTAL SCIENCES

Figure 4-22: Recorded SREs and fauna habitat (northeast)

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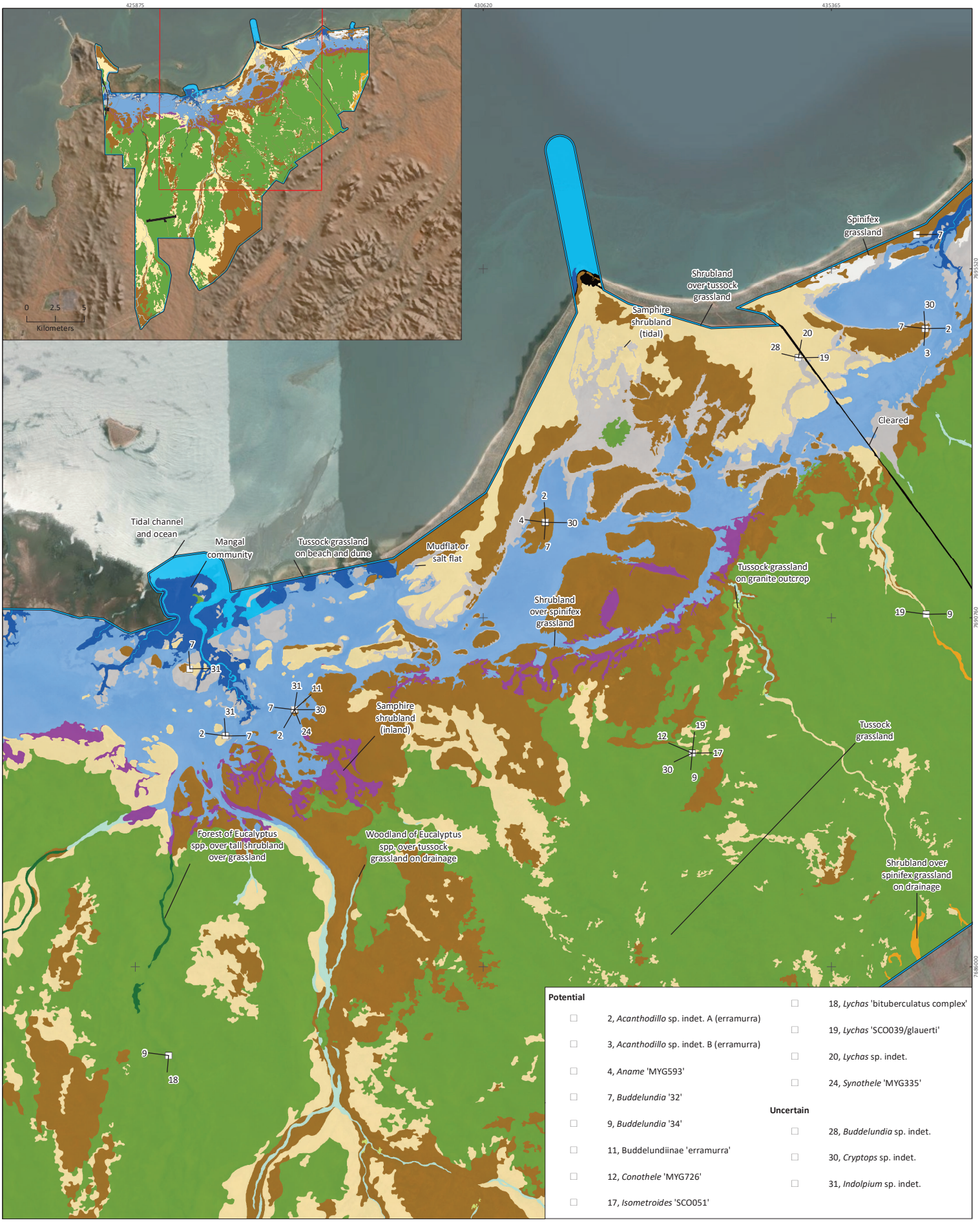

Leichhardt Salt Pty Ltd
Eramurra Solar Salt Project

Project No	1320-ESP-LI-VER
Date	9/06/2022
Drawn by	IN
Map author	JC

0 1 2
Kilometers

1:47,000 (at A3) GDA 1994 MGA Zone 50

Terrestrial fauna study area

Fauna habitat

- Forest of Eucalyptus spp. over tall shrubland over grassland
- Mangal community
- Mudflat or salt flat
- Samphire shrubland (inland)
- Samphire shrubland (tidal)
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Spinifex grassland
- Tidal channel and ocean
- Tussock grassland
- Tussock grassland on beach and dune
- Tussock grassland on granite outcrop
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Cleared

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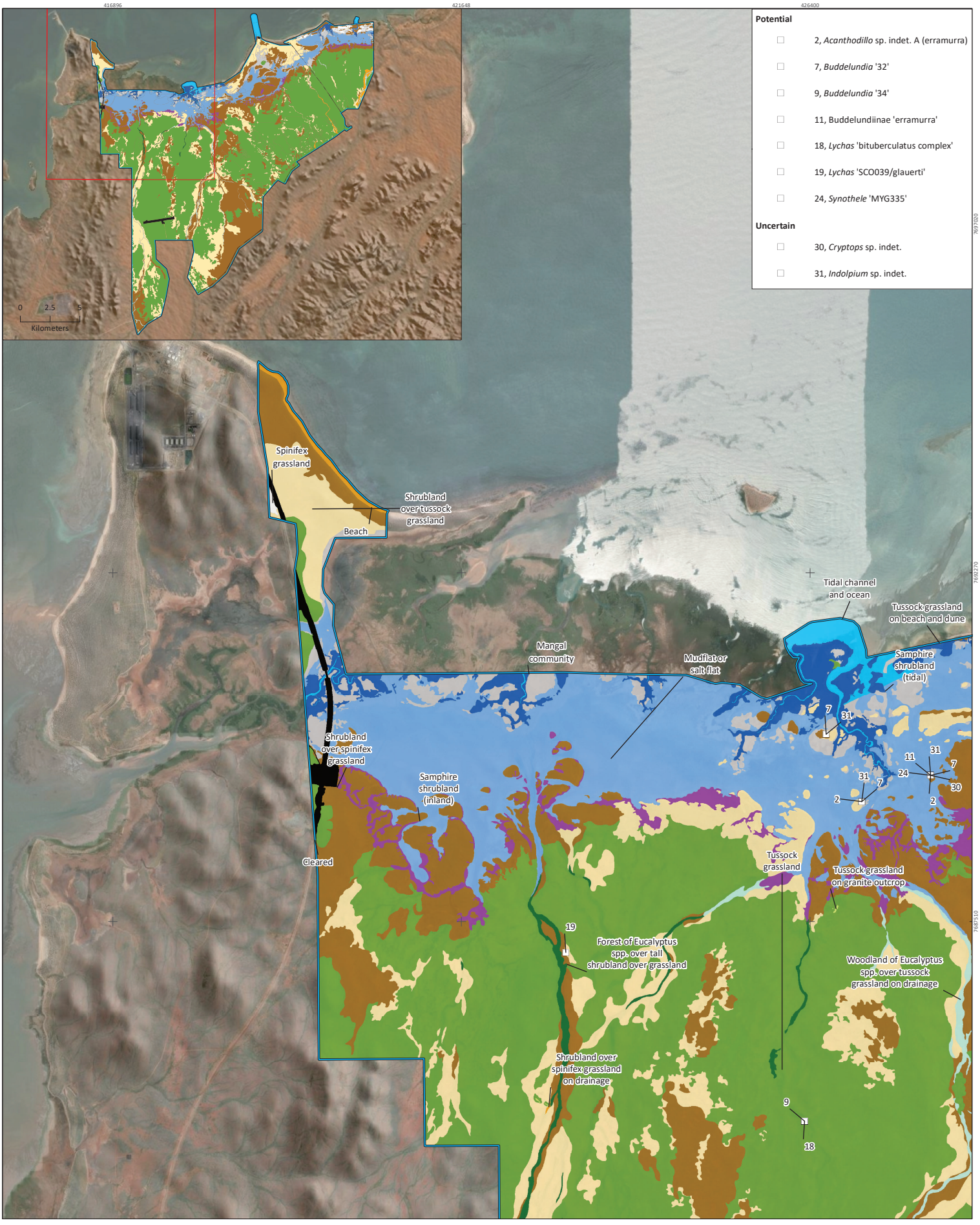
Figure 4-23: Recorded SREs and fauna habitat (north)



Leichhardt Salt Pty Ltd
Eramurra Solar Salt Project

Project No	1320-ESP-LI-VER
Date	9/06/2022
Drawn by	IN
Map author	JC

0 1 2
Kilometers

1:47,000 (at A3) GDA 1994 MGA Zone 50

Terrestrial fauna study area

Fauna habitat

- Beach
- Forest of Eucalyptus spp. over tall shrubland over grassland
- Mangal community
- Mudflat or salt flat
- Samphire shrubland (inland)
- Samphire shrubland (tidal)
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Spinifex grassland
- Tidal channel and ocean
- Tussock grassland
- Tussock grassland on beach and dune
- Tussock grassland on granite outcrop
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Cleared

Figure 5-6c

SRE habitats and recorded SRE taxa

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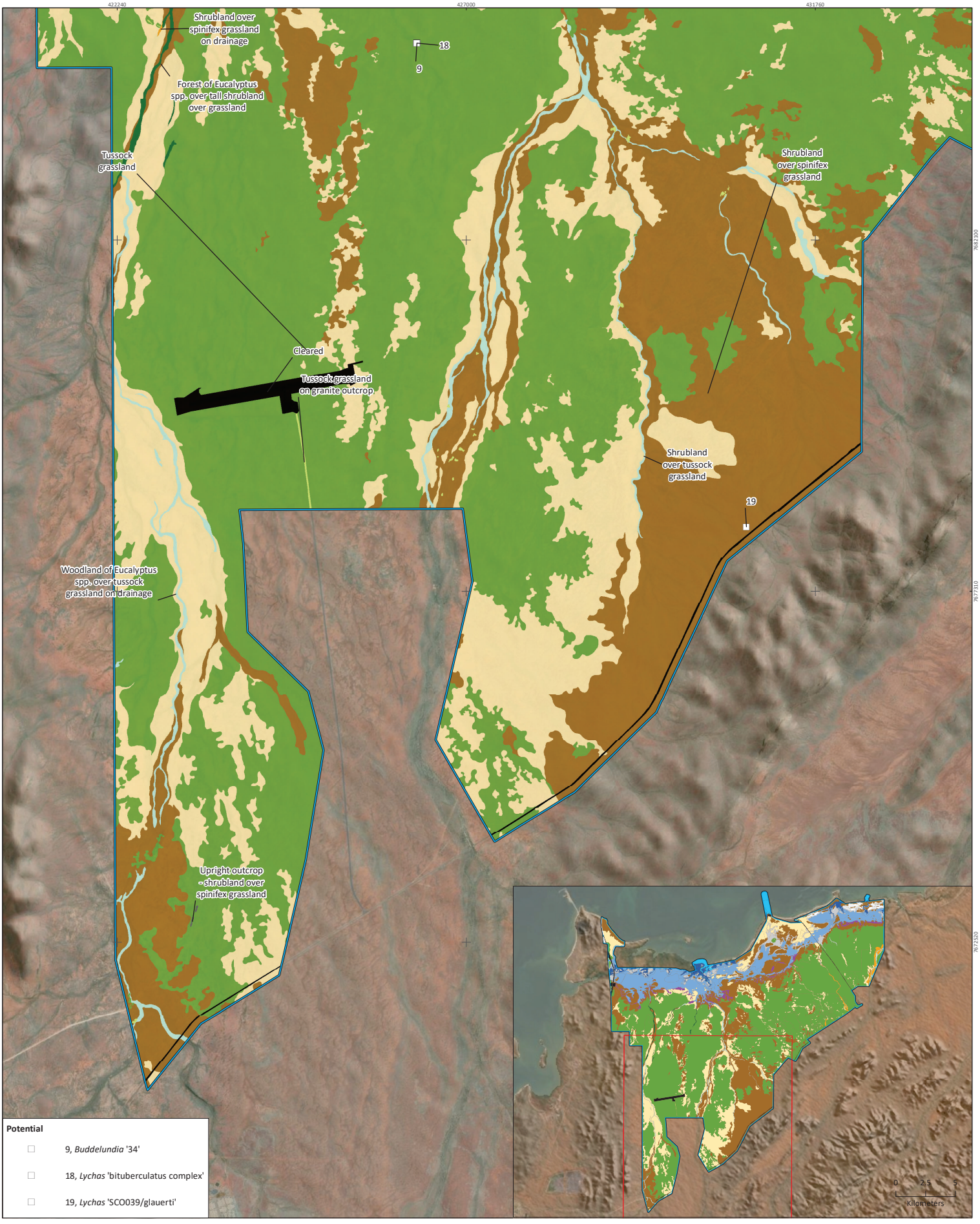
Figure 4-24: Recorded SREs and fauna habitat (northwest)



Leichhardt Salt Pty Ltd
Eramurra Solar Salt Project

Project No	1320-ESP-LI-VER
Date	10/06/2022
Drawn by	IN
Map author	JC

0 1 2
Kilometers

1:47,000 (at A3) GDA 1994 MGA Zone 50

Terrestrial fauna study area

Fauna habitat

- Forest of Eucalyptus spp. over tall shrubland over grassland
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Tussock grassland
- Tussock grassland on granite outcrop
- Upright outcrop - shrubland over spinifex grassland
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Cleared

PHOENIX ENVIRONMENTAL SCIENCES

Figure 4-25: Recorded SREs and fauna habitat (southwest)

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4.6 HYDROLOGY

4.6.1 INLAND SURFACE WATER

SWS (2025) undertook a hydrologic assessment of the Project. The proposed ponds are located in three primary catchment areas: Eramurra Creek, McKay Creek, and Devil Creek (Figure 4-32). The total contributing catchment area of the three creeks is approximately 704 km^2. Catchment delineations and area tabulations are indicative only as there is some crossflow between the catchments that varies by flood event. In particular, there are some conjoined floodplains and anabranches connecting Eramurra Creek and McKay Creek.

Several creeks dissect this alluvial outwash plain. The creeks are generally small as the catchment is not large and the watershed is roughly coincidental with the position of the NWCH However, along the eastern edge of the site is a larger creek called Devil Creek which drains a larger inland area, as does Eramurra Creek that follows the western side of the proposed ponds. There is only one large named creek (McKay Creek) that flows through the middle of the ponds. This creek is locally incised down about 1 m in the creek bed or about 3 m of incision across the 200 m wide floodplain.

The central and eastern parts of the PIDE comprise a line of coastal beach ridges, dunes and cheniers forming a coastal barrier rising locally to over 12 m along the crest of the main dune. A backwater has formed behind the coastal barrier and this area is referred to as intertidal and supratidal flats. Several small (high tide) islands are present in the backwater and these provide evidence of former coastlines which are now partially buried beneath the lagoonal sediments associated with the backwater. Mangroves fringe the western aspect of this area and inland of intertidal and supratidal flats is an area of alluvial outwash. The land falls at a gradient of about 1 m in 300 m from the southeast towards the northwest.

The PIDE is located approximately 80 km from the nearest gauged catchments, which include several catchments with drainage areas approximately equal to the site catchments. Due to the elongated, linear shape of the Eramurra catchments, the Regional Flood Frequency Estimation (RFFE) results state that the applicability of the predicted peak flow rates may be limited.

Table 4-20 shows the RFFE results for Eramurra Creek, McKay Creek and Devil Creek. The RFFE results indicate substantial uncertainty with peak flow estimates from 5% and 95% confidence limits. As such, the results will be used for reference only, and more detailed rainfall-runoff modelling will be undertaken as the pond and drainage design progresses.

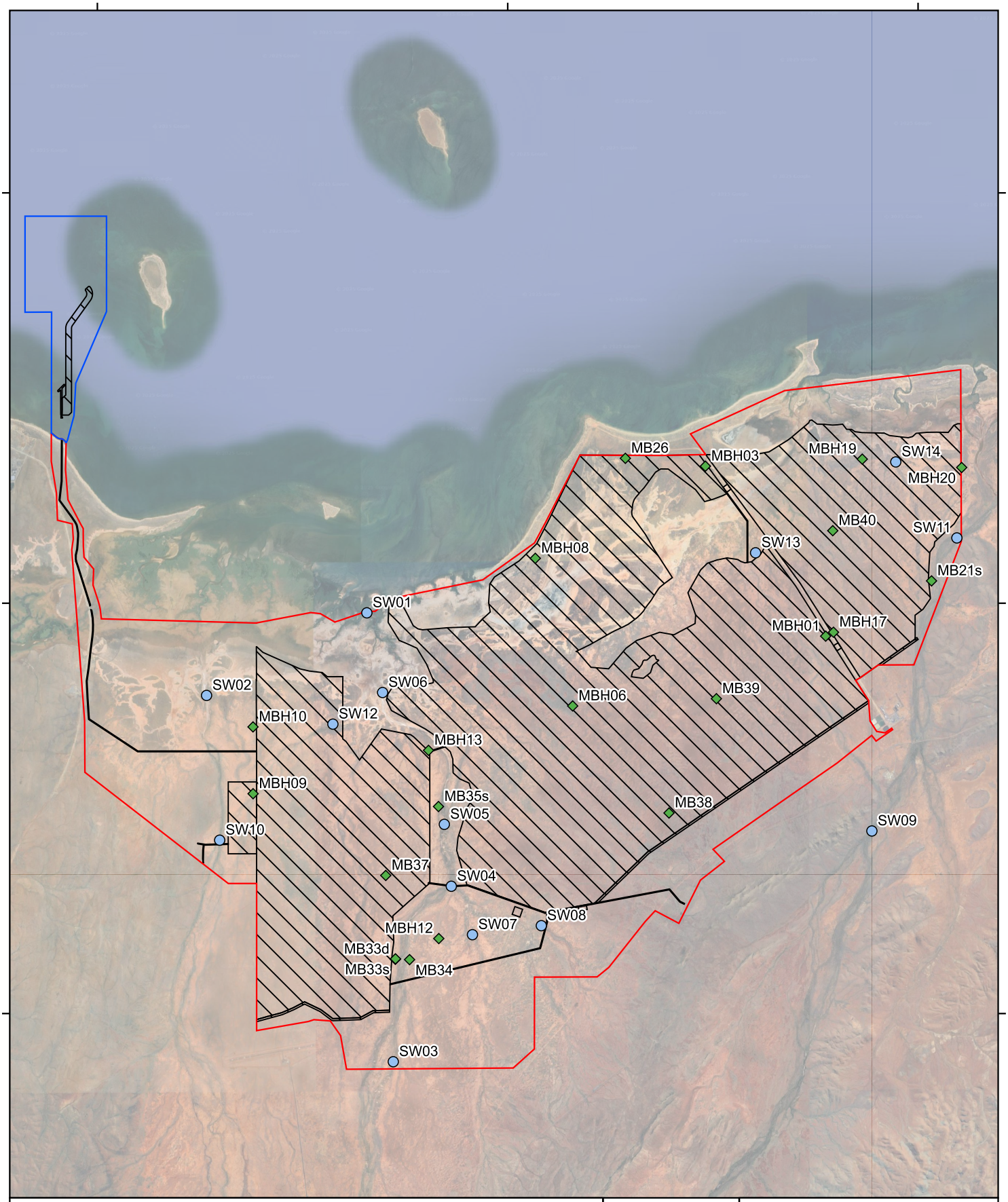
Table 4-20: RFFE results for Eramurra Creek, McKay Creek and Devil Creek surface water catchments

Catchment	Area (km^2)	AEP	Discharge (m^3/sec)	Lower Confidence Limit (5%) (m^3/sec)	Upper Confidence Limit (95%) (m^3/sec)
Eramurra Creek	151	50	27.0	5.30	138
		20	77.5	15.3	397
		10	126	24.9	647
		5	184	36.2	942
		2	267	52.6	1,370

Catchment	Area (km^2)	AEP	Discharge (m^3/sec)	Lower Confidence Limit (5%) (m^3/sec)	Upper Confidence Limit (95%) (m^3/sec)
		1	333	65.6	1,710
McKay Creek	291	50	26.0	5.10	134
		20	74.6	14.6	383
		10	122	23.8	624
		5	177	34.7	909
		2	257	50.4	1,320
		1	321	62.9	1,650
Devil Creek	262	50	33.8	6.70	171
		20	96.9	19.2	490
		10	158	31.3	798
		5	230	45.6	1,160
		2	334	66.3	1,690
		1	417	82.7	2,110

Key Surface Water Features

Several creeks dissect the PIDE. The creeks are generally small as the catchment is not large and the watershed is roughly coincidental with the position of the NWCH. Surface water and monitoring locations and data logger locations are shown in Figure 4-26 and Figure 4-27, respectively.



Legend

- Pond and Infrastructure Development Envelope
- Marine Development Envelope
- Disturbance Footprint
- Groundwater Monitoring Locations
- Surface Water Monitoring Locations

Imagery: Google Satellite

LEICHHARDT

Preston Consulting

Figure 4-26: Surface Water and Groundwater monitoring locations

0 2 4 km

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GDA 2020 (MGA Zone 50)

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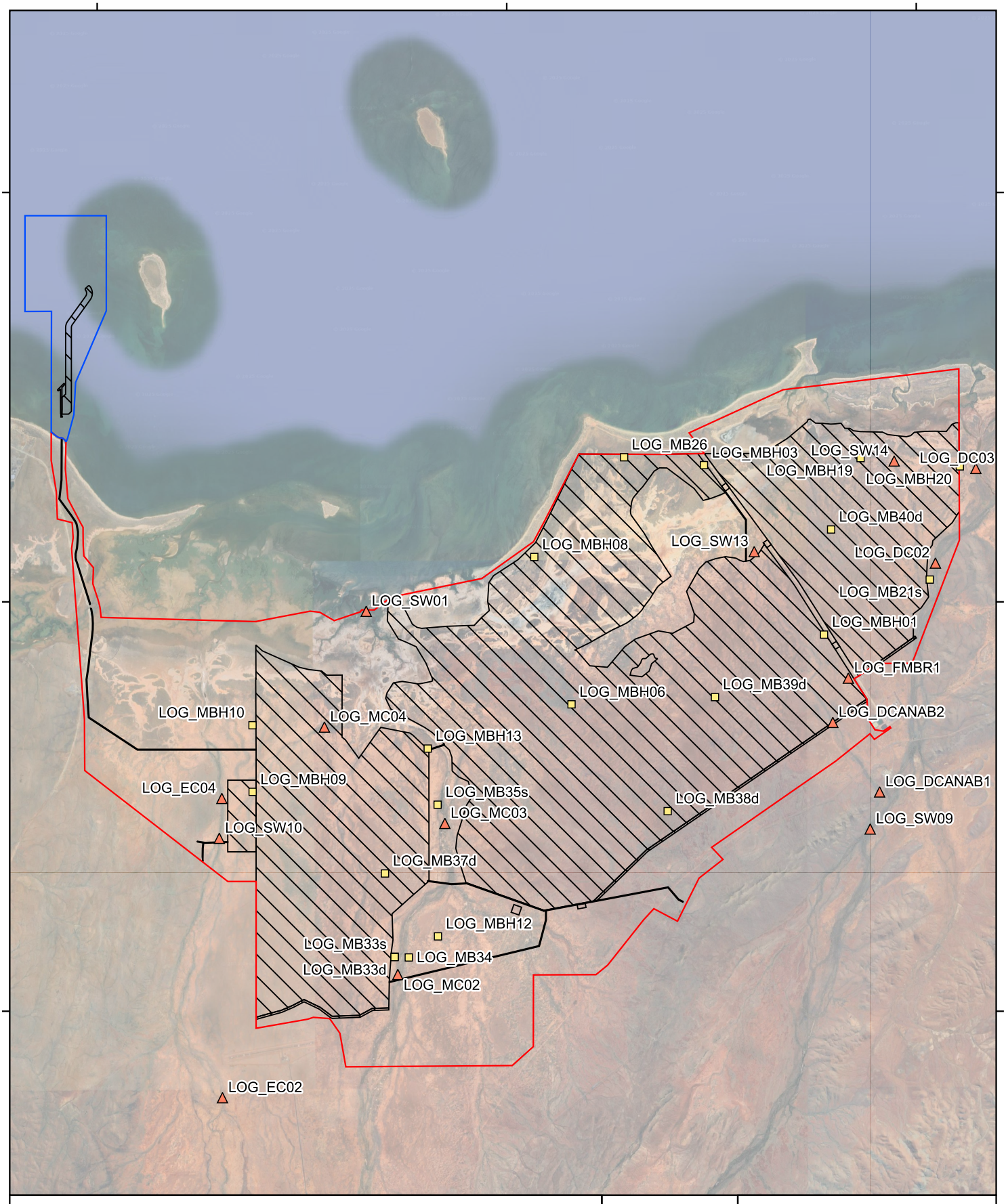
21/02/2025



Legend

- Pond and Infrastructure Development Envelope
- Marine Development Envelope
- Disturbance Footprint
- Groundwater Data Logger Location
- Surfacewater Data Logger Location

Imagery: Google Satellite

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Preston Consulting

Figure 4-27: Surface Water and Groundwater Logger locations

0 2 4 km

N

GDA 2020 (MGA Zone 50)

1:125,000 (A4)

LEI_0535_011

AS

21/02/2025

Devils Pool

Devils Pool is an ephemeral surface water feature located in an area of elevated basement geology characterised by underlying low permeability igneous rock. An indication of the permanence of surface water at Devils Pool is provided by the DEA Multi Year Water Observation Statistics from Landsat data. This a statistical summary that combines all years (2004 to near present) and plots the percentage of wet observations that were observed in the landscape. According to these data, Devils Pool holds water less than 2% of the time (Figure 4-28). This observation is supported by surface water monitoring in the area which indicates dry conditions within Devils Pool and Devils Creek for the majority of time since monitoring began in December 2021 (LWC, 2025). Images collected from monitoring in November 2023 are shown in Figure 4-29 with dry conditions observed at both Devils Pool surface water gauging point and Devils Creek surface water sampling point. Locations of these sampling points are shown in Figure 4-26 and Figure 4-27.

Monitoring data since January 2024 from the Devils Pool surface water logger is shown in Figure 4-30 with comparison made against Karratha rainfall data. Monitoring records indicate minor fluctuations over the period of record that lack correlation with rainfall data. The observed fluctuations are therefore most likely attributed to changes in atmospheric pressure as opposed to surface water flows.

Additional data to support the current understanding of Devils Pool has been obtained from recent groundwater drilling investigations undertaken in the vicinity of Devils Pool (CDM Smith, 2024). Drilling of MB21s, located around 150 m west of Devils Pool, encountered groundwater at around 10 m bgl. When viewing the recent groundwater levels (~8.5 m bgl) with respect to creek bed elevations, the observed depth to groundwater suggests groundwater discharge to Devils Creek and Pool is unlikely.

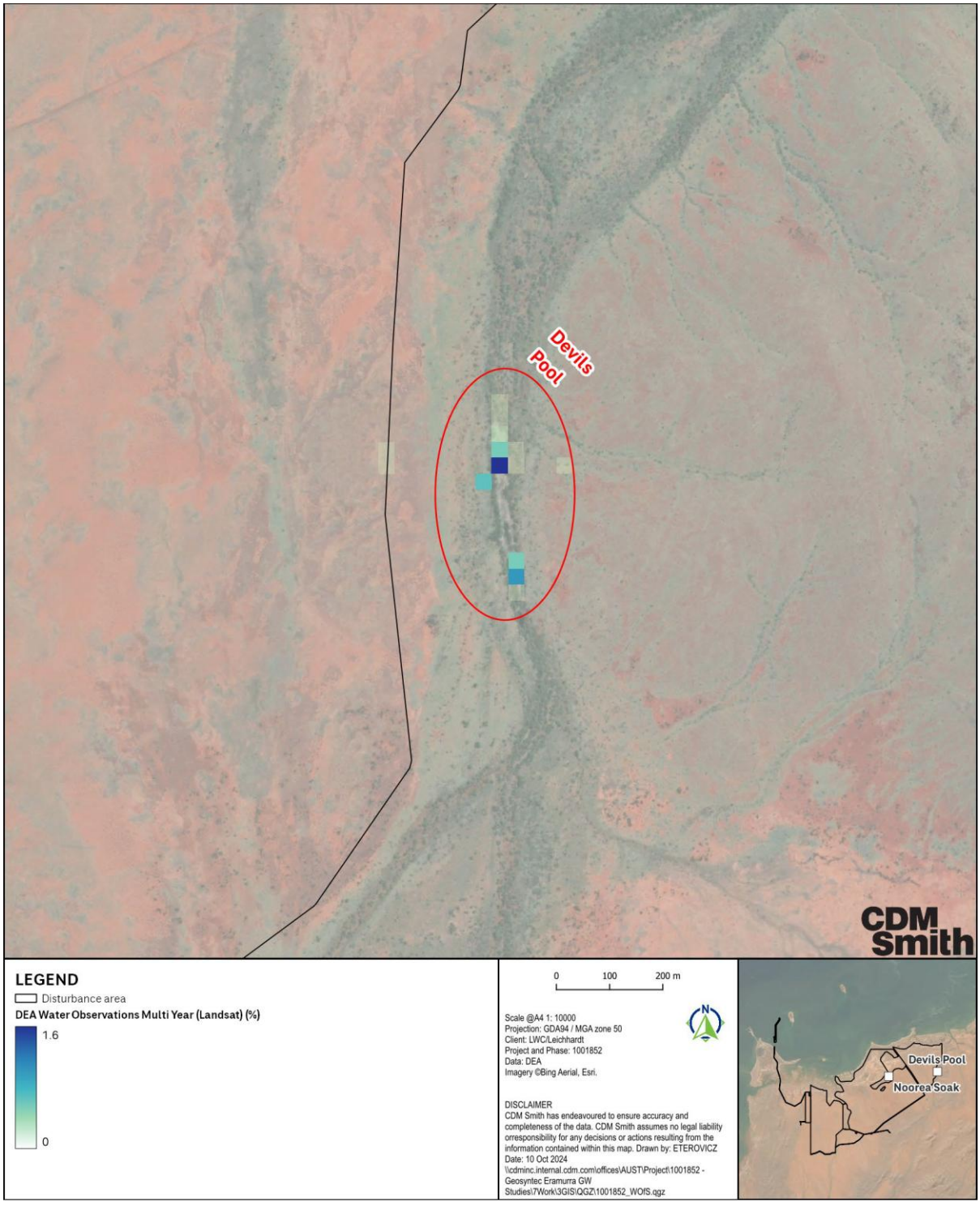

Figure 4-28: Percentage of Landsat observations in which water is detected

Figure 4-29: Devils pool surface water logger location (Y5850 - left) and Devils Pool surface water sampling location (SW11 – right)

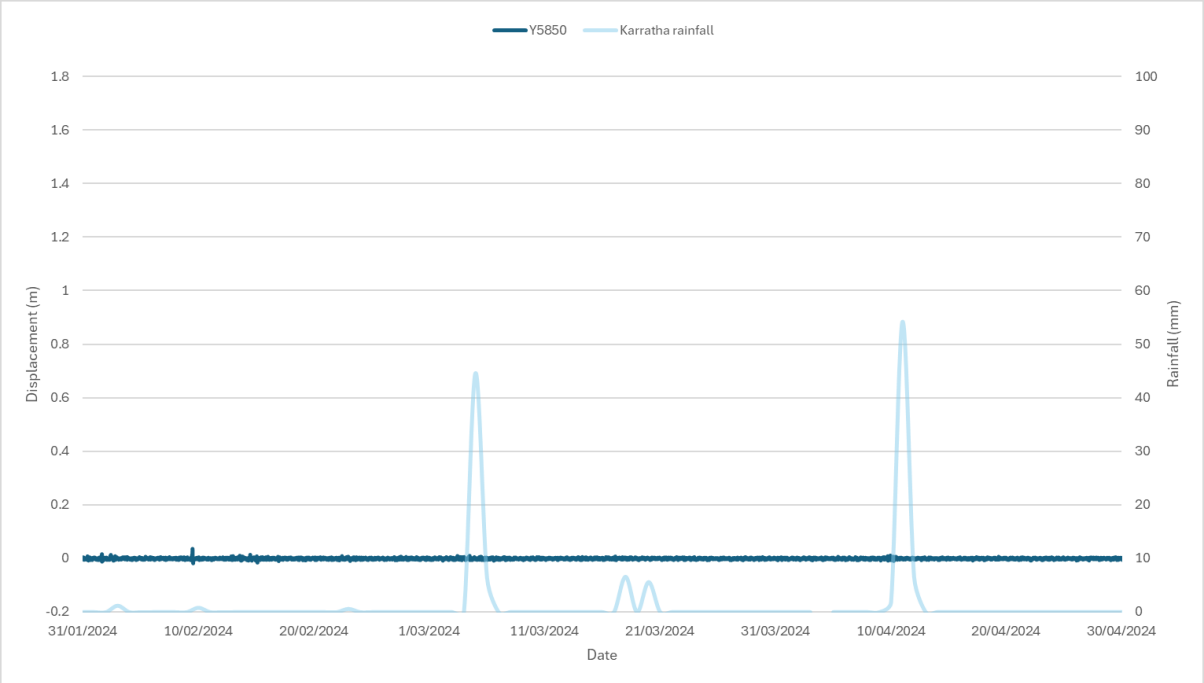

Figure 4-30: Devils Pool surface water logger (Y5850) records

Noorea Soak

Noorea Soak is a depression located at the at the bottom of a catchment and collects water during rainfall and run off events (Figure 4-31). It is located within the central point of the PIDE in a topographical low point that is underlain by crystalline basement outcrop. Available information from both aerial imagery and remote sensing suggests Noorea Soak dries out on occasion and is not a permanent water feature. While groundwater contributions to this feature are possible, the depth to water at the nearest groundwater monitoring bores (MB06 at ~1 km and MB09d at ~1.5km) measured around 8.5 and 9 m below top of casing respectively. Groundwater

monitoring to date indicates little fluctuation (<1 m) of groundwater heads suggesting that discharge of groundwater to the Noorea Soak is unlikely to occur from seasonal fluctuations in groundwater elevation. CDM Smith (2023) predicted that groundwater heads would need to increase by more than 2 m for discharge to occur to this feature. Furthermore, granitic basement rock underlying the Noorea Soak is thought to be very low permeability (ranging between 1 x 10^{-5} to 1 x 10^{-4} m/d and very unlikely to support the storage and transmission of groundwater in large quantities. Due to the lack of permanent inundation, depth and fluctuation of groundwater in the surrounding areas, and permeability of the underlying basement stratigraphy, it is unlikely the soak currently receives substantial groundwater inflows and more likely the case this feature is driven by surficial pooling within the topographic low point it resides.

An additional monitoring bore is planned to be installed closer to Noorea Soak to obtain additional data to inform the conceptual understanding of this feature and guide future management.

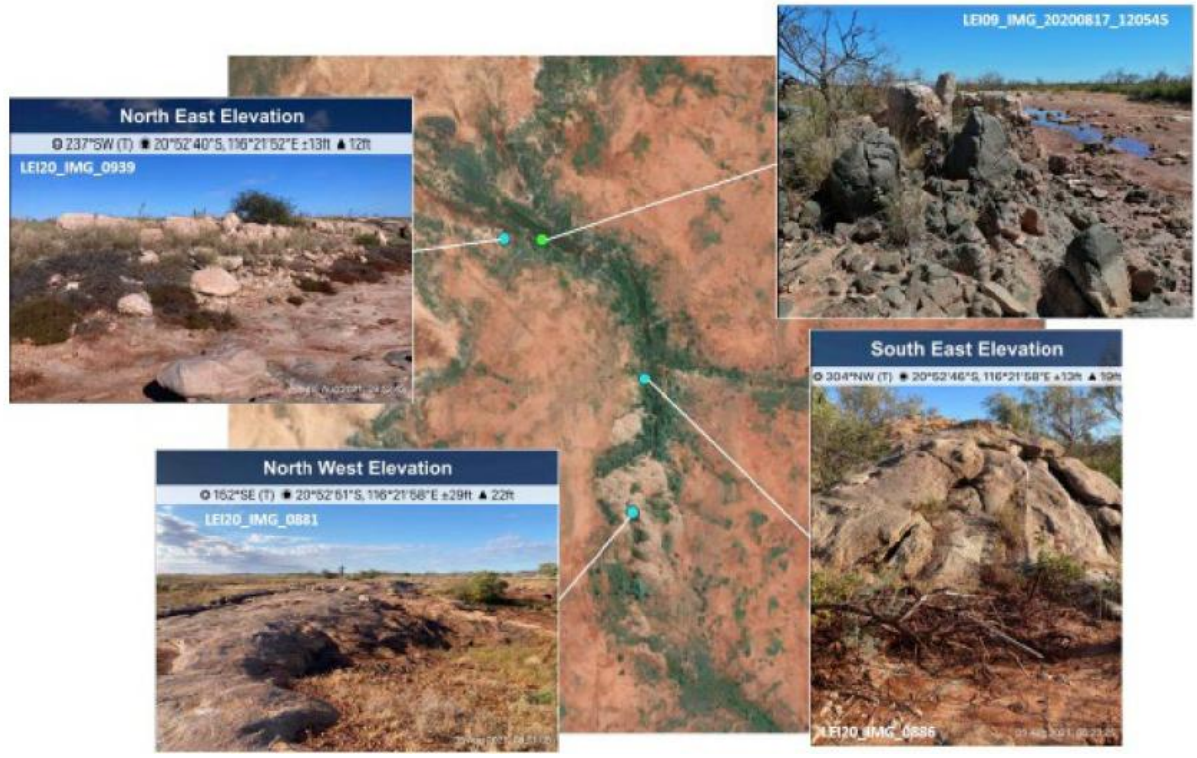

Figure 4-31: Field photographs of outcropping basement in the area of Noorea Soak

Surface Water Quality

The opportunity to collect surface water quality samples has been limited by extended periods of drought in the area. However, LWC (2025; Appendix 1) was engaged to undertake surface water monitoring in March, May, November 2022, and June 2023 when sufficient run-off water was present. Surface water samples were collected from targeted locations and were analysed for key potential chemical substances of concern. Key findings of the monitoring events included the following:

- The reported concentrations of pH, total dissolved solids (TDS), major cations/anions (calcium, chloride, sodium, sulfate and hardness), various metals/metalloids and nutrients were observed above the adopted guideline criteria for drinking water, recreation, freshwater, marine water, irrigation and/or livestock water use; and
- The data quality assessment indicates that the chemical and physical hydrogeological data reported for the March, May and November 2022, June 2023, November 2023 and July 2024 programs of work is suitable to inform the baseline hydrological assessment for the Project.

A summary of the field parameter ranges and hydro-geochemical conditions in surface water across the PIDE is provided in Table 4-21.

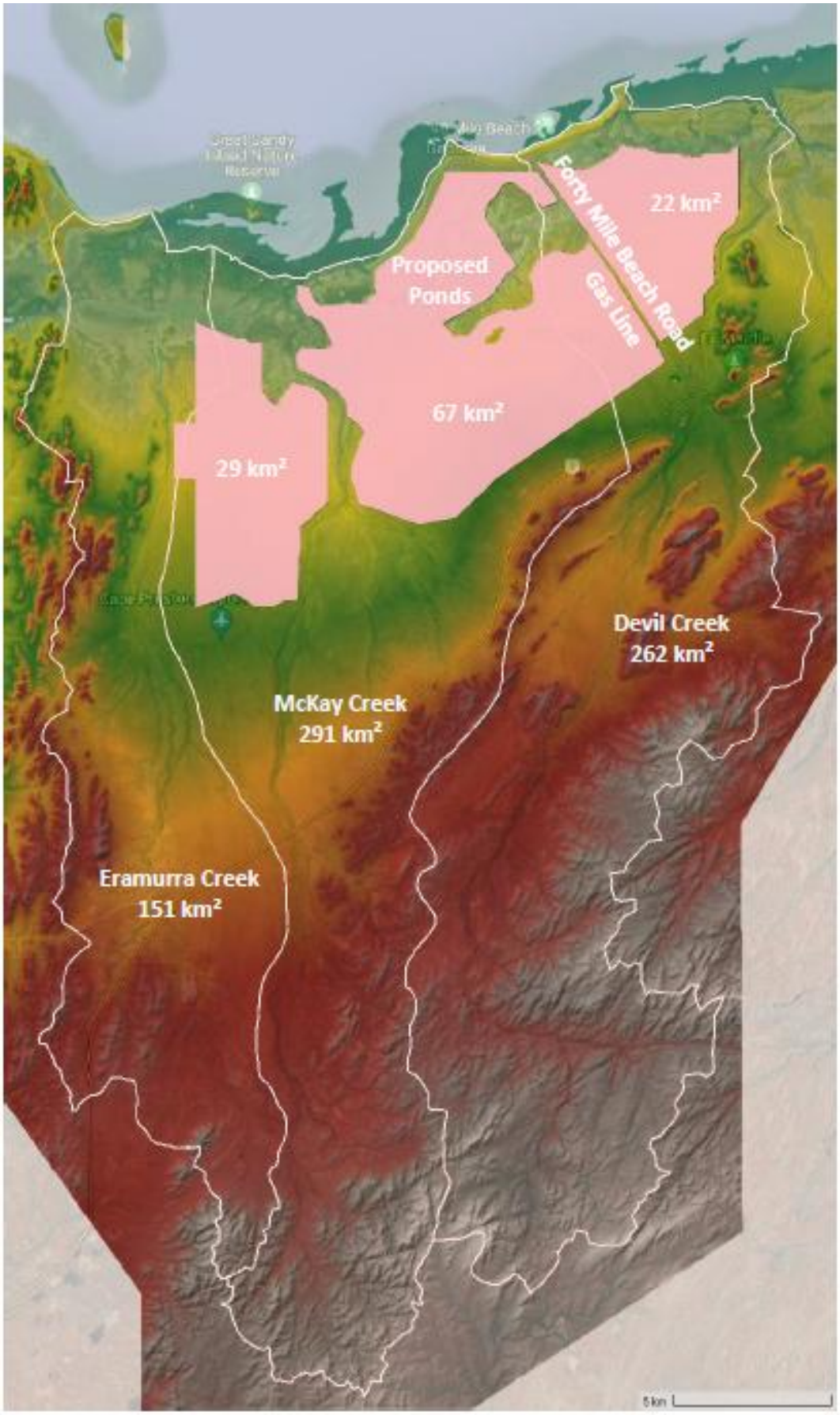

Figure 4-32: Project pond layout and contributing catchment areas

Table 4-21: Summary of surface water monitoring results

Field Parameter	Units	March 2022	May 2022	November 2022	June 2023	November 2023	July 2024	Comment
pH	pH units	7.4 (SW01) – 8.9 (SW06)	6.3 (SW11R) – 8.9 (SW04)	5.99 (SW06) to 7.57 (SW01)	5.07 (SW06) to 6.00 (SW05)	7.97 (SW01) to 8.22 (SW02)	6.85 (SW01) and 8.48 (SW14)	Slightly acidic to slightly alkaline conditions were observed in surface waters. Field results were generally confirmed by the laboratory analytical results.
EC	µS/cm	256 (SW13) – 141,399 (SW06)	81 (SW14) – 179,665 (SW06)	61,698 (SW01) to 204,939 (SW02)	215 (SW13) to 102,834 (SW06)	65,772 (SW01) to 170,156 (SW06)	1,050 (SW14) and 66,644 (SW01)	Higher salinities (i.e., TDS >1,000 mg/L) were reported for surface water sampled at SW01, SW02, SW06 and are all located near the marine/estuary environment. Field results were generally confirmed by the laboratory analytical results, however, there were some variations between field and laboratory results higher salinities.
TDS	mg/L	167 (SW13) – 91,909 (SW06)	53 (SW14) – 116,782 (SW06)	40,103 (SW01) to 133,210 (SW02)	140 (SW13) to 66,842 (SW06)	42,752 (SW01) to 110,601 (SW06)	683 (SW14) and 43,319 (SW01)	
Redox	mV	19.1 (SW06) – 109.5 (SW02)	-4.7 (SW03R) – 349.4 (SW14)	-90.2 (SW01) to-70.4 (SW06)	66.6 (SW05) to 99.5 (SW06)	-97.9 (SW01) to 69.4 (SW02)	31.2 (SW01) and 52.0 (SW14)	Converting these values to the Standard Hydrogen Electrode (e.g., addition of 199 mV), positive oxidation-reduction potentials were observed at all locations.
Dissolved Oxygen	mg/L	2.6 (SW01) – 5.3 (SW06)	0.0 (SW06) – 6.2 (SW07)	0.60 (SW06) to 5.10 (SW01)	0.01 (SW01 & SW06) to 6.20 (SW05)	3.14 (SW02) to 5.20 (SW01)	1.60 (SW01) and 3.90 (SW14)	Dissolved oxygen levels were variable between locations.
Temperature	ºC	26.9 (SW01) – 36.6 (SW13)	22.0 (SW08) – 36.5 (SW06)	23.9 (SW02) to 27.8 (SW06)	14.4 (SW06) to 22.3 (SW05)	22.4 (SW04) to 30.2 (SW06)	13.5 (SW14) and 18.6 (SW01)	Temperatures were considered representative of atmospheric conditions at the time of sampling.

4.6.2 GROUNDWATER

Groundwater abstraction for water supply was included in the referral documentation for the Project under Section 38 of the EP Act, however it has since been decided that potable water requirements for Project will be sourced via onsite desalination of seawater. Potential closure impacts from groundwater abstraction are therefore not applicable to the Project.

The hydrogeological study by CDM Smith (2023; Appendix 1) has therefore focused on:

- Characterising the existing hydrogeological systems, and describing their relationships with key surface water processes; and
- Determining the extent and nature of changes to those systems as a result of seepage and/or mounding from the proposed ponds.

The text in this section has been sourced from CDM Smith (2023) and O2 Metocean (2023) unless stated otherwise.

Geology and Geomorphology

The Pilbara coast is one of the most geologically and geomorphologically diverse and complex arid coasts in the world (Semeniuk, 1996). The region harbours a major tidal estuary which contains tidal creeks of various forms and sizes. The tidal creeks contain extensive areas of subtidal and intertidal flats, fringing and estuarine mangroves. The coastline immediately seawards of the proposed ponds is about 18 km long, and contains a variety of coastal morphologies, inferred sediment transport regimes and sediment transport pathways. At the eastern margin of the ponds are a number of tidal creeks. Further east are the wave-dominated deltas of some relatively small rivers, the Yanyare and Maitland, beyond which is the complex array of islands of the Dampier Archipelago.

The regional bedrock geology and boreholes from Cape Preston (Table 4-22) indicate that the Cape Preston promontory is underlain by igneous and similar hard basement rocks, and the nearby islands are probably cemented limestones. Across almost the entire PIDE, these sediments overlie granitic rock belonging to the Dampier Granitoid Complex present in creek beds and encountered in boreholes. This granite was encountered at elevations around 0 m AHD immediately south of the 40-Mile Beach foredune and at shallow levels in test pits further south along the Santos pipeline route out towards the NWCH. At the proposed jetty area, basement rocks are finer-grained and metamorphosed igneous rocks.

Table 4-22: Generalised coastal stratigraphy, based on boreholes at Cape Preston (SKM, 2013)

Lithology	Depth range to top of layer (m)	Layer thickness range (m)	Strength range	Typical description
Coastal sand deposit	-	0.5 to 6.0	Very loose to medium dense, SPT number ranges from 1 - 20.	Fine to coarse grained, well graded, sub-rounded, dark brown and grey, with silt and sub-angular gravels, shells, corals and rootlets. Encountered in all the boreholes.
Calcrete	0.5 - 6.0	Absent to 4.0	Strength variable; highly fractured in some areas.	Fine, off-white, distinctly weathered. Encountered in all the boreholes.

Lithology	Depth range to top of layer (m)	Layer thickness range (m)	Strength range	Typical description
Ferricrete	0.5 - 5.0	0.5 to 9.0	Extremely low to high strength.	Fine, yellow brown, massive, distinctly weathered. Encountered in all the boreholes.
Dacite	6.0 - 9.0	Absent to base of borehole	Highly variable, extremely low to high strength.	Fine, much quartz, off-white, extremely weathered to fresh. Encountered in BH 05 to BH 10.
Basalt	4.0 - 12.0	Base of borehole	Medium to very high strength, highly fractured in some areas.	Fine, grey, massive, distinctly weathered to fresh. Encountered in all the boreholes except BH 05 and BH 07.

CMW (2020) describe the main surface units as:

- Mangrove and marine "muds" fringing the coast but about 1 km wide in the west;
- Shelly sand in coastal dunes and old beach deposits;
- Coastal limestone, lime-cemented shelly sand, dune sand and beach conglomerate;
- Silt and mud in supratidal and intertidal flats and a low lagoon landward of the tidal creek systems, including being 2 - 3 m thick at the Cape Preston Causeway; and
- Quartzo-feldspathic windblown sand with quartz and rock fragments – mostly occurring at the base of granitic outcrops.

The pond areas are located in a flat area, where the surface sediments are interpreted as Holocene and recent muds and sandy muds The pattern of sea-level change for the last 7,000 - 8,000 years indicates that there will be little modern sediment on the upper tidal flats and supratidal coastal plain.

Hydrogeology

The information provided in this section has been sourced from SWS (2025), LWC (2025), CDM Smith (2023) and CDM Smith (2024) provided in Appendix 1.

CDM Smith (2023) developed a conceptual hydrogeological model of the Project (Figure 4-33). The model has been revised since earlier versions to include to include additional information obtained from drilling and sampling programs completed during 2023 and 2024, expected salinity gradients, further descriptions of hydrogeological processes and predicted groundwater flow from the groundwater modelling.

The Project is located within the Pilbara Craton geological province which comprises Archean aged volcanic and sedimentary rocks. The Pilbara Craton has been subject to a long history of tectonic and orogeny with various igneous intrusions occurring and deposition of shelf sediments such as the Hamersley Basin containing extensive BIF deposits.

Local to the Project, the Pilbara Craton is overlain by a number of Cainozoic sedimentary units comprising marine muds and silts, coastal sands and beach deposits, limestone, alluvial/colluvial sands and clays as well as residual calcretes and eluvial sands from weathered granitoid rocks (Hickman and Strong, 2000). These sediments are underlain by granitic basement belonging to the Dampier Granitoid Complex which has been intruded by a series of cross cutting dolerite and gabbro dykes.

Geological investigations by CMW (2020) indicate surface expressions of the basement exist within the central and eastern portions of the Project often within eroded creek beds. However, in general, the depth to basement distribution is currently not well understood.

The monitoring bore drilling completed between 2023 and 2024 identified the presence of an extensive covering of eluvium comprising of highly weathered crystalline basement rocks belonging to undifferentiated volcanics and the Dampier Granitoid Complex (CDM Smith, 2024). Drilling indicates the eluvium acts as an aquifer of low to moderate permeability and likely forms the main water bearing unit over the PIDE.

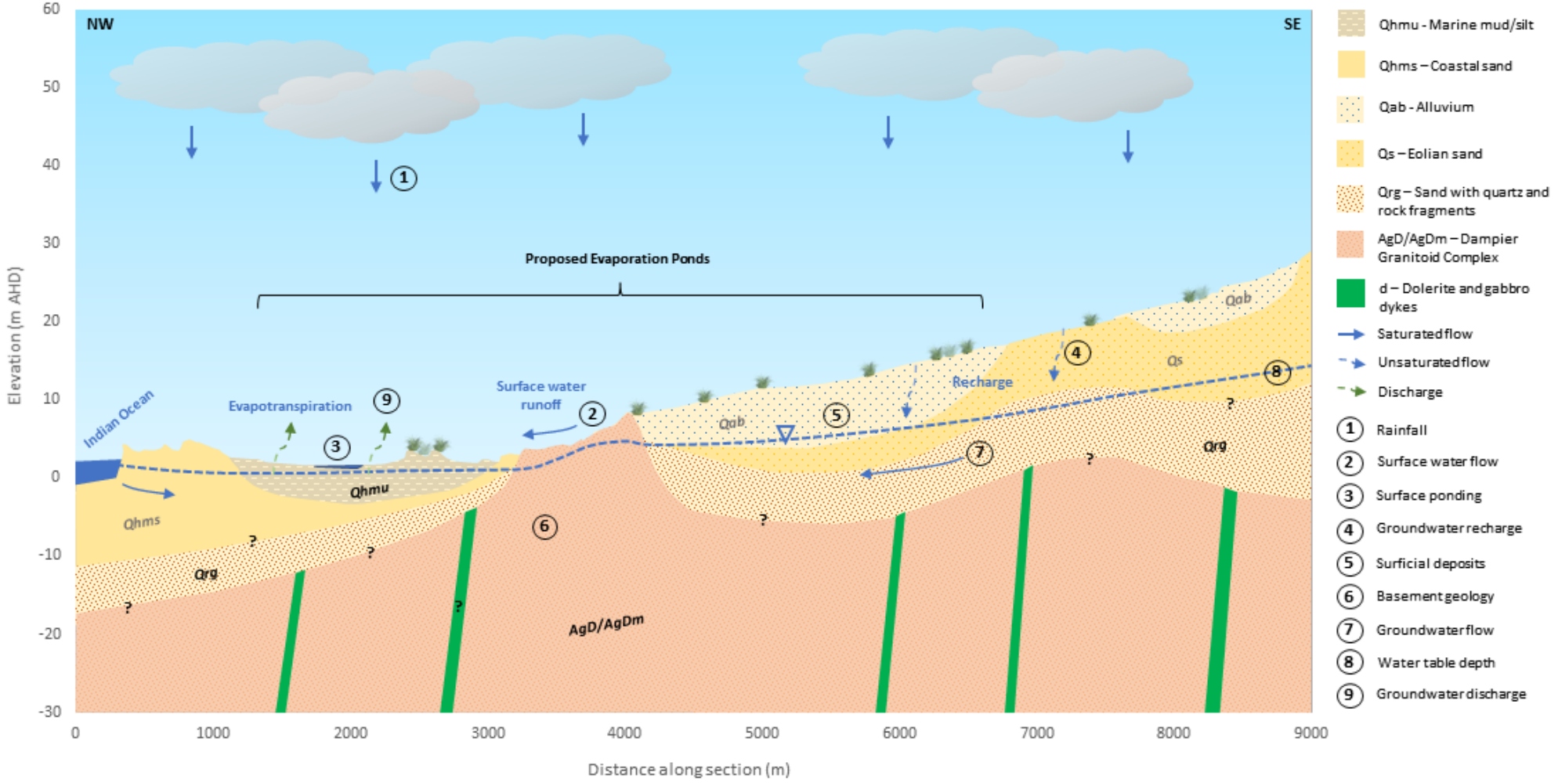

Figure 4-33: Conceptual hydrogeological model

Groundwater Quality

LWC (2025; Appendix 1) were engaged to undertake groundwater quality monitoring in March, May and November 2022, June 2023, November 2023 and July 2024. They have also completed monitoring in January and February 2025 however these results are not available at this stage. Groundwater samples were collected from targeted locations and were analysed for key potential chemical substances of concern. Key findings of the monitoring events included the following:

- The reported concentrations of pH, total dissolved solids, major cations/anions (calcium, chloride, sodium, sulfate and hardness), various metals/metalloids and nutrients were observed above the adopted guideline criteria for drinking water, recreation, freshwater, marine water, irrigation and/or livestock water use in groundwater; and
- The data quality assessment indicates that the chemical and physical hydrogeological data reported for the March, May and November 2022, June 2023, November 2023 and July 2024 programs of work is suitable to inform the baseline hydrogeological assessment for the Project. An acceptable degree of field and laboratory Quality Assurance/Quality Control (QA/QC) was collected and reported, providing confidence in the accuracy and precision of all reported results.

The results showed numerous natural exceedances of various water quality guidelines for a detailed assessment of groundwater quality, refer to Appendix 1.

Calibrated Groundwater Level Contours and Salinity Distribution

Groundwater head contours have been developed using the latest available groundwater level data and are presented in Figure 4-34. The contours are representative of groundwater heads measured during the July 2024 monitoring event undertaken by LWC (2025). Groundwater elevations range from approximately 11 m AHD in the southeast to near sea level (i.e., 0 m AHD) adjacent to the coast. Within the inter- and supratidal flats (i.e., sabkha), where a natural low point in the topography exists, groundwater modelling by CDM Smith (2023b) predicts the high levels of evapotranspiration experienced within the PIDE, contribute to lower the groundwater levels below sea level causing groundwater inflow from the ocean. A drilling program targeting coastal Environmental Values, cultural EVs (Noorea Soak) and basement stratigraphy (including incomplete monitoring bores in the 2023/2024 program), is planned as part of further environmental baseline studies to obtain a more detailed understanding of groundwater levels and flow conditions within the backwater area.

Water level data from monitoring bores adjacent to the ephemeral drainages (within 150 m) within the PIDE suggests groundwater could be encountered at around 2 m beneath creek beds. Eucalypt vegetation is documented to occur within the creeks and would be expected to access groundwater at such depths through evapotranspiration (Phoenix, 2025). When accounting for evapotranspiration, water levels beneath the creeks are expected to be several metres deep. This aligns with the depth in which water has generally been encountered during drilling (10 - 12 m bgl) (CDM Smith, 2024) and the lack of streamflow observations and permanent inundation along creek beds.

In general, the water level data indicates that groundwater flows in a north to northwest direction across the PIDE which is observed through a steady decline in groundwater elevation in this direction at an average gradient of around 0.001 (~10 m of fall over a 7 km horizontal distance). Groundwater flow is also understood to occur in a southeast direction as inflow from the ocean. The information gathered from the newly installed monitoring wells (MB21 - MB40) did not change the groundwater flow direction from prior assessments, however, does provide greater resolution of groundwater heads across the site and suggests a flatter gradient than previously shown by CDM Smith (2023).

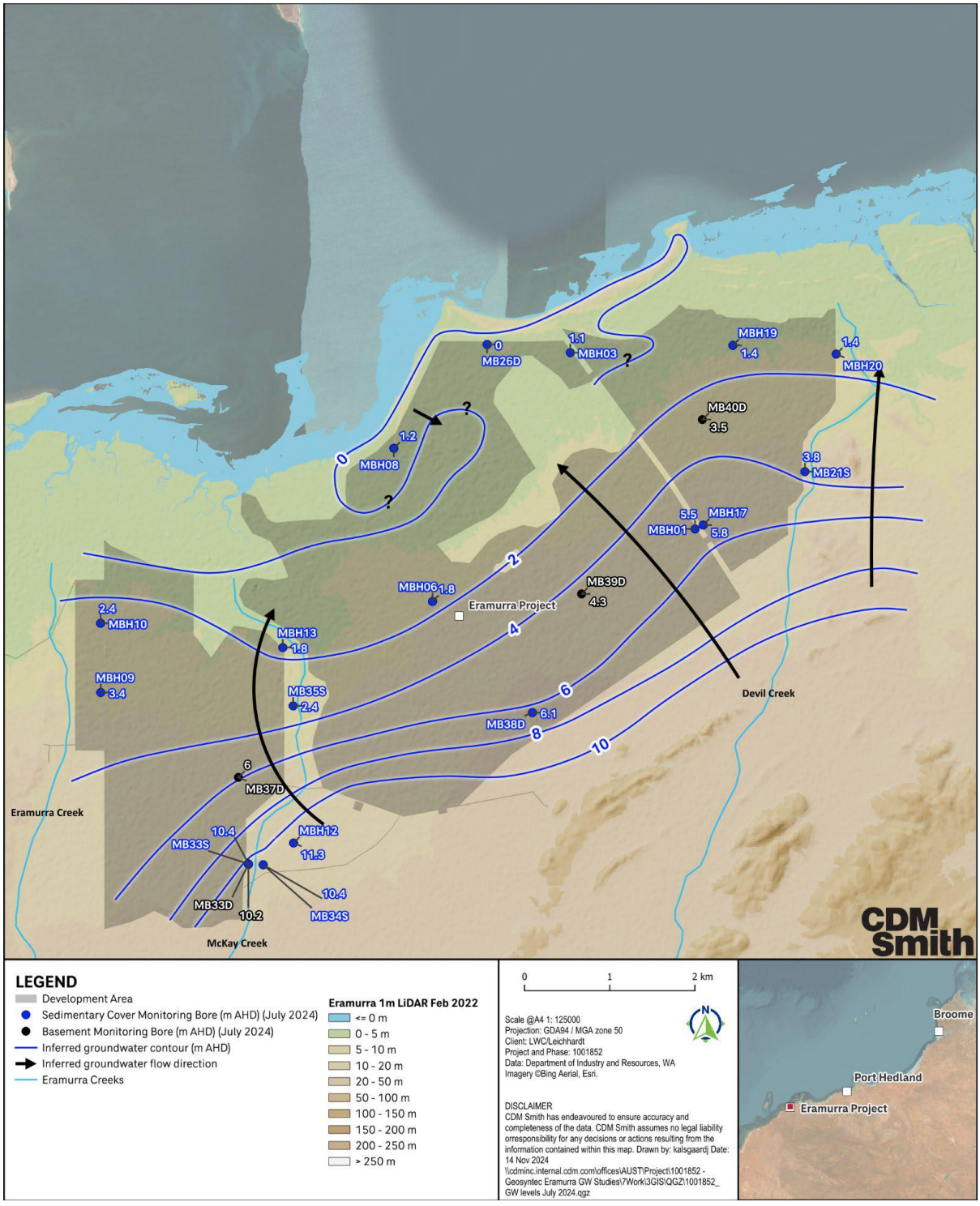

Figure 4-34: Inferred groundwater elevation contours and flow direction (July 2024)

4.6.3 TIDAL CHARACTERISTICS AND INFLUENCES

The text in this section has been sourced from O2 Metocean (2023) and Larcombe et al. (2025), unless stated otherwise.

Tidal Cycle

The simulation period (24 March – 8 April 2021) encompassing some of the largest tidal ranges (in the measured data) was developed to allow for the comparison of tidal inundation processes during the full range of tides experienced at the site. The period was adopted for the inundation simulations based upon the availability of high quality validation data concurrently gathered at oceanographic data collection sites (UNS05, NCP05 and ERA05) and creeks (STR02, and SIC02) (Figure 4-36).

Figure 4-35 presents water levels available for water elevation validation of the O2 Metocean tidal inundation model. The high tide water levels during the selected period were between Mean High Water Springs (1.7 m MSL) and Highest Astronomical Tide (HAT; 2.37 m MSL) for Cape Preston.

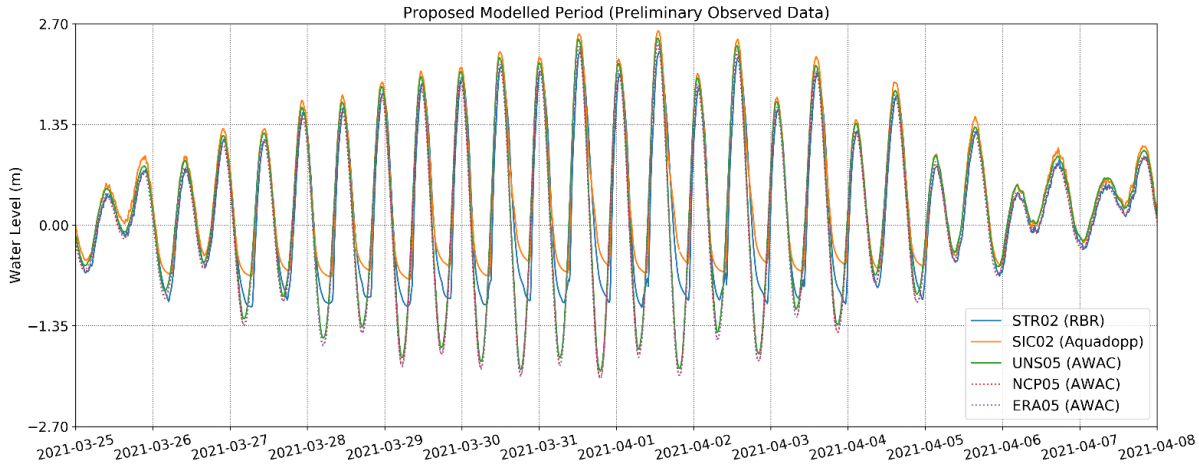

Figure 4-35: Measured water level data

The tidal inundation model domain extends from the western side of Cape Preston through to the coastline just prior to West Intercourse Island, covering approximately 50 km of coastline, centred at Regnard Bay. Depths range from approximately 25 m AHD near the offshore boundary through to heights of approximately 10 – 15 m AHD south of the ponds, allowing for full coverage of the intertidal regions. Substantial attention was made to optimise the geographic resolution of the complex intertidal regions, to best resolve the various creek systems surrounding the ponds and utilise high-resolution bathymetry data.

Figure 4-37 presents a map extending to the intertidal region of interest, illustrating the percentage of time wet for the existing bathymetry model simulation. The map demonstrates that there are two main intertidal creek systems which flood under normal spring high tide conditions but remain isolated from each other.

Figure 4-36: Metocean data collection sites

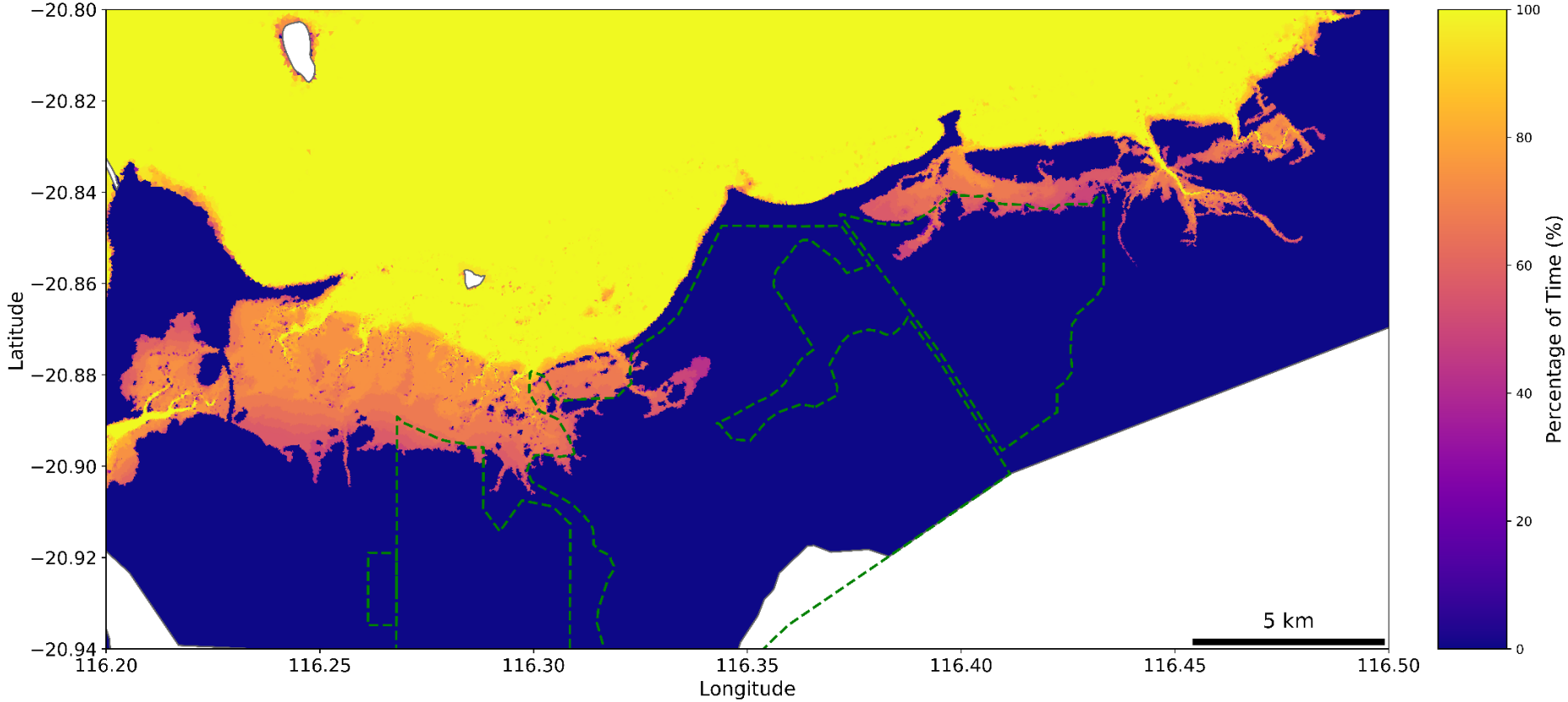

Figure 4-37: Percentage time 'wet' (pre-development)

Influence of Cyclones and Tropical Lows

The region is exposed to tropical storms and cyclones during the wet season. The Karratha to Onslow coastline is the most cyclone-prone section of the Australian coast, with one cyclone making landfall on average every two years. Cyclones affecting the Pilbara typically form in the tropical waters between the Kimberley and the Timor Sea and intensify as they propagate westward and poleward, though tracks of significant cyclones impacting Cape Preston within the last 30 years are varied. In addition to tropical storms, troughs of low pressure also bring rain, strong winds, and sharp changes in wind direction.

Despite the presence of La Nina, cyclone impacts in the Pilbara Region were very mild during the 2020 – 2021 cyclone season. The only storms reaching cyclone classification were Tropical Cyclone (TC) Marian (21 February – 9 March 2021), and the interacting systems TC Seroja (3 – 12 April 2021) and TC Odette (3 – 10 April 2021), although each of these reached full intensity far to the west of Cape Preston. In addition to these extreme events there were numerous other weaker tropical storms in the region (e.g., TL02U 6 – 12 December 2020; TL08U 15 – 23 January 2021 and; TL12U 28 January – 5 February 2021).

A total of 31 cyclonic events passed within 200 km of the site since the beginning of 1988. The track passage was categorised as a northwest passage (passing to the north and/or crossing land to the west), a southeast (crossing land east of the site) or a direct hit (passing within 20 km). Most (20 of 31) passed the site to the northwest, with most of those making landfall to the west. Cyclones travelling a northwest passage generate strong onshore winds and associated storm surges at the site. Cyclones travelling a southeast passage generate strong offshore winds that may reduce the associated storm surge. Cyclones that pass directly over the site generate a more complex (time-dependent) wind field at the site.

Cyclone associated rainfall was highly variable, as measured at the BoM Eramurra site which is 15 km inland and at 50 m elevation. Measured rainfall varied from 0 – 280 mm with an average of 85 mm (at Eramurra). Rainfall spatial distribution was highly variable, with large differences often measured between the weather station at Eramurra and stations at Karratha Airport (65 km northeast) and Mardie (33 km southwest).

Storm Surges

A storm surge is a rise along a shore above the normal water level resulting from strong onshore winds and/or reduced atmospheric pressure. Storm surges accompany a tropical cyclone as it comes ashore. The combination of storm surge and normal (astronomical) tide is known as a ‘storm tide’ (BoM, 2018). The greatest impacts occur when the storm surge arrives on top of a high tide. Storm surge influences are often amplified by pounding waves generated by the powerful winds.

SWS (2025) analysed available data to calculate storm surge and extreme water levels for the Project. The outcomes from that study indicated the following return period guidance:

- 100-year still water sea level is on average 3.19 m above MSL; and
- 10-year sea level is on average 2.69 m above MSL.

Tidal Creeks

Tidal creeks are meandering and bifurcating drainage channels that connect the landward intertidal flat basins (claypans) with the ocean, through a series of banks and washes, and play an important role in the movement of water and sediment. Tidal creek systems and associated tidal flats display the majority of tide-driven coastal changes in the Pilbara, with rapid switching between erosion and accretion in response to changing metocean conditions (Department of Planning Lands and Heritage (DPLH), 2013).

Freshwater inputs are virtually absent in tidal creeks and marine water is largely contained within channels on inundating adjacent mudflats during spring tides. These systems are dominated by high levels of tidal energy. Catchment derived sediments and nutrients are limited in tidal flats and creeks, with fine material only delivered by sheet runoff during rain events and coarser material during extreme storms. Marine sediments and nutrients dominate and are deposited in intertidal habitats, while strong tidal energy leads to erosion of finer sediments in subtidal habitats (Hadwen et al., 2012).

Tidal channels are frequently interconnected and flanked by large areas of low-gradient intertidal flats, mangroves, saltmarsh, and salt flat environments. The coastal mudflats that generally surround tidal creeks tend to be at or above the limit of high tide, and seawater is mainly confined to the tidal channel, except during spring tides (Ryan et al., 2003).

Evaporation is a significant process in tidal creeks due to the extensive intertidal area and extreme climatic conditions. Saltflat environments are inundated rarely (e.g., 3 – 4 days per month), resulting in hypersaline groundwater and often a saline crust on the surface. Ebb flows from these areas can cause tidal creeks to become hypersaline, but typically only for short periods of time, due to strong tidal flushing (Ryan et al., 2003).

The Project harbours a major tidal estuary, which contains tidal creeks of various forms and sizes, and within which are extensive areas of subtidal and intertidal flats, fringing and estuarine mangroves. The coastline north of the proposed ponds is about 18 km long, and contains a variety of coastal morphologies, inferred sediment transport regimes and sediment transport pathways. At the eastern margin of the ponds are located several tidal creeks, again of various forms and sizes. Further east are the wave-dominated deltas of some relatively small rivers – the Yanyare and Maitland – beyond which is the complex array of islands of the Dampier Archipelago.

Sea Level Rise

Sea level rise data around the world are curated by the Permanent Service for MSL (PSMSL), Liverpool, from whom data are available (PSMSL, 2022). Data for the last 50 years around Australia indicate an average rate of sea level rise of 2.1 mm/year. The Project is located between monitoring stations at Onslow to the southwest and Dampier to the east, for which data indicates high variability and a mean rate of sea level rise since 1985 of 2 – 4 mm/year.

4.6.4 Flood Level Joint Probability

The intertidal areas can be simultaneously flooded from the upstream catchment as well as coastal inundation from storm surges. Generally, both events are associated with cyclonic activity. However, a cyclone-related flood in the upstream catchment would occur sometime after any associated abnormal sea level (the height of which can vary greatly), as the cyclone tracked across the coast and moved inland. Hence significant storm surge and upstream flooding are not dependent and generally do not occur simultaneously.

A common way of handling this joint probability between the two flood mechanisms is provided in the 'Flood Risk Management Guide' (New South Wales (NSW) Department of Environment, Climate Change and Water 2010/759, 2010). This approach adopts a probability ratio for the two flood mechanisms of 1:5, i.e., assuming 20-year ARI catchment flooding in conjunction with 100-year sea levels, or 100-year catchment flooding in conjunction with 20-year sea levels. The 'Karratha Coastal Vulnerability Study' (JDA, 2012) studied the joint probability between river flood levels and storm surge in the Karratha area and found no obvious correlation; that study therefore adopted the 100-year catchment flood flow in conjunction with the 20-year sea level (estimated as 3.9 mRL) as the downstream boundary condition.

4.7 Social and Heritage Values

4.7.1 Aboriginal Heritage and Cultural values

The information in this section was provided by Leichhardt's Aboriginal Heritage Consultant.

Native Title/Traditional Owners

Native Title rights and interests comprise either the exclusive right to possession, occupation, use and enjoyment of the relevant land or a set of non-exclusive rights which include, among others, the right to maintain and protect places of significance.

The Mardudhunera People are the Traditional Owners and determined Native Title holders for the land that underlies the Project. The Native Title Determination Area covers an area of 9,927 km^2. The WAC RNTBC is the registered prescribed body corporate that holds on trust the Native Title rights and interests for the Mardudhunera People. Many of the Traditional Owners currently reside in Karratha, which is 55 km northeast of the Project.

Aboriginal Heritage

The Aboriginal Heritage values within the development envelopes have been identified through cultural heritage surveys with Mardudhunera People and ongoing consultation with the WAC. The Heritage Agreement provides a process for the conduct of heritage surveys, including when surveys are required, survey methodology, monitoring, procedures in the case sites are located, and relevant fees.

One registered site, Noorea Soak (ID 11871), was identified within the Survey Area through the AHIS. This site was recorded in 1975 as a freshwater soak with an engraving. Six other sites listed on the AHIS within the Survey Area have either been assessed by the Aboriginal Cultural Material Committee as being sites to which section 5 of the AH Act does not apply, or the sites are in fact outside of the Survey Area.

Demarcated Areas

There are five demarcated recreational areas identified by WAC during consultation meetings and fieldwork. These areas continue to be used by Mardudhunera People today. 40-Mile Beach is used by many Mardudhunera People and the general public who visit the area to camp and fish. Mardudhunera People also have a strong cultural association with the 40-Mile Beach Area.

Concerns were raised by WAC during the consultation engagements about continued access to the five areas, particularly 40-Mile Beach. Access to 40-Mile Beach is via Forty Mile Beach Road, a public road maintained by the City of Karratha. This road will not be impacted by the Project and access to 40-Mile Beach will remain unrestricted. The demarcated areas are shown in Figure 4-38.

Eramurra Creek

Eramurra Creek was identified as a key place of recreation where Mardudhunera People continue to gather for social purposes. It is also a place where the current cohort of elders used to visit with their parents and recreate. It is a place that people stopped off at when visiting Balmoral Station travelling on horseback and when carrying out mustering on Karratha Station. Several ethnobotanical features were identified along the creek including bush tomato, bush potato and Vicks bush.

The Mardudhunera elders requested that a further ethnobotanical survey be undertaken after heavy summer rainfall to identify culturally significant flora species in the Eramurra Creek area. They also identified this area as potentially suitable for a Keeping Place for displaced cultural artefacts that will be salvaged prior to construction of the Project.

McKay Creek

The area in and around McKay Creek was identified as a place where numerous bush tucker species can be identified following summer rainfall. The Mardudhunera elders observed numerous portable grinding stones and concluded that the area would have been heavily used by their ancestors. The Mardudhunera elders were interested to find out what species of seeds were processed on the grinding stones next to McKay Creek. Their recommendations included limiting the disturbance of the area and conducting residue analysis on the grinding stones to determine what species were used and if they still occur in the area today.

Gnoorea Point – 40-Mile Beach

The Mardudhunera elders observed that the dune vegetation at Gnoorea Point is easy to access from Karratha for any current usage requirements. They requested that the dunes not be impacted by the Project and remain as they are. Access to this coastal area is very important to maintain so Mardudhunera People can continue to use the coastal resources, camp and continue to practice their culture.

The Mardudhunera elders noted that this is an area they want to officially manage through a Ranger Program to reduce the environmental impacts of tourism. Leichhardt has committed to assist WAC in this objective, including through the provision of funding and facilitating discussions with the City of Karratha, who currently manage the camp sites.

Pelican Point

This area is characterised as a sheltered mangrove lined creek which continues to be a very popular fishing spot for the Mardudhunera People who have been coming to this area for generations. Concerns were raised about potential indirect impacts to the mangroves and water levels, and concerns were raised that the Project may change the nature of the area. It was observed that bush onions are abundant in this area. This place was also observed to have a spiritual importance as it is a place where the Mardudhunera People 'sing in the whales'.

Bills Mill

This place has historical significance for some Mardudhunera People who used to live and work on Karratha Station. It is still frequented today as it has been for several generations. The area is where Devil Creek changes from being tree lined with dense riparian vegetation to treeless on the saline plain. The Mardudhunera People are keen to ensure that no impacts occur to this place.

4.7.2 European Heritage

A search of WA databases (inHerit) identified no European heritage sites in the development envelopes. The De Grey – Mullewa Stock Route (No. 8701) traverses through Woodenooka and Tallering Peak north from Mullewa. The site is located to the south of the Project and generally aligns with NWCH south of the Project. Enderby Island (No. 8668), located in the Dampier Archipelago heritage area, contains at least one historic burial and one shipwreck. The heritage area of the Archipelago follows the 40-Mile Beach coastline, encompassing the Dampier Archipelago and the Burrup Peninsula to the west. No shipwreck sites or maritime heritage sites have been identified or recorded within the development envelopes from video surveillance survey methods.

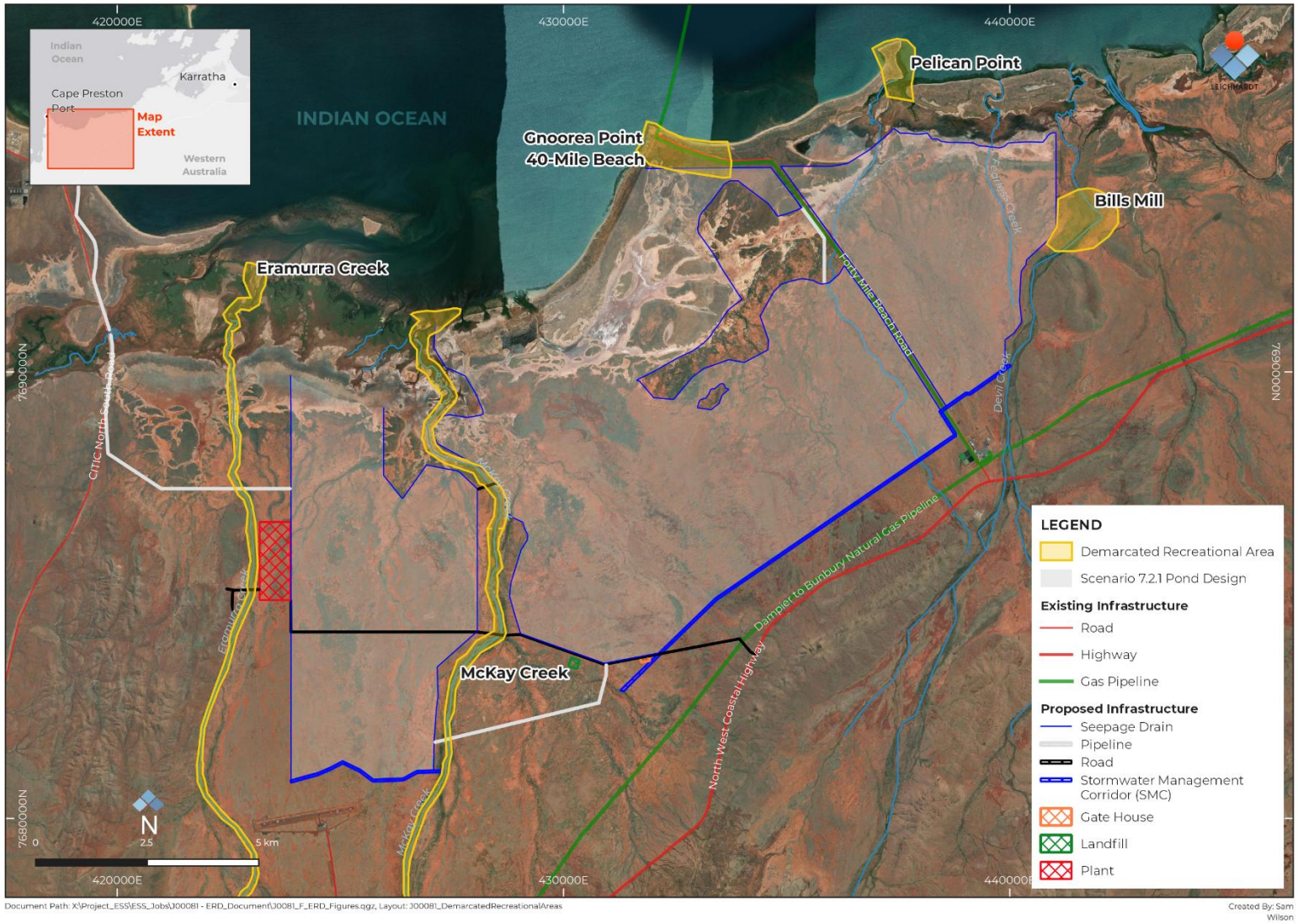

Figure 4-38: Demarcated recreational areas

4.7.3 Recreational/Community Use

The coastline north of the Project is regularly accessed for recreational purposes, generally from the northeast reaches of 40-Mile Beach through to McKay Creek located south-southwest of Gnoorea Point (Figure 4-39). Zone three in Figure 4-39 is a designated camping region at Gnoorea Point, with a boat ramp and basic facilities. Zone four features an extension of campsites that sprawl along the coastline. Zone two includes a secondary main campsite, with several other individual locations available for camping. Zones one and five are not allocated camping locations, and therefore feature little to no camping activity, but are used for recreational activities such as swimming and fishing.

Figure 4-39: Recreational Study Areas

4.7.4 Regional Socio-Economic Characterisation

Regional socio-economic characterisation provides an overview of the population characteristics and economics of the region. This information can be useful to guide closure planning, so that the proposed PMLU is consistent with the characteristics of the region.

The Strategic Plan 2023-25 released in 2023 by the Pilbara Development Commission (PDC), provides key information on the region including population, contributions made by each sector of the region's economy, and economic opportunities.

The population of the Pilbara region in 2022 was 62,841, noting that at any one time an additional 25,000 people are in the region working (Pilbara Development Commission, 2023).

The top five major industries include resources; construction; agriculture, forestry and fishing; transport, postal and warehousing; and tourism and hospitality. Salt is the largest mined commodity.

The Pilbara Strategic Plan 2023-25 identified that "… the Pilbara's continues to be an economic powerhouse for the Western Australian and national economies, producing $78 billion in Gross Regional Product (GRP) in 2023, which represents more than 56% of regional Western Australia's GRP. Exports of Minerals and Petroleum products from the Pilbara reached $189.4 billion in 2021-22. Unemployment in the Pilbara is 1.8%, which is half the State unemployment rate, creating a tight job market and challenges for small businesses to attract and retain staff".

The PDC Strategic Plan 2023-25 has five areas of focus which respond to regional needs and align with government priorities. These are:

- Regional liveability
- Economic development, diversification and innovation
- Aboriginal empowerment and prosperity
- Climate resilience and low carbon transition
- Organisational excellence.

4.8 Other Closure Related Data

Leichhardt will research and monitor environmental aspects of Project closure throughout the operations phase. Information will also be collated from local and global sources throughout the life of mine (LOM) as research and technologies are identified. The data will be maintained within the Environmental Management System (EMS) and referred to as closure strategies are developed. Environmental aspects such as vehicle movements and chemical management that are adequately addressed within the existing EMS are not repeated in this section.

4.8.1 Embankment Stability and Erosion

The Project closure strategy is to reinstate hydrology at the Project site by selective removal of sections of the pond embankments.

Within the inter-tidal areas this will allow high tides to inundate the former pond areas, draining these areas as the tides recede. In higher areas, bund breaches will allow overland flow of storm floodwaters. This inundation and draining cycle will progressively remove accumulated salts from the former ponds, ultimately returning site soil salinity profiles to pre-Project levels.

Cycles of inundation and draining will, over time, erode the remaining embankment sections. Some entrained eroded material will deposit as alluvium within the former pond footprints and other areas of the Project site. The remainder of entrained material will be transported into the marine environment. As the embankments will be constructed from in-situ materials, and inundation / discharge volumes and velocities will be constrained by the limited embankment sections to be removed at closure, it is considered unlikely that embankment erosion will have a significant effect on water quality and sedimentation (i.e., inundation / discharge energies will be similar to pre-project conditions and no new materials will be introduced to the area). Erosion and deposition rates will be assessed prior to closure, providing guidance for the selective removal of embankments.

4.8.2 REVEGETATION

Seed is typically collected prior to or during construction for use in revegetation during the closure phase. Any seed collected during construction of this Project will not be viable at closure due to the extended LOM (60+ years). Collection and storage of seed is therefore not proposed for this Project. Native provenance seed may be collected locally nearer to closure for rehabilitation purposes. Alternatively, a passive revegetation strategy may be selected.

Further studies will be required to determine the topography and barrier structures most suitable to capture sediments within the former pond footprint and thereby promote natural revegetation. Leichhardt intends to develop sediment budgets by using long term data collection from comparable mud flats to determine the effectiveness of passive rehabilitation as seen in the South Bay Restoration Project (Section 4.9.3).

4.8.3 REHABILITATION MATERIALS

Salt flats are areas where plants only grow around the fringes. Plant such as *Tecticornia* and mangroves are adapted to the fresh to hypersaline, dry to flooded extreme conditions that occur on the flats. Algal mats are able to exploit this unique environment where no other plants can survive. The substrate materials on the salt flats are sourced from the surrounding terrestrial and marine environments. They are generally extremely saline, sodic and have little value as a plant growth substrate. With many years of leaching, they may become useful for plant substrate (as evidenced by the growth of plants on embankments in other salt projects).

Leichhardt will harvest and stockpile topsoil from the, access road, wash plant and NPI footprints where they cover vegetated areas in order to meet future Project rehabilitation requirements. Topsoil will be excavated to a depth of up to 100 mm where possible.

Topsoil from the embankment footprint will be stockpiled and formed into a section or sections of pond embankments. These areas will be recorded in as-built drawings so that the materials may be used as growth medium during site closure. Where topsoil is not assessed to be geotechnically suitable for embankment construction, it may be supplemented by other in situ materials (e.g., clays), and / or armoured, as required. Embankment sections constructed from topsoil will be demarcated on site plans, and the site plans included in future revisions of this MCP.

Topsoil excavated from the access road, wash plant and NPI footprints will be stockpiled in proximity to the cleared areas.

4.9 LEARNINGS FROM OTHER SALT OPERATIONS

4.9.1 LAKE MACLEOD

Leichhardt have recently acquired the Lake MacLeod salt operations from Dampier Salt Limited. The information and knowledge that the acquisition provides, including long term mine closure planning, shall be used to inform closure planning for the Project operations.

4.9.2 Mardie Salt Trial Pond and Ancillary Works

In 2019 DEMIRS approved a Programme of Works (Registration ID:81661) for the Mardie Salt Trial Pond and Ancillary Works. The trial's objective was to inform the construction and decommissioning of the Mardie Project by:

- Assessing the suitability and performance of the proposed pond wall designs and construction method to be employed by the proposed Project;
- Testing the proposed Mardie Project pumping strategy;
- Confirming the pond water balance by tracking losses through evaporation and seepage;
- Refining techniques to capture sediments and maintain environmental integrity; and
- Researching and trialling decommissioning and closure approaches.

Leichhardt will review the trial findings regarding decommissioning and closure, which will be published within future revisions of the Mardie Project MCP.

4.9.3 Study: South Bay Salt Pond Restoration Project

The South Bay Salt Pond Restoration Project is a collaborative project between United States government agencies and not for profit organisations to rehabilitate salt evaporation ponds in the southern reaches of the San Francisco Bay into tidal wetlands. The result has been the successful rehabilitation of a combination of tidal salt marsh and managed ponds for wildlife.

The salt ponds were established over 150 years ago with up to 90% of the tidal marsh lost throughout the long history of the industry. The restoration project encompasses 15,000 ha and uses the experience of hydrologists and engineers to work out which levees to breach that will enable inwards tidal movement bringing sediments that recreate the mudflats. In addition, natural tidal inflows bring plant material and seeds which passively revegetate the rehabilitated areas.

By breaching the levees and restoring the marshes, the restoration project has recorded measurable improvements in water quality, an influx of native species back to the region and improved flood protection for adjacent businesses (for milestones and photographs, see https://www.southbayrestoration.org/page/our-progress#anchor-progress_in_pictures__before__after).

Findings from the research at South Bay can inform closure of the Eramurra Solar Salt Project. As the South Bay rehabilitation project is significantly advanced, Leichhardt will continue to monitor reports regarding the progress and issues as it proceeds.

4.10 Data Analysis and Implications for Mine Closure

This section provides a brief summary of the key points arising from the baseline data and consideration of other information sources, their implications for mine closure and rehabilitation. Planning for closure has identified information gaps and additional data to enable detailed planning for closure and rehabilitation of the Project footprint. Some impacts may only occur in the operational phase and will be reduced upon cessation of operations; others are more likely during closure due to the consideration of longer time periods.

The points listed below are being considered in impact assessment for the Project and may have implications relevant to closure. They will be reviewed and updated as further baseline and operational monitoring and modelling data is gathered. They summarise the environmental setting and key implications for closure.

- The Project requires minimal earthworks – embankments to retain water are designed to broadly follow contours to minimise material movements. The embankments are largely located on salt flats and gilgai plains. The gilgai plains are vegetated, the salt flats have fringing vegetation, but are largely bare;
- A key impact of the Project is changes to surface water and tidal/storm surge flows;
- The operation is located in an area bounded to the west by a significant iron ore mining and export operation (the Sino Iron Project), to the south by the NWCH and Dampier to Perth Natural Gas Pipeline (including the Devils Creek Gas Plant), to the east by Devil Creek;
- The coastal strip associated with the dune and mangrove systems is regularly used for recreation;
- Climate is generally hot and dry, with significant rainfall and storm surge events associated with tropical low pressure and cyclone systems. Any revegetation planning needs to consider the amount and timing of rainfall in the area;
- There are few surface water drainage features and they flow sporadically. They bound the Project to the West (Eramurra Creek) and east (Devil Creek);
- The key disturbance footprint of the Project is on salt lake playas, Gilgaied clay plains, salt flats and claypans. Adjacent areas of mangroves and coastal dunes and swales also form the conceptual closure models for landforms at closure;
- The Project utilises the transitional area between marine and terrestrial environments, with the interaction between these environments dictating the landforms and processes in action;
- The Project footprint overlays a range of vegetation types and variety of species capable of surviving in the transition zone, the most significant of these are:
    - Samphire vegetation;
    - Algal mats; and
    - Mangroves.
- The Project footprint overlays a range of fauna habitat types for species exploiting the transition zone, the most significant of these are:
    - Migratory shorebirds;
    - Juvenile and specialised marine species; and
    - Six significant fauna species.
- With the Project infrastructure spanning the intertidal zone through to terrestrial, surface water quality is highly variable, ranging from fresh to hypersaline within the same surface water feature;
- The groundwater is generally saline to hypersaline and has no beneficial use;
- Flood events may provide a brief freshwater window for germination, hatching and establishment of new populations of small vertebrate and invertebrate fauna;
- The product and by-products from the operation are all naturally occurring in seawater and no additional chemicals are used in the process; and
- The operational life of the Project provides sufficient time to support the investigation and testing the detailed implementation of the closure concept to provide confidence in their outcomes, practicality and cost.

The implications of the relevant information and information gaps for mine closure are:

- Residual salt in ponds will have an economic value and can be marketed;
- Selected embankments and structures may be removed in stages so that surface water and tidal/storm surge flows can be resumed;
- The dynamic environmental conditions help to provide opportunities for colonising plants and animals, as well as risks of causing instability;
- Consultation with key stakeholders will be required to plan and implement closure; and
- Detailed modelling and planning is required to support the planned removal of infrastructure and recovery of inundated areas and embankment footprints.

4.10.1 KNOWLEDGE GAPS

Solar salt production facilities tend to be long life operations as they rely on seawater as an input and hence do not exhaust the source of salt. Experience with decommissioning, closure and rehabilitation of production scale salt evaporation ponds is therefore limited. The key information gaps identified at this stage relate to reinstating the hydrological regime at the Project site and managing the release of any residual accumulated salts (primarily from the pond floors).

This MCP is the first of what will be a series of MCPs. Each MCP will be updated as more information becomes available as the Project is implemented. Key gaps in the information required for appropriate risk management and effective Project closure are summarised in Table 4-23.

Table 4-23: Knowledge Gaps

Knowledge Gap	Action / Research	Timeframe / Status
Infrastructure to be retained post-closure.	Consultation with landholders and others who may be impacted by closure or wish to take ownership and responsibility for retained infrastructure. Written agreements for any retained infrastructure.	Life of Project. As agreed with Third Party and documented.
Design basis for closure landforms.	Identify embankment sections to remove. Hydrological modelling. Salt transport modelling. Impact assessment.	Operations (pre-closure).
Impact of PASS when ponds are drained at closure.	ASS investigation and monitoring.	Operations (pre-closure) and closure
Benthic Communities and Habitat (BCH)	BCH monitoring to determine changes of extent and locations over time from baseline to pre-closure phase.	Operations (pre-closure).
Sea-level	Monitoring to determine changes to sea-level over time from baseline to pre-closure phase.	Operations (pre-closure).
Revegetation strategy	Model topography and remaining barrier designs for stability and identify those most suitable to capture sediments and promote natural revegetation. Develop sediment budgets.	Operations (pre-closure)

5 POST-MINING LAND USE

5.1 CONSIDERATIONS

The DMIRS (2020a) Statutory Guidelines for Mine Closure Plans state that the post mining land use (PMLU) must be:

- Relevant to the environment in which the mine will operate or is operating;
- Achievable in the context of post-mining land capability;
- Acceptable to the key stakeholders; and
- Ecologically sustainable in the context of the local and regional environment.

Existing or immediate past land uses in the area are reflected in the underlying tenure in the area (see Section 1.4). Historically, the Pilbara coast has provided:

- Land used by Traditional Owners for traditional cultural purposes;
- Broad scale pastoral land on relatively flat country suitable for grazing;
- Fishing, oil and gas production offshore;
- A key transport route connecting coastal communities and ports; and
- Recreational opportunities.

More recently the Pilbara coast has provided:

- Ports for export of bulk commodities including iron ore and salt;
- Ports and onshore facilities for oil and gas;
- Opportunities for recreation for increasing numbers of tourists, fishers and locals; and
- Larger areas included in conservation estate.

The Project area was formerly largely pastoral lease, with limited recreation activity. In 2015, as part of the re-negotiation of pastoral leases, the Government resumed some sections of land. The gilgai plains, known as the Horseflat Land System is extensive in the southern section. This includes an area that was resumed in 2015. The Mullewa-De Grey stock route also crosses the southern section of the Mining Proposal area. Stock routes are no longer used for droving along the Pilbara coast.

The existing and recent land uses have been extensive in nature (stock grazing and transport) and left the Project area relatively unchanged in terms of the key features. They have led to changes in vegetation from grazing, with the introduction of weeds and areas of degradation from overgrazing. A small recreational node based on Gnoorea Point and the 40 Mile Camp continues to attract increasing numbers of campers and fishers. More recently the acquisition of ex Mardie Pastoral lease areas that include the Horseflat PEC shows a change in planned use towards conservation.

Leichhardt has studied baseline environmental conditions at the Project area during the pre-mining / approvals phase of the Project and archived the reference data collected. Operational monitoring data, models and records will also be stored throughout the LOM. Characterisation of pre-Project environmental baseline conditions has been used to inform the objectives and targets for the planned PMLU (reinstate the pre-mining land use) and objectives will be further refined as additional baseline information is acquired.

Data collected by environmental monitoring undertaken during operations will be analysed to understand the direct impacts of the operations and to determine which environmental elements will require additional resources to achieve the PMLU.

5.2 Selection Approach

The Mardudhunera People have customary and traditional connections with the land on which the Project is located, and the Mardudhunera People have been determined by the Federal Court to have Native Title rights and interests over this land. Consultation with the Mardudhunera, and consideration of Mardudhunera's Native Title rights and interests, have influenced PMLU selection. Returning the area to the pre-mining land use has been accepted by the Traditional Owners and is considered appropriate for future customary activities. This approach is consistent with the native title holders' aspiration for ongoing management of their native title determination area more generally and their aspiration for ongoing use of the area.

Existing and prior land use is familiar for many key stakeholders and provides a level of comfort if it is able to be maintained or re-instated post-mining. Leichhardt has consulted directly with stakeholders and regulators regarding current land uses and development plans, helping to inform the selection of proposed PMLU.

5.3 Post Mining Land Use

The factors that Leichhardt took into consideration when selecting the PMLU were:

- Current land use;
- Land tenure;
- Heritage
- Acceptability to key stakeholders; and
- Compatibility with surrounding area.

Leichhardt's overall approach to PMLU is to reinstate the pre-mining land use. An objective to reinstate land use at the Project site to be as similar as possible to the pre-Project land use, which includes customary and recreational activities, with conservation interests, was made with consideration given to the environmental factors that affect the suitability of the PMLU, and stakeholder consultation outcomes.

It is considered unlikely that pastoral activity will be re-established over the land. The extensive gilgai soil areas will have been inundated for many years and are likely to require some time to leach entrained salts to levels that will enable salt-sensitive plants to re-establish.

6 CLOSURE RISK ASSESSMENT

A rehabilitation and closure risk assessment was conducted for the Project in accordance with the DMIRS (2020b) MCP guidelines. The purpose of the risk assessment was to:

- Identify environmental and regulatory risks and opportunities when planning for rehabilitation and closure; and
- Identify management measures to be implemented to ensure the defined completion criteria can be achieved.

6.1 IDENTIFICATION OF CLOSURE RISKS

Leichhardt employs a risk-based approach to identifying and assessing potential issues and appropriate management strategies. Leichhardt has developed a risk management procedure with reference to *AS ISO 31000:2018 Risk management - Guidelines* (Standards Australia, 2018) and *Leading Practice Sustainable Development in Mining: Risk Management* (Commonwealth of Australia, 2016a). The procedure sets out processes and tools for the management of risks that, if left untreated, would have the potential to cause harm to individuals or otherwise impact upon the success of the operation. This includes the environmental risks associated with the mine closure process.

It is the intent of Leichhardt to manage risks to meet or exceed the standard required by relevant specific regulations, standards or industry code of practice. Where no regulations or standards exist, the management actions will be aimed at eliminating or reducing the risk to as low as reasonably practicable.

Application of the main elements of risk management, as described in *Leading Practice Sustainable Development Program for the Mining Industry: Risk Management* (Commonwealth of Australia, 2016a) to identification of Project closure risks is summarised as follows.

6.1.1 COMMUNICATE AND CONSULT

Leichhardt has communicated and consulted with key internal and external stakeholders to identify project risk, including environmental risk, as described in Section 3. Key external stakeholders include regulators (DEMIRS and DWER), Traditional Owners (Mardadhunera People), the underlying pastoral lease holder, and recreational groups. Key internal stakeholders include the Leichhardt Board, senior management, project manager, and environment / approvals team.

6.1.2 ESTABLISH THE CONTEXT

The introductory sections of this document establish the context for this risk assessment (Sections 1 - 5).

6.1.3 IDENTIFY RISKS

Risk identification was undertaken collaboratively by the Leichhardt environment / approvals team and independent, qualified, technically competent environmental management practitioner. Environmental risks were identified based on analysis of the environmental context, potential pathways, impacts and receptors, project parameters such as layout, footprint, infrastructure / facilities, and processes, and experience on previous projects.

The identified closure related risks are listed and evaluated in Appendix 2.

6.1.4 ANALYSE RISKS

Risks were analysed qualitatively by the Leichhardt environment / approvals team in collaboration with an independent, qualified, technically competent environmental management practitioner.

In undertaking the risk analysis component of the overall assessment, the approach focussed on addressing the 'credible worst-case consequence of the risk and the likelihood of the credible worst-case consequence occurring'. This approach was deemed the most appropriate due to the scale of the project.

Consequence levels are defined in Table 6-1. Likelihood ratings, in terms of frequencies and probabilities, is defined in Table 6-2. A matrix of risk levels assigned in accordance with consequence and likelihood ratings is shown in Table 6-3.

The draft risk analysis was reviewed by Leichhardt subject matter experts and feedback provided to the environmental practitioner, for discussion and revision. Once the risk analysis was agreed between Leichhardt and the independent practitioner, appropriate risk management strategies were developed.

Leichhardt acknowledges that assessing probability of critical risks, such as those that may result in fatalities or business collapse, may be detrimental to the risk management process. It can be challenging to accurately estimate the likelihood of rare events, and applying consequence ratings to such events can be difficult. A conservative approach was therefore taken to analysing risk for events with catastrophic consequences.

Table 6-1: Maximum reasonable consequence descriptions

CONSEQUENCE OF IMPACT	ENVIRONMENTAL FACTOR			
	BIODIVERSITY	WATER RESOURCES	LAND AND SOILS	REHABILITATION AND MINE CLOSURE
Insignificant	No or insignificant impact to ecosystem component with no effect on biodiversity or ecosystem function	Low impact to isolated area without affecting beneficial use	Confined to immediate area around source, clean-up by site personnel, remediated immediately	Site is safe, stable and non-polluting PMLU is not adversely affected
Minor	Moderate to minor impact to biodiversity or ecosystem functioning Minor offsite impacts at a local scale	Contained low impact with negligible effect on beneficial use	Confined to operational area, clean-up by site personnel, remediated within 1 year	Site is safe, all major landforms are stable, any stability or pollution impacts are contained and require no residual management PMLU is not adversely affected
Moderate	Minor and short-term impact to listed species or high value ecosystem Offsite impacts at a local scale	Uncontained impact that will materially affect beneficial use, but is able to be rectified in the short term	Clean-up by site personnel, remediated within 1-3 years Minor impact outside disturbance envelope	Site is safe, any stability or pollution impacts require minor, ongoing maintenance by end land user
Major	Long term impact to listed species or sensitive ecosystem. Long term impact on a wide scale	Extensive impact on beneficial use requiring long term rectification	Clean-up requiring external specialist, remediated within 3-10 years Significant impact outside disturbance envelope	Site cannot be considered safe, stable or non-polluting without long term management or intervention PMLU cannot proceed without ongoing management
Severe	Irreversible impact to threatened species or sensitive ecosystem component Irreversible and significant impact on a wide scale	Impact on beneficial use unable to be feasibly rectified	Clean-up requiring external specialist, remediation >10 years External stakeholders are significantly impacted	Site is unsafe, unstable and/or causing pollution or contamination with long term impact PMLU cannot be achieved

Table 6-2: Likelihood Definitions (Frequencies and Probabilities)

Descriptor	Expected Frequency	Probability
Almost Certain	More than once per year	Event is expected to occur as there is a history of continuous occurrence with similar projects
		Event will occur during the Project
		High number of known incidents.
Likely	Once per year	Strong possibility the event will occur as there is a history of frequent occurrence with similar projects
		Event likely to occur during the Project
		Regular incidents known
Possible	Once in 3 years	Event might occur at some time as there is a history of infrequent occurrence of similar issues with similar projects
		Event may occur in some instances during the Project
		Occasional incidents known
Unlikely	Once in 10 years	Not expected, but slight possibility it may occur at some time
		Event is not likely to occur during the Project
		Some occurrences known
Rare	Once in 15 years	Highly unlikely but may occur in exceptional circumstances
		Event will occur in exceptional circumstances during the Project
		Very few or no known occurrences

Table 6-3: Consequence and Likelihood Matrix

LIKELIHOOD	CONSEQUENCE				
	1 - Insignificant	**2 - Minor**	**3 - Moderate**	**4 - Major**	**5 - Severe**
A-Almost Certain	Low	High	High	Extreme	Extreme
B-Likely	Low	Medium	High	Extreme	Extreme
C-Possible	Low	Medium	Medium	High	High
D-Unlikely	Low	Low	Medium	Medium	High
E-Rare	Low	Low	Low	Medium	Medium

6.2 Risk Management Process

Closure risk management is undertaken in accordance with *Leading Practice Sustainable Development Program for the Mining Industry: Risk Management* (Commonwealth of Australia, 2016a) as follows.

6.2.1 Evaluate Risks

Environmental management practitioners compared the estimated levels of risk against acceptability criteria derived from DEMIRS' objectives for environmental factors, with consideration given to the balance between potential benefits and adverse outcomes. Risks were then prioritised, and the appropriate level of treatment was determined. Leichhardt's over-arching objective is generally to reduce identified rehabilitation and closure risks to as low as reasonably practicable.

6.2.2 Treat Risks

Practical, cost-effective management controls were developed by environmental management practitioners so that the identified rehabilitation and closure risks would be reduced to as low as reasonably practicable. In determining management controls, the following hierarchy of control principles was adopted:

- Elimination of the hazard;
- Substitution with a lower risk activity or product;
- Engineering solutions to reduce the impact of the hazard; and
- Implementation of administrative procedures to control the hazard.

The management controls were reviewed by Leichhardt subject matter experts (project manager and environment / approvals team) to assess the feasibility and likely efficacy of the controls. Feedback was provided to the environmental practitioners, and the proposed controls revised collaboratively where required.

The management controls developed are listed in Appendix 2.

6.2.3 Monitor and Review

Leichhardt will monitor the effectiveness of the risk management process to ensure changing circumstances do not alter priorities. General monitoring and reporting under the Leichhardt EMS are discussed in Section 9. Monitoring and studies comprise treatments for some of the closure environmental risks identified, in response to the data gaps identified (Section 4.10.1). Monitoring of treatment measures is required to determine whether completion criteria have been met (Section 7.2).

6.3 Risk Assessment Information

Appendix 2 includes columns to describe each risk, pathway and potential impact; there are direct links between the cause / source of each risk and the proposed treatment measures. This has enabled identification of any remaining potential gaps in risk identification.

Elimination or substitution of risk pathways have been the preferred treatments, and these have been incorporated into mine planning where possible. Decisions made during the planning phase are generally captured in the accompanying MP. Closure risk treatments using elimination / substitution have been described within this MCP. Where closure risk consequence ratings have been reduced post-treatment by means other than elimination or substitution, adequate justification is provided in Appendix 2.

6.4 Further Guidance Material

The following guidance material was referenced when assessing environmental risk in addition to the DMIRS (2020b) MCP guidelines:

- AS ISO 31000:2018 Risk management - Guidelines (Standards Australia, 2018);
- Leading Practice Sustainable Development Program for the Mining Industry: Risk Management (Commonwealth of Australia, 2016a);
- Leading Practice Sustainable Development Program for the Mining Industry: Mine Closure (Commonwealth of Australia, 2016b);

- Leading Practice Sustainable Development Program for the Mining Industry: Mine Rehabilitation (Commonwealth of Australia, 2016c);
- Leading Practice Sustainable Development Program for the Mining Industry: Preventing Acid and Metalliferous Drainage (Commonwealth of Australia, 2016d); and
- Strategic Framework for Mine Closure (Australian and New Zealand Minerals and Energy Council & Minerals Council of Australia, 2000).

6.5 Site Specific Assessment

Risk assessment and management for the Project is site and project specific. In addition to site specifics such as location, baseline environment, proposed infrastructure and operations, and Project practices and processes, Project risk management is also informed by Leichhardt's professional experience and independent environmental management specialists.

Appendix 2 demonstrates that site specifics have been considered and addressed.

6.6 Materials Characterisation

The Project will be constructed largely or entirely from in-situ materials, comprising generally benign surficial soils (sands, silts and clays). Environmental closure risks associated with materials characterisation are limited to PASS and saline soils.

The soils are naturally saline in the northern section of the indicative disturbance footprint due to proximity to the marine environment and regular seawater inundation in parts of the pond footprint. The Gilgai soils are less saline, generally with heavier texture and are expected to have low permeabilities.

Surficial soils within the pond footprint are likely to be considerably more saline at closure than pre-Project due to long-term inundation with brine. Tidal inundation at closure could result in hypersaline discharge into mangal and / or fringing *Tecticornia* / samphire vegetation.

The salinity and hydrology of flows into and out of the decommissioned ponds will be modelled prior to closure. The embankment decommissioning strategy to re-establish pre-Project site hydrology will be informed by this modelling, with a possible outcome being that sections of the embankments are retained, thus regulating tidal and stormwater flow volumes, and associated salt transport. Salts accumulated in surficial soils will also leach down through the soil profile in response to inundation and rainfall events, leaching salts to lower levels in the soil profile, eventually to the extent that salt-sensitive species may re-establish. Residual risk of indirect impacts on vegetation and fauna habitat causing a decline in vegetation health/habitat quality was assessed as 'medium'.

6.7 CONTAMINATED SITES

No historical potentially contaminating activities are known to have occurred at the Project.

Potentially contaminating Project activities during operations will be limited to storage and use on-site of hydrocarbons for transport and power generation during construction and operations (including pumps - leading to leaks and / or spills). A contaminated sites assessment will be undertaken in accordance with the *National Environment Protection (Assessment of Site Contamination) Measure* (National Environment Protection Council, 1999) at onsite power generation and pump locations after decommissioning of these facilities. Identified contaminated soils will be removed as a controlled waste and disposed of according to the DWER (2019) *Landfill Waste Classification and Waste Definitions*.

7 CLOSURE OUTCOMES AND COMPLETION CRITERIA

7.1 CLOSURE OUTCOMES

Leichhardt's objectives for closure are to:

- Comply with mine closure obligations;
- Consider stakeholders interests during the mine closure process;
- Achieve the agreed set of completion criteria to the requirements of DEMIRS;
- Leave the site in a safe, stable, non-polluting and tidy condition with no remaining infrastructure that is not required for post operational use or agreed use by other stakeholders;
- Identify any potential soil, surface water or groundwater pollution associated with closure and formulate an action plan to address this;
- Re-establish site hydrology analogous to pre-Project conditions; and
- Continue environmental monitoring at the Project during decommissioning, rehabilitation and post-closure, and take appropriate action until the approved completion criteria targets have been met.

The following closure outcomes have been developed such that, when completed, the closure objectives will have been met:

- Compliance
  - Binding obligations and conditions shall be met.
- Landforms
  - Constructed landforms shall be made physically safe.
- Re-Establishing Site Hydrology
  - Constructed landforms have been decommissioned such that tidal flows and floodwaters are not restricted from the former ponds.
  - Frequency and extent of tidal and floodwater inundation of the former pond areas is similar to pre-Project conditions.
  - Tidal discharge from the decommissioned ponds does not significantly impact soil and water quality.
  - Tidal discharge from the decommissioned ponds does not adversely affect the biological function of mangal and fringing *Tecticornia* / samphire vegetation.
  - Habitat is established suitable for the pre-Project faunal assemblage.
- Closure activities
  - No new weed species introduced by closure or rehabilitation activities.
- Infrastructure
  - The site is safe, stable, non-polluting and in a tidy condition with no remaining plant or infrastructure that is not required for post operational use or agreed use by other stakeholders withstanding.
  - All pipes, pumps and other ancillary infrastructure (including the wash plant) will be decommissioned and made safe or else legal responsibility will be assumed by a third party.

- Waste
    - Waste materials shall be identified and disposed of to a licensed recycling / disposal facility during decommissioning / closure.
- Contamination
    - Any identified site contamination reported in accordance with the CS Act.
    - No contaminated soils at the Project site post-closure.
- Heritage
    - No unauthorised disturbance of Aboriginal heritage

Leichhardt will retain the access road and other tracks if required for future access purposes by a pastoralist, tenement holder, or other stakeholder withstanding (e.g. City of Karratha or PPA).

7.2 COMPLETION CRITERIA

Completion criteria have been developed for the Project in accordance with the Australian and New Zealand Minerals and Energy Council & Minerals Council of Australia (2000) *Strategic Framework for Mine Closure* and *A framework for developing mine-site completion criteria in Western Australia* (Young *et al*., 2019). Completion criteria should:

- Be specific enough to reflect unique set of environmental, social and economic circumstances;
- Be flexible enough to adapt to changing circumstances without compromising objectives;
- Include environmental indicators suitable for demonstrating that rehabilitation trends are heading in the right direction;
- Undergo periodic review resulting in modification, if required, due to changed circumstances or improved knowledge; and
- Based on targeted research which results in more informed decisions.

These completion criteria have been cross referenced to the appropriate closure outcomes (Table 7-1). Completion criteria may be further refined in consultation with the relevant stakeholders, as required.

Table 7-1: Completion criteria

Aspect	Closure Outcome	Completion Criteria	Measurement Tools	Evidence of Completion
Compliance	Binding obligations and conditions shall be met.	Site obligations fulfilled, infrastructure liability transferred to third party, or new owner identified and accepted.	Letters of acceptance for responsibility, tenure or ownership certificates evidence for any retained infrastructure. Post-closure audit of legal obligations, conditions and commitments. Monitoring will continue until criteria are met.	Post-closure audit report.
	Constructed landforms shall be made physically safe.	No vehicle access to slopes greater than 30°.	Geotechnical review of surface water and drainage structures within the first 10 years of operation. Erosion and stability monitoring of embankments using LIDAR (or similar survey) for a minimum of 5 years post closure.	Geotechnical report Post-closure audit report.
Re-Establishing Site Hydrology	Constructed landforms have been decommissioned such that tidal flows and floodwaters are not restricted from the former ponds.	Closure landform hydrology study complete. Constructed landforms are eroding at acceptable rates in response to tidal flows and floodwaters.	Hydrological model. Erosion and stability monitoring of embankments using LIDAR (or similar survey) for a minimum of 5 years post closure.	Post-closure monitoring report.
	Frequency and extent of tidal and floodwater inundation of the former pond areas is similar to pre-Project conditions.	Closure landform hydrology study complete. Area of Project site inundated by tides and flood waters post-closure is greater than, or within 10% of pre-Project conditions. Frequency of Project site tidal inundation and flooding is within 10% of pre-Project conditions.	Tidal inundation and flooding extent and frequency monitoring within first year of embankment decommissioning, and additional monitoring if required to confirm completion criteria are met. Monitoring of selected sites with data loggers. Use of aerial imagery.	Closure water monitoring reports.
	Tidal discharge from the decommissioned ponds does not significantly impact soil and water quality.	Salinity and pH of tidal discharge from Project site within 15% of analogue site/s	Closure soil and water monitoring (TDS and pH) at selected locations.	Closure water monitoring reports.
	Tidal discharge from the decommissioned ponds does not adversely affect the biological function of mangal	Mangal and fringing *Tecticornia* / samphire vegetation condition is similar to the surrounding environment in terms of floral compositions at analogue sites (>50% species richness, >50% stems cover/density).	Flora and vegetation monitoring (including BCH) designed and conducted by suitably qualified professional in the first year post closure and then at least biennially, until completion criteria targets are achieved.	Flora and vegetation monitoring report.

Aspect	Closure Outcome	Completion Criteria	Measurement Tools	Evidence of Completion
	and fringing *Tecticornia* / samphire vegetation.		Plot-based vegetation monitoring within mangal and fringing *Tecticornia* / samphire sites (plots to be determined by contracted revegetation specialist during progressive rehabilitation). Monitoring will continue until criteria targets are met.	
	Habitat is established suitable for the pre-Project faunal assemblage.	All habitat types identified during pre-Project fauna surveys are present.	Fauna and habitat survey conducted by suitably qualified professional and additional monitoring if required to confirm completion criteria are met.	Fauna and habitat survey report.
Closure Activities	No new weed species introduced by closure or rehabilitation activities.	No new weed species present. Revegetation areas have a weed infestation of less than 20% above the weed infestation of analogue sites (e.g., 2% increase if the analogue sites have a 10% weed infestation).	Revegetation monitoring designed and conducted by suitably qualified professional in the fifth year (or later) following completion of rehabilitation earthworks. Plot-based vegetation monitoring within rehabilitation and analogue sites (plots determined prior to completion of rehabilitation). EMS and Annual Environmental Report (AER) to report incidents and follow ups. Equipment inspections to be undertaken to check hygiene of earthmoving equipment or and vehicles.	Annual Environmental Report. Weed monitoring reports.
Infrastructure	The Project site is safe, stable, non-polluting and in a tidy condition with no remaining plant or infrastructure that is not required for post operational use or agreed use by other stakeholders withstanding. All pipes, pumps and other ancillary infrastructure (including the wash plant)will be decommissioned and made safe or else legal responsibility will be assumed by a third party.	All pipes, pumps and other ancillary infrastructure (including the wash plant) have been decommissioned, or legal responsibility agreement finalised. Access road and tracks have been rehabilitated with natural drainage lines re-established except where approved agreements are in place for retention. All hydrocarbon storage tanks have been emptied and removed. Any monitoring bores will be decommissioned prior to relinquishment	Post-closure audit.	Post-closure audit report. Record of agreements for any remaining roads, tracks, or other infrastructure. Decommissioning records.

Aspect	Closure Outcome	Completion Criteria	Measurement Tools	Evidence of Completion
Waste	Waste materials shall be identified and disposed of to a licensed recycling / disposal facility during decommissioning / closure.	Waste disposal plan drafted prior to decommissioning and closure. All waste materials have been removed to a licensed recycling / disposal facility.	Waste disposal plan. Post-closure audit.	Waste transport certificates. Waste disposal certificates. Post-closure audit report.
Contamination	Any identified site contamination reported in accordance with the CS Act.	Contaminated sites will be managed in accordance with the *Contaminated Sites Act 2003*.	Close out report demonstrates that all contaminated sites have been managed as per the Contaminated *Sites Act 2003*.	Close out report
	No contaminated soils at the Project site post-closure.	Any contaminated sites will be managed to achieve the post-mining acceptable end-point classifications as per the *Contaminated Sites Act 2003*.	Close out report demonstrates that all contaminated sites have achieved the classifications as per the *Contaminated Sites Act 2003* required to achieve the preferred PMLU	Close out report.
Heritage	No unauthorised disturbance of Aboriginal heritage.	Heritage condition survey finds no unauthorised disturbance of Aboriginal heritage.	Condition surveys on the identified Aboriginal heritage sites.	Aboriginal heritage site condition report

8 CLOSURE IMPLEMENTATION

8.1 CLOSURE IMPLEMENTATION STRATEGY

Closure planning is linked to the LOM Plan and reflects the infrastructure and mine landforms that are expected at the end of mine life. Mine closure can also occur earlier than planned due to the mine being closed for economic reasons. Once a salt project is established, the operating costs are relatively low and stable, and interruptions to mine life are not anticipated. However, consideration must be given to unplanned closure or the need to place the operations in care and maintenance (C&M) mode. In all cases environmental and rehabilitation liabilities remain with the project owner.

Planning for closure will continue throughout the life of operations. Operational monitoring data will form an important body of data to use to plan, model and predict for closure planning. In addition to the mandatory and discretionary monitoring during operations, specific investigations will be required to provide data for closure modelling and planning. Key mine closure planning investigations proposed during operations include:

- Selection of analogue sites for water, soil and vegetation monitoring;
- Monitoring of fauna utilising pond areas during operations;
- Modelling of embankment removal and flows of water, salts and sediments; and
- Design of post-closure landforms.

Other rehabilitation tasks will occur upon project completion because:

- All ponds and crystallisers are required for salt production;
- Most infrastructure is required for the duration of operations;
- The resource (seawater) is effectively infinite (i.e. unlike multi-pit mines, portions of the Mining Lease will not become progressively exhausted); and
- Opportunities for progressive rehabilitation will be limited.

8.2 DOMAIN SPECIFIC CLOSURE WORKS

For the purpose of planning rehabilitation and closure, and in line with MCP Guidelines (DMIRS, 2020a) the Disturbance Envelope has been divided into specific domains. Each domain has been broken down into sub-domains to further group items that have similar rehabilitation and closure processes and requirements. For the Project, the following domains have been identified and are shown in Figure 1-3:

- Drainage Infrastructure;
- Infrastructure;
- Landfill;
- Ponds;
- Roads and tracks; and
- Seawater intake.

The closure objectives allow for some flexibility in target landforms for some of the Project domains, consistent with the early stages of closure planning. The closure work programs will vary according to the selected target landform option as the identified knowledge gaps are addressed. The domain specific closure works in the section below identify the likely tasks associated with the currently identified target landform options. These will be clarified over time as the knowledge gaps are addressed and ensure closure objectives remain consistent with industry standards.

8.3 Research, Investigation and Trials

Leichhardt has identified research, investigations and trials that will inform closure implementation. Commitments to undertake these studies have been made in the Closure Works Program. Research, investigation and trial findings will be summarised in future MCP revisions as they become available. Planned studies will address identified risks and include modelling of tidal discharge salinity and hydrology of flows in response to bund decommissioning and removal.

8.4 Progressive Rehabilitation

Unlike conventional mining, there is little scope for progressive rehabilitation throughout the life of mine. All significant domain areas will stay online until a point when the operation is closed, and the site will be rehabilitated. Progressive rehabilitation will take place where areas, such as laydown and stockpiling areas used during construction, exhausted borrow pits or tracks no longer required. In this case rehabilitation outcomes will add knowledge for final closure activities.

With significant public usage of the Gnoorea Point area, Leichhardt will liaise with City of Karratha regarding site management and rehabilitation and translate learnings into closure planning for the Project.

Knowledge gaps that may be informed by progressive rehabilitation activities include:

- Drainage design;
- Landform surface treatments (ripping, selective application of topsoil, placement of materials);
- Revegetation methodologies via research and trials;
- Rehabilitation performance monitoring; and
- Ongoing improvement and refinement of rehabilitation techniques.

8.5 Early Closure or Suspension of Operations Under Care and Maintenance

Unlike conventional mining operations where an ore body is exploited, the Project has an infinite resource (seawater) and therefore closure is unlikely to occur in a predetermined timeframe. More probable would be a scenario where economic, environmental, safety or external pressures inhibit the profitability of the operations, forcing closure. Such scenarios may include:

- Reduced profit margins due to decreases in product demand;
- Reduced profit margins due to increases in the cost of production;
- Loss of license to operate because of legal non-conformance;

- Catastrophic loss of infrastructure caused by environmental conditions; or
- Major safety incident shutting down operation during investigation.

In such an event, a detailed C&M plan will be prepared, based on the Mining Proposal and this MCP. The C&M plan will follow the requirements under the Care and Maintenance Environmental Notes on Mining (Department of Mines and Petroleum (DMP), 2009) and will be submitted to DEMIRS for acceptance.

Treatments to manage closure and rehabilitation environmental risk, including premature/unexpected closure will be implemented as follows:

- Removal of all salt product from crystallisers, stockpile and spillage areas;
- Modelling of tidal discharge salinity and hydrology of tidal and stormwater flows in response to removal of bunds completed before closure;
- Constraints on rate of embankment removal to control flows;
- Sections of landforms will be retained post-closure where permitted;
- Triennial updates of the MCP;
- Cost estimation and provisioning to International Financial Reporting Standard (IFRS);
- MRF reporting and contributions;
- Drafting and implementation of a C&M Plan specific to the circumstances;
- Agreement with stakeholders to accept responsibility for any retained infrastructure; and
- Post-closure water quality monitoring (salinity and pH).

Some pumping or transfer of water may be required to make areas safe and will be completed according to the C&M plan. Additional closure activities will be undertaken as per the MCP depending on the unplanned closure circumstances. It should be noted that in most cases the goal would be to continue operations once the events leading to unplanned closure have been mitigated.

8.6 DECOMMISSIONING

This section identifies the key decommissioning processes required to close each domain. Since the decommissioning phase usually takes place towards the end of the mine life, details on the strategy and activities required are limited and will be developed throughout the Project life.

8.6.1 DRAINAGE INFRASTRUCTURE

The closure strategy for Drainage Infrastructure is to reinstate the pre-Project hydrological regime while managing the gradual release of salts, sediment and any other water quality considerations into the environment.

The sub-domains under drainage infrastructure and relevant tasks have been provided in Table 7-2.

Table 7-2: Drainage infrastructure task list

Sub-domain	Task	Verification
Drains	• Model post-closure hydrology to design surface water management plan • Decommission drains after surrounding catchment characteristics are reinstated	Audit Rehabilitation monitoring report Surface water management plan.

Sub-domain	Task	Verification
All Areas	• Implement post-mining monitoring and external completion report processes	Audit Rehabilitation monitoring report Surface water management plan.

8.6.2 INFRASTRUCTURE

Some infrastructure may be retained post-closure to provide services for the rehabilitation team while other facilities may remain in place through stakeholder agreements, e.g., with local landowners, Shire, agency or Native Title Group. The sub-domains under Infrastructure and relevant tasks have been provided in Table 7-3.

Table 7-3: Infrastructure task list

Sub-domain	Task	Verification
Administration hub	• Implement post-mining monitoring and external completion report processes. • Re-establish infrastructure according to landowner agreements.	Audit to confirm removal.
Workshop and store facilities		
Electrical power supply		
Re-fuelling facilities		
Laboratory		
Potable water		
All areas	• Implement post-mining monitoring and external completion report processes. • Re-establish infrastructure according to landowner agreements.	Audit. Rehabilitation monitoring report.

8.6.3 LANDFILL

The landfill planned for the site operations will be developed for the management of normal Project waste streams and quantities. The relevant tasks for a conventional landfill associated with a mine are provided in Table 7-4.

Table 7-4: Landfill task list

Sub-domain	Task	Verification
Landfill	• Back-fill landfill cell with stockpiled specified cover thickness and topsoil material. • Re-contour to match surrounding ground levels and re-establish drainage. • Rip and seed with local native species. • Remove fencing.	Audit to confirm removal. Rehabilitation monitoring report.
All Areas	• Implement post-mining monitoring and external completion report processes.	Audit. Rehabilitation monitoring report.

8.6.4 Ponds

The Project will result in large areas of ponds that contain salts or brine and as such the rehabilitation of fauna habitat may be impeded by the presence of salt post-closure. Rehabilitation is expected to be gradually occur once the salts have been harvested. Each pond will be individually assessed for water quality, and BCH and sea-level monitoring will be re-assessed to determine potential impacts from each pond to sensitive areas (i.e., BCH). Pond walls will then be flattened or gradually opened up to tidal flows to allow flushing of the saline sediments accordingly. Additional seawater may be pumped into individual ponds as required to address potential impacts to downstream sensitive (BCH) areas.

Calcium carbonate and calcium sulphate will precipitate on the concentration pond floors as the brine salinity (and density) increases. Precipitate composition and volumes will vary across different stages of the ponds. Prior to closure, the volumes of these deposits will be measured to enable effective planning for remediation. It may be necessary to tine areas to expose underlying soil for future revegetation requirements.

Crystallisers have a smaller surface area than the concentration ponds and are located above the intertidal zone. Post-closure, the pond floors will be hypersaline. After the removal of harvestable solid halite salts the crystallisers will be flushed with seawater for further salt removal. Pond embankments will be initially breached to re-establish overland flooding regimes. Remaining embankments will be pushed down to return the area to a gently graded landform sloped northwards toward the intertidal area.

The relevant tasks for ponds are provided in Table 7-5.

Table 7-5: Infrastructure task list

Sub-domain	Task	Verification
Concentration ponds	• Model post-closure hydrology to design surface water management plan; • Decommission and remove all above ground infrastructure (pumps and pipes); • Assess contamination at potentially impacted areas (pump locations, chemical storages); • Remove excess salt and brine from the concentration ponds; and • Remove embankments to reinstate hydrological flows across the intertidal zone and overland floodwater routing.	Audit Rehabilitation monitoring report Surface water management plan.
Crystallisers	• Model post-closure hydrology to design surface water management plan; • Decommission and remove all infrastructure (pumps and pipes); • Assess contamination at potentially impacted areas (pump locations, chemical storages); • Remove excess salt and brine from the ponds; and • Breach or flatten embankments to reinstate hydrological flows.	Audit Rehabilitation monitoring report Surface water management plan.
All Areas	• Implement post-mining monitoring and external completion report processes	Audit Rehabilitation monitoring report Surface water management plan.

8.6.5 Roads and Tracks

The access road from the NWCH to the Process Plant and CPE, together with an access network around the site during operations (generally by way of trafficable bunds) will remain at site closure and form part of the Roads and Tracks Domain. Some other unsealed light vehicle tracks already exist at the Project site. These are not included in the Roads and Tracks Domain as they will largely be inundated when the ponds are filled.

It is possible that an interested party will take ownership of the access road to maintain access to CPE and post-closure Project site land use/s. The access road will be closed to prevent access and rehabilitated if no stakeholders take ownership of the asset.

The closure design will incorporate adequate drainage / water sheeting control to prevent erosion and promote the establishment of vegetation. Where public access is to be deterred, signage and physical barriers will be installed.

The relevant tasks for roads and tracks are provided in Table 7-6.

Table 7-6: Roads and tracks task list

Sub-domain	Task	Verification
Roads and tracks	• Identify stakeholder to take ownership of the Access Road; or • Deep rip the surface; • Establish long term drainage systems; • Cover with stockpiled topsoil (windrows); • Revegetate; and • Limit access to prevent unauthorised access.	Audit Rehabilitation monitoring report
All Areas	• Implement post-mining monitoring and external completion report processes	Audit Rehabilitation monitoring report

8.6.6 Seawater Intake

The intake infrastructure (intake and pumps) will be decommissioned and removed. Any constructed infrastructure (e.g., armour, walls) will be removed. Once bund infrastructure has been removed, the area will be allowed to form a 'natural' shape in response to tidal movements and stream flows.

The relevant tasks for the seawater intake are provided in Table 7-7.

Table 7-7: Seawater intake task list

Sub-domain	Task	Verification
Pumps	• Decommission and remove intake and pumps • Assess contamination at potentially impacted areas (pump locations).	Audit Rehabilitation monitoring report
All Areas	• Implement post-mining monitoring and external completion report processes.	Audit Rehabilitation monitoring report

8.6.7 BITTERNS DISCHARGE PIPE

The Bitterns Discharge pipe will be decommissioned. Where the pipe is above ground, it will be removed and the corridor rehabilitated. Where the pipe is below ground, greater than 0.5m below surface, it will be made safe and sealed. Any constructed infrastructure associated with the pipe will be removed.

The relevant tasks for the Bitterns Discharge pipe are provided in Table 7-8.

Table 7-8: Bitterns Discharge pipe task list

Sub-domain	Task	Verification
Pumps	• Decommission and remove intake and pumps; and • Assess contamination at potentially impacted areas (pump locations).	Audit Rehabilitation Monitoring Report
Above ground pipe	• Decommission and remove pipe and associated infrastructure; • Deep rip the surface; of pipe corridor; • Establish long term drainage systems; • Cover with stockpiled topsoil (windrows); • Revegetate; and • Limit access to prevent unauthorised access.	Audit Rehabilitation Monitoring Report
Below ground pipe	• Decommission and seal below ground pipe to prevent access.	Audit Close Out Report
Diffuser	• The seabed diffuser for the bitterns discharge will be decommissioned and removed	Audit Close Out Report
All Areas	• Implement post-mining monitoring and external completion report processes.	Audit Rehabilitation Monitoring Report

9 CLOSURE MONITORING AND MAINTENANCE

Closure monitoring and maintenance will be undertaken by Leichhardt from the period following operational closure until the agreed closure completion criteria have been achieved as per Section 7.2.

Some maintenance will be required to ensure that retained infrastructure required throughout the closure process is functional and safe. In particular, any retained pumps will require servicing and inspection to ensure that they are safe and operational. Some earthworks may be required to protect embankment integrity, repairing areas of erosion or degradation.

Monitoring is expected to cover the key environmental risks during closure and include:

- Monitoring of water quantity, quality and flow rates in areas adjacent to and within ponds that are being re-integrated into natural drainage processes;
- Nearby vegetation that may be impacted by elevated salinity or turbidity associated with re-introduction of natural drainage;
- Groundwater levels and quality in key locations;
- Complaints and issues reported by key stakeholders;
- Re-establishment of selected key fauna species in rehabilitating areas;
- Monitoring of soil salinity; and
- Vegetation in areas being re-vegetated.

In addition, audits will be completed to demonstrate that closure criteria and agreements are being met.

All monitoring and maintenance will be undertaken:

- Using recognised or acceptable methodologies and standards recognising the wider receiving environments, receptors and exposure pathways;
- Incorporating appropriate quality control systems and procedures in the sampling, analysis and reporting of results, such as the ISO 9000-based quality management system;
- Recording trends against expected or predicted performance based on statistically robust data; and
- Providing for intervention and contingency strategies if key environmental indicators move outside agreed limits.

9.1 CLOSURE WORKS PROGRAM

Rehabilitation and closure performance will be monitored against closure objectives and criteria. It is assumed that some rehabilitation and closure areas will require some maintenance interventions to ensure objectives and outcomes are met. The post-closure monitoring and maintenance planned to be undertaken is summarised in Table 9-1.

Monitoring requirements during operations are defined by legal obligations, such as tenement conditions and conditions of environmental approvals, licences and permits. This monitoring provides a useful 'baseline' data set and forms a logical basis for continued monitoring as the operations are closed and rehabilitated. Some of the monitoring will be targeted towards risks that are only active during operations, and will logically cease when the risk is no longer active, and some will still be relevant during the closure phases.

Specific monitoring and data capture will be designed to support the case for completion of rehabilitation and closure obligations with a view to enabling tenement relinquishment for the site. The monitoring programme is described in more detail in the following section.

Table 9-1: Post-closure monitoring program

Aspect	What is being monitored / why?	Method	Frequency	Timing / duration
Compliance	Legal obligations, conditions, and commitments.	As stipulated	As practicable	Until completion criteria achieved
Landforms and Soils	Soil salinity	Soil sampling.	5 years	Until salinity levels align with background levels.
	Land stability	Survey and visual.	Survey at least twice after landforming. Visual observation during regular routine inspection.	Survey within 3 years of landforming. Visual monitoring until completion criteria achieved.
	Soil loss	Visual. Quantitative assessment only if visual monitoring suggests necessary.	Visual observation during regular routine inspection.	Until completion criteria achieved.
	Topsoil management	Visual inspection. Surface water quality monitoring.	Visual observation during regular routine inspection	Until completion criteria achieved.
Revegetation	Vegetation establishment	Site inspection records and/or rehabilitation report (plot-based assessment, seedling counts, survivor counts). Comparison to reference sites. Annual Environmental Report.	Biannual monitoring of trends. Regular site inspection records and/or rehabilitation report.	Until completion criteria achieved.
	Flora and vegetation species diversity.			
	Fauna habitat			
General rehabilitation	Topsoil depth	Survey and visual.	At least once.	While spreading topsoil.
Surface water	Quality (pH, EC, TDS)	Flow depth and flow velocity. Field Water Quality (FWQ) analysis. Sample and analysis.	Continuous (hourly; flow). Quarterly (sample). After substantial flows (>25 L/sec).	Until completion criteria achieved.
Groundwater	Abstraction, water levels, FWQ, comprehensive analysis, water efficiency, and vegetation & fauna health.	As per the GMMP.		Until completion criteria achieved.

Aspect	What is being monitored / why?	Method	Frequency	Timing / duration
Infrastructure and waste	Site safety, stability, and potential pollutants.	Site inspection reports. Hazardous materials register. Register of disposal areas.	As practicable. Visual observation. during regular routine inspection.	Until completion criteria achieved.
Contamination	Contaminated sites	Site Investigations by a suitably qualified contaminated site investigator.	As per the CS Act.	Until completion criteria achieved.

10 FINANCIAL PROVISIONING FOR CLOSURE

The objective of a financial provision is to ensure that at the end of operational life, when no further revenue will be generated, but closure expenditure is still to be incurred, there is adequate provision to cover the anticipated expenditure.

Leichhardt plans to put closure provisioning processes in place in which the estimated costs of post-operational decommissioning and rehabilitation activities and closure programmes are estimated through until tenement relinquishment. A 'closure provision' is then created and maintained on the Companies list of liabilities to address site final closure costs as required by the IFRS.

Leichhardt will utilise schedules of rates for various required activities to estimate closure costs. Closure costs will be calculated to reflect, as far as possible, the real cost of closure and include:

- Decommissioning costs (which occur at or near the end of operational life);
- Demolition and removal of unwanted facilities and services on the site;
- Remediation: the clean-up of contaminated areas of soil or water to an agreed standard;
- Maintenance and monitoring, including the management of the site through to relinquishment;
- Rehabilitation costs, which include the cost of rehabilitating disturbed areas that (for an operational or environmental reason), were not progressively rehabilitated during the life of the project;
- Project management costs, which include the human resourcing, facilities and administration related support required to implement closure activities; and
- Contingency costs which include provisions for unplanned events such as extreme weather or other external factors.

As required by the IFRS, Leichhardt will prepare a detailed cost estimate to support the MCP when operations commence.

11 MANAGEMENT OF INFORMATION AND DATA

11.1 INFORMATION REQUIREMENTS AND USE

This MCP is intended to be a live document that will respond to changes during mine operations and mine closure. Closure planning is a lengthy process that commences before mining, continues through operations and evolves with the project and improved knowledge. This plan will be reviewed periodically and updated accordingly for currency with legislation, standards, guidelines and operational requirements. The revision of the document and record keeping will also undertake a complete record of:

- A history of closure planning for the site;
- A history of past and recent developments;
- Information utilised to support planning;

- The potential for improved future land use or site development;
- A change in the closure risk assessment due to new information or environmental incidents, or new legislative requirements; and
- Continual improvement opportunities, such as new technologies, advances and research outcomes.

11.2 DATA MANAGEMENT PROCESSES

Leichhardt will implement an EMS, including data management, aligned with *AS/NZS 14001:2016 Environmental Management Systems - Requirements with guidance for use* (Standards Australia, 2016). This EMS is considered sufficient for the purposes of the Eramurra Solar Salt Project.

Leichhardt has developed procedures and tools for the collection and storage of environmental information as part of its EMS. These information management tools include:

- Document control, for tracking incoming, outgoing and internal reports, designs, approvals, letters, etc, and managing any changes to such documents;
- Databases for the storage and retrieval of temporal information, such as water quality monitoring results and baseline vegetation survey data;
- GIS geodatabases for the storage and retrieval of spatial data, such as monitoring points or approved disturbance boundaries; and
- Systematic and secure storage of compliance evidence for reporting against internal and external conditional authorisations.

All records are to be archived in electronic format.

12 REVIEWED MINE CLOSURE PLAN

As per the Statutory Guidelines for MCPs, in addition to the above information, where a MCP is reviewed under s84AA of the Mining Act or included in a revision to an approved Mining Proposal, the reviewed MCP must also include:

- A revision summary table that clearly outlines all changes made in the reviewed MCP;
- A summary table documenting how the aspects identified by the department for improvement in the prior revision of the MCP have been addressed; and
- A table documenting how the knowledge gaps identified in the prior revision of the MCP have been addressed, as well as any new gaps identified.

All MCPs approved by DEMIRS must be regularly reviewed over the life of a mine: the Mining Act requires MCPs to be reviewed and submitted for re-approval by DEMIRS every three (3) years or other such time as specified in writing by DEMIRS. This requirement will be stipulated in a tenement condition.

DEMIRS requires a complete reviewed version, as well as summary table indicating the sections where changes have been made and a summary of information pertaining to the changes. DEMIRS may request the modifications in the revised and resubmitted document during assessment to be highlighted to assist in finalising the assessment process. The MCP checklist (provided at the front of this MCP) will be used as a tool for reviewing this MCP.

In the circumstance where there has been no mining and/or rehabilitation activities undertaken during the review period, Leichhardt will still be required to submit a reviewed MCP. This reviewed MCP will include other closure planning activities that will have taken place during this period (e.g., ongoing stakeholder consultation and rehabilitation monitoring); and these activities will be reported in the context of mine closure planning.

13 GLOSSARY

Term	Meaning
µS/cm	microSiemens per centimetre
AEP	Annual Exceedance Probability
AER	Annual Environmental Report
AH Act	*Aboriginal Heritage Act 1972*
AHD	Australian Height Datum
AHIS	Aboriginal Heritage Inquiry System
ASS	Acid sulfate soils
BC Act	*Biodiversity and Conservation Act*
BCH	Benthic Communities and Habitat
BIF	Banded iron-formation
BoM	Bureau of Meteorology
C&M	Care and maintenance
CALM Act	*Conservation and Land Management Act 1984*
CEC	Cation Exchange Capacity
CMW	CMW Geosciences Pty Ltd
CPE	Cape Preston East
CPMMA	Cape Preston Mangrove Management Area
CPT	Cone Penetration Testing
CR	Critically Endangered
CS Act	*Contaminated Sites Act 2003*
Cth	Commonwealth
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Environment, Energy and Water.
DEMIRS	Department of Energy, Mines, Industry Regulation and Safety
DER	Department of Environment Regulation
DMA	Decision Making Authorities
DMIRS	Department of Mines, Industry Regulation and Safety
DMP	Department of Mines and Petroleum
DoT	Department of Transport
DotEE	Department of the Environment and Energy
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning Lands and Heritage
DWER	Department of Water and Environmental Regulation
EAAF	East Asian – Australasian Flyway
EC	Electrical conductivity
ECU	Edith Cowan University
EMS	Environmental management system
EN	Endangered

Term	Meaning
EP Act	*Environmental Protection Act 1986* (WA)
EPA	Environmental Protection Authority (WA)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
ERD	Environmental Review Document
ESD	Environmental Scoping Document
FRDMMA	Fortescue River Delta Mangrove Management Area
FWQ	Field Water Quality
GIS	Geographic Information System
GARD	Global Acid Rock Drainage
GLpa	Gigalitres per annum
GMMP	Groundwater Monitoring and Management Plan
GPS	Global Positioning System
ha	Hectares
HAT	Highest Astronomical Tide
ID	Identification
IFRS	International Financial Reporting Standard
JTSI	Department of Jobs, Tourism, Science and Innovation
kg/L	Kilograms per litre
km	Kilometres
Leichhardt	Leichhardt Salt Pty Ltd
LNG	Liquefied Natural Gas
LOM	Life of mine
LVs	Light vehicles
LWC	Land and Water Consulting
m/s	Meters per second
MCP	Mine Closure Plan
Mig,	Migratory
Mining Act	*Mining Act 1978* (WA)
MLA	Mining Lease Application
MNES	Matters of National Environmental Significance
MP	Mine Plan
MRF	Mining Rehabilitation Fund
mRL	Minimum Reporting Level
MRWA	Main Roads Western Australia
MS	Ministerial Statement
MSL	Mean High Water Springs
MSL	Mean sea level
Mtpa	Million tonnes per annum
mV	milliVolts
MW	Megawatts
N/A	Not applicable

Term	Meaning
NAIF	Northern Australia Infrastructure Facility
NPI	Non-process infrastructure
NSW	New South Wales
NWCH	North West Coastal Highway
OGV	Ocean Going Vessels
PASS	Potential acid sulfate soil
PDC	Pilbara Development Commission
PEC	Priority Ecological Communities – plant communities listed as being potentially threatened under the *Wildlife Conservation Act 1950*
Phoenix	Phoenix Environmental Sciences
PIDE	Ponds and Infrastructure Development Envelope
PIL4	Roebourne; of the IBRA subregions
PMLU	Post-mining land use
PoW	Programme of Works
PPA	Pilbara Ports Authority
Project	Eramurra Solar Salt Project - a solar salt project to extract up to 2.4 million tonnes per annum of salt from seawater, using a series of evaporation ponds, crystallisation ponds and processing plant.
QA	Quality Assurance
QC	Quality Control
RFFE	Regional Flood Frequency Estimation
RNTBC	Registered Native Title Bodies Corporate
SBSA	Migratory Shorebird Study Area
SCHMP	Social, Cultural Heritage Management Plan
SEP	Stakeholder Engagement Plan
SKM	Sinclair Knight Merz
SPT	Standard Penetration Test
SRE	Short-range Endemic
TACC	Technical Advisory and Consultative Committee
TC	Tropical Cyclone
TDS	Total Dissolved Solids
TEC	Threatened Ecological Communities – plant communities listed as being threatened and legally protected under the *Biodiversity Conservation Act 2016* and / or the *Environment Protection and Biodiversity Conservation Act 1999*
TFSA	Terrestrial Fauna Study Area
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorus
tph	Tonnes per hour
TSV	Trans-Shipment Vessel
UAV	Unmanned Aerial Vehicles
VU	Vulnerable

Term	Meaning
WA	Western Australia
WAC	Wirrawandi Aboriginal Corporation
WAFIC	WA Fishing Industry Council
WAM	Western Australian Museum
WAMSI	WA Marine Science Institute
WoNS	Weeds of National Significance
XRD	X-Ray Diffraction
YACMAC	Yaburara and Coastal Mardudhunera Aboriginal Corporation

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15 APPENDICES

Appendix 1: Relevant Study and Survey Reports
Appendix 2: Project Environmental Risk Register
Appendix 3: Historical Stakeholder Engagement Register

Appendix 3: Historical Stakeholder Engagment Register

Timing	Stakeholder	Type	Purpose of planned engagement	Issues to be raised
2023 - ongoing	City of Karratha	Letters and meetings	Letter summarising the Project status (i.e., approvals to date and path forward). Meetings to agree City of Karratha support for establishment of a public road to access the Project.	• Approvals required for the City (e.g., building). • Approvals required to support the gazetting of Mardie Road. • Future applications. • Path forward for the Project. • Ongoing support of 40-mile camping and recreational area.
2023- ongoing	CITIC Pacific Mining	Emails, phones calls, meetings	Correspondence summarising the Project status and timing on pathway forward.	• Project summary, status, timing. • Invitation for comment. • Tenement applications.
2023 - ongoing	DBCA	Telephone, email and meetings	Correspondence to obtain approval under the EP Act. Ongoing monitoring data. Potential input to offset programs	• Potential impacts to species listed under BC Act or by DBCA. • Additional information requirements. • Approval conditions. • Management Plans. • Ongoing monitoring of Migratory birds. • Offsets.
2023 - ongoing	DCCEEW	Telephone, email and meetings	Correspondence to obtain approval under the EPBC Act.	• Potential impacts to MNES. • Additional information requirements. • Approval conditions. • Management Plans. • Ongoing monitoring of Migratory birds. • Offsets.
2023 - ongoing	DEMIRS	Telephone, email and meetings	• Correspondence to obtain grant of mining tenements and approval of Programme of Works (PoWs), MP and MCP. • Agreement on salt royalty rates.	• Tenement applications. • MP and MCP assessment. • Timing. • Project specific requirements. • Closure requirements. • Project Management Plan assessment. • Salt royalty rates.
2023 - ongoing	DPIRD	Letters and meetings	Correspondence to ensure Project has minimal impacts on commercial and recreational fishing.	• Project summary, status, timing. • Invitation for comment/discussion. • Project operations to minimise impacts.
2023- ongoing	DWER (Industry Regulation)	Telephone, email and meetings	Correspondence to obtain works approvals under Part V of the EP Act.	• Future Works Approvals and Licence requirements (concentration ponds and crystallisers, bulk material export, landfill etc.). • Project timing (i.e., construction). • Potential environmental impacts.

Timing	Stakeholder	Type	Purpose of planned engagement	Issues to be raised
2023 - ongoing	DWER - EPA Services	Telephone, email and meetings	• Correspondence to obtain approval under Part IV of the EP Act. • EPA Board meeting.	• Minor or Preliminary Works approval (if required). • Mangrove Management Area. • Review of draft ERD. • Response to public comments. • Draft conditions. • EPA Board meeting.
2021 – 2022	MRWA	Letter	Letter summarising the Project status and future planning.	• Future applications. • Site access. • Timing (i.e., construction and operation). • Operating hours. • Site access/routes.
2023 - ongoing	Mardie Station	Ongoing meetings and formal access agreement	• Correspondence summarising the Project status and timing on pathway forward. • Formal access agreement.	• Project summary, status, timing. • Invitation for comment. • Tenement applications. • Access agreement.
2023 - ongoing	PPA and Dampier Technical Advisory and Consultative Committee	Letters and meetings	Correspondence to: negotiate terms of port leases; gain port Development and Construction Application approvals and support the Taking of the Lands required for the Port.	• Future applications. • Export options. • Path forward for the Project. • Ongoing management of dredging and dumping activities.
2023 – ongoing	Relevant Ministers	Letters and meetings	Letter summarising the Project status (i.e. approvals to date and path forward).	• Approvals and tenure status. • Future applications. • Studies undertaken. • Key findings. • Path forward for the Project.
2023- ongoing	Santos	Phone calls and meetings	Correspondence summarising the Project status and timing on pathway forward.	• Project summary, status, timeline. • Notify/seek permission prior to works in vicinity.
2023 - ongoing	WAC and YACMAC Native Title Claim Groups	Letter, copies of draft approval documents and meetings	Correspondence summarising feedback on Project design and ongoing negotiations regarding Native Title agreement.	• Approvals to date. • Future applications. • Studies undertaken and key findings. • Path forward for the Project. • Potential for Indigenous contracting and employment opportunities. • Bush tucker/bush medicine management.

Timing	Stakeholder	Type	Purpose of planned engagement	Issues to be raised
2023 – ongoing	WAFIC	Letters and meetings	Correspondence to ensure Project has minimal impacts on commercial and recreational fishing.	• Project summary, status, timing. • Invitation for comment/discussion. • Project operations to minimise impacts.