



# OPTIMISED MARDIE PROJECT MIGRATORY SHOREBIRD MONITORING & MANAGEMENT PLAN V3

<b>COMPANY NAME:</b>	Mardie Minerals Pty Ltd (ACN 152 574 457) a wholly owned subsidiary of BCI Minerals Limited (ACN 120 646 924)
<b>STATEMENT No &amp; DATE</b>	MS 1211 (19 October 2023)
<b>EPBC REFERRAL No</b>	EPBC 2018/8236
<b>DOCUMENT DATE:</b>	19 August 2024
<b>CONTACT:</b>	Approvals & Government Relations BCI Minerals Ltd 6311 3400 <a href="mailto:ApprovalsandCompliance@bciminerals.com.au">ApprovalsandCompliance@bciminerals.com.au</a>

This document has been prepared consistent with *Instructions on how to prepare and Environmental Protection Act 1986 Part IV Environmental Management Plans* (EPA, 2020), and *Environmental Management Plan Guidelines* (DotE, 2014), and with reference to the associated guidance.

## Declaration of accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed:

Name: Shaun Meredith  
Position: Head of Approvals and Government Relations  
Organisation: Mardie Minerals Pty Ltd  
ABN 50 152 574 457  
Date: 19/08/2024

## Version history

Note: A Long-term migratory shorebird monitoring program was originally prepared by Phoenix Environmental Sciences and went through several iterations between October 2020 and November 2022. This Migratory shorebird Monitoring and Management Plan has subsequently been prepared, incorporating and superseding the monitoring program. Full version history is provided here, and version numbering continued, for completeness.

Author/s	Reviewer/s	Version	Version number	Date submitted	Submitted to
<b>Long-term migratory shorebird monitoring program for the Mardie Project</b>					
P. Strickland and J. Clark	J. Clark	Draft for client comments	0.1	13-Oct-20	N. Dixon
J. Clark		Client comments addressed	1.0	4-Nov-20	N. Dixon
F. Holmes	J. Clark	Final, DAWE and DWER comments addressed	1.1	1-Oct-21	M. Frame
J. Clark		Updated for Optimised Mardie Project	2.0	12-Aug-22	G. Edwards
P. Williams	F. Holmes	Update addressing DCCEEW additional comments	2.1	3-Nov-22	C. Greenem
F. Holmes	J. Clark	Update addressing client additional comments	2.2	17-Nov-22	C. Greenem
J. Mahony	F. Holmes G. Edwards	Update address EPA comments	2.3	22-Mar-23	EPA Services
<b>Migratory shorebird Monitoring and Management Plan</b>					
F. Holmes K. Crews	K. Frehill	Update monitoring plan to monitoring and management plan in accordance with EPA template; addressing DWER comments, Phoenix additional changes, biostatistician comments and independent reviewer comments	3	19-Aug-24	EPA Services

**EXECUTIVE SUMMARY**

<b>Proposal name</b>	Optimised Mardie Project
<b>Proponent name</b>	Mardie Minerals Pty Ltd (ACN 152 574 457) a wholly owned subsidiary of BCI Minerals Limited (ACN 120 646 924)
<b>Ministerial Statement number</b>	1211
<b>EPBC Act referral number</b>	EPBC 2018/8236 (original Mardie Salt Project) <i>Approval pending for EPBC notice for Optimised Mardie Project</i>
<b>Purpose of the EMP</b>	To describe the monitoring and management program for migratory shorebirds at the Optimised Mardie Project (the Proposal), the management responses that would arise if a negative impact on migratory shorebirds due to the Proposal is observed, and reporting and stakeholder engagement processes.
<b>Key environmental factor/s, outcome/s and objective/s</b>	The desired outcomes for migratory shorebirds are: <ol style="list-style-type: none"> <li>1. Ensure there is no decline in the relative abundance or richness of migratory shorebirds utilising the coastal samphire and mudflat habitats in the Development Envelope attributable to the Proposal; and</li> <li>2. Ensure that fatalities, injuries or other loss of condition to individual migratory shorebirds are avoided or minimised.</li> </ol>
<b>Condition clauses</b>	MS1211, Condition B (6-4) EPBC 2018/8236, Condition 22
<b>Proposed construction date</b>	October 2021
<b>EMP required pre-construction?</b>	No



# Table of Contents

**EXECUTIVE SUMMARY ..... I**

**TABLE OF CONTENTS..... III**

**1 CONTEXT, SCOPE AND RATIONALE ..... 1**

1.1 The Proposal ..... 1

1.2 Association with other management plans ..... 2

1.3 Key environmental factor ..... 3

1.3.1 Significance of the Mardie area to migratory shorebirds..... 3

1.3.2 Baseline surveys ..... 5

1.3.3 Baseline survey results ..... 6

1.3.4 Migratory shorebird habitats at Mardie..... 6

1.4 Condition requirements..... 6

1.5 Rationale and approach..... 8

1.5.1 Management objectives ..... 8

1.5.2 Baseline study findings ..... 8

1.5.3 Key assumptions and uncertainties..... 9

1.5.4 Rationale for choice of indicators, triggers and management actions..... 9

1.6 Responsibilities ..... 9

**2 EMP COMPONENTS..... 11**

2.1 Outcomes..... 11

2.2 Annual survey program ..... 11

2.2.1 Approach and indicators ..... 11

2.2.2 Study areas ..... 11

2.2.3 Monitoring locations ..... 11

2.2.4 Survey methods..... 12

2.2.4.1 Aerial surveys ..... 12

2.2.4.2 Ground surveys..... 13

2.2.5 Survey schedule..... 14

2.2.6 Trigger levels and response actions ..... 14

2.2.7 Data analysis..... 17

2.2.8 Reporting ..... 21

The timing and distribution of survey results is discussed in section 4 of this plan. .... 21

2.3 Shorebird incidents..... 21

2.3.1 Recording of wildlife encounters..... 21

2.3.2 Management response..... 21

2.3.3 Reporting ..... 22

**3 ADAPTIVE MANAGEMENT AND REVIEW OF EMP ..... 23**

3.1 Adaptive management ..... 23

3.2	Review requirements.....	23
3.3	Approval requirements for revisions to plan.....	23
3.4	Close-out of the plan .....	23
<b>4</b>	<b>STAKEHOLDER CONSULTATION AND REPORTING .....</b>	<b>24</b>
4.1	Record-keeping.....	24
4.2	EIA process.....	24
4.3	Incidents, reports and complaints .....	24
4.4	Traditional owners .....	24
4.5	Availability and reporting .....	24
<b>5</b>	<b>CHANGES TO THE EMP .....</b>	<b>25</b>
<b>6</b>	<b>REFERENCES.....</b>	<b>26</b>
	<b>FIGURES.....</b>	<b>27</b>
	<b>GLOSSARY AND ABBREVIATIONS .....</b>	<b>39</b>
	<b>APPENDICES.....</b>	<b>41</b>

# 1 CONTEXT, SCOPE AND RATIONALE

This Migratory Shorebird Monitoring and Management Plan (MSMMP) describes the monitoring and management measures to be implemented by Mardie Minerals Pty Ltd (Mardie Minerals) during the construction and operation of the Optimised Mardie Project (the Proposal, OMP) to ensure that residual impacts to migratory shorebirds and their habitats are minimised.

## 1.1 THE PROPOSAL

The Proposal is a greenfields high quality salt and sulphate of potash (SoP) project and an associated export facility at Mardie, located approximately 80 km south west of Karratha, in the Pilbara region of Western Australia (WA; Figure 1).

BCI Minerals referred the original Mardie Salt Project to the State Environmental Protection Authority (EPA) and Commonwealth Department of Climate Change, Energy, Environment and Water (DCCEEW) in 2018. The original Mardie Salt project was assessed under an accredited process and was granted approval via:

- State Ministerial Statement MS 1175, in November 2021, and
- Commonwealth EPBC 2018/8236 in January 2022.

In 2022, Mardie Minerals Pty Ltd submitted a referral for the OMP, which was considered to be a 'significant change' to the original Mardie Salt project approved under MS 1175 and EPBC 2018/8236. The OMP was also assessed under an accredited process. The OMP was granted approvals via:

- State Ministerial Statement MS 1211 in October 2023 and
- Commonwealth EPBC 2022/9169 is anticipated in Q3 2024.

The OMP is a solar evaporative salt project that uses seawater, a series of concentrator solar ponds, crystallisation ponds and processing plants to produce up to 5.35 Mtpa of salt and up to 140 ktpa of SoP.

The salt and SoP production process commences with seawater being abstracted from an adjacent tidal creek via a screened intake and pumped into a series of concentrator ponds, where it progressively evaporates to form a saline brine. The brine from the final concentrator pond is pumped into the primary and secondary salt crystalliser ponds, where halite (NaCl) salts are crystallised and harvested once the remaining brine has been decanted and pumped into the kainite type mixed salt (KTMS) crystalliser ponds where potassium rich salts are recovered. Mechanically harvested halite salts from the primary and secondary crystallisation ponds are transported to a salt washing plant, where impurities (mainly gypsum and ambient dust) are washed out of the salt using seawater, to produce a high purity final product. Potassium-rich salts produced in the KTMS crystallisers are stockpiled and processed within the SoP processing plant to produce SoP fertiliser. SoP is then transported to the stockyards alongside the halite salt ready for export.

The SoP fertiliser product is then transported to the stockyards alongside the halite salt ready for export through the jetty. Remaining brines that cannot be reprocessed are sent to the waste bitterns storage pond, from where the bitterns are diluted with seawater and discharged out to sea through a multi-port diffuser.

Unlike typical mining/resource operations, the Proposal does not rely on a finite resource and therefore will not close due to resource depletion. As a result, the life of the Proposal is expected to be at least 60 years.

A quarry will be located approximately 1.7 km north-west of the intersection of Mardie Road and North-west Coastal Highway. The quarry will be mined to supply rock, rip rap, concrete aggregate and road base required for construction of the OMP.

Table 1 describes the activities proposed for the OMP. This list is not expansive and will be updated as more detail is available. As the proposed extents below are subject to change, the Company will comply with disturbance limits imposed in regulatory approvals.

**Table 1: Proposal activities**

Element
<b>Physical elements</b>
Ponds Envelope – evaporation and crystalliser ponds, processing plant, desalination plant, administration, accommodation camp, associated works (access roads, laydown, etc.)
Marine Envelope – trestle jetty export facility, seawater intake and pipeline, bitterns pipeline, outfall diffuser and mixing zone
Terrestrial Infrastructure Envelope – access / haul road, quarry, laydown, groundwater source bores, additional infrastructure
Transshipment Corridor Envelope – channel to allow access for transshipment vessels
<b>Operational elements</b>
Bitterns discharge
Groundwater abstraction
Dredge volume

The Development Envelope and Indicative Disturbance Footprint of the original Mardie Salt project and the OMP are shown in Figure 2 and Figure 3, respectively.

**1.2 ASSOCIATION WITH OTHER MANAGEMENT PLANS**

Table 2 outlines how this management plan is designed to align with the other OMP management plans as part of the project-wide Environmental and Social Management System (ESMS).

**Table 2: Comparison of the MSMMP with other Mardie environmental management plans**

Management plan	Role of plan in relation to the monitoring and management of direct and indirect impacts to shorebird populations and habitats
Benthic Communities and Habitat Monitoring and Management Plan (BCHMMP)	<ul style="list-style-type: none"> <li>Monitoring the physical condition (health, productivity and extent) of benthic communities and habitats (including shorebird habitats) within the intertidal area, and responding to adverse changes in that condition.</li> </ul>
Groundwater Monitoring and Management Plan (GMMP)	<ul style="list-style-type: none"> <li>Monitoring the quality and level of groundwater within the intertidal area and around Mardie Pool to ensure adverse changes attributable to the project can be detected and responded to accordingly so as to avoid or minimise adverse impacts to surrounding ecological values.</li> </ul>
Marine Environmental Quality Monitoring and Management Plan (MEQMMP)	<ul style="list-style-type: none"> <li>Monitoring the quality of marine waters that may be affected by routine operations or uncontrolled incidents, and responding to adverse changes in water quality.</li> <li>Monitoring the physical condition (health, productivity and extent) of benthic communities and habitats within the subtidal area, and responding to adverse changes in that condition.</li> </ul>
Illumination Plan	<ul style="list-style-type: none"> <li>Implementation of lighting controls and design measures to minimise light spill and reduce impacts to wildlife from lighting.</li> <li>Response measures if lighting impacts to fauna are observed, such as in the MSMMP.</li> </ul>
Feral Animal Control Plan	<ul style="list-style-type: none"> <li>Implementation of routine safeguards and feral animal control programs and verification of program effectiveness through remote monitoring.</li> </ul>



Management plan	Role of plan in relation to the monitoring and management of direct and indirect impacts to shorebird populations and habitats
Closure Plan	<ul style="list-style-type: none"> <li>• Ensure that closure and decommissioning actions are assessed in terms of impacts to migratory shorebirds, so that a closure strategy and implementation plan can be developed that seeks to maintain shorebird utilisation of the project area, while addressing the other requirements of site closure.</li> </ul>

### 1.3 KEY ENVIRONMENTAL FACTOR

The key environmental factor relevant to this MSMMP is Terrestrial Fauna. The EPA (2016) defines the factor “Terrestrial Fauna” as: *animals living on land or using land (including aquatic systems) for all or part of their lives*. The EPA objective for Terrestrial Fauna is “to protect terrestrial fauna so that biological diversity and ecological integrity are maintained”.

#### 1.3.1 Significance of the Mardie area to migratory shorebirds

The Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides protection for 105 migratory species (not including sub-species) listed under numerous international agreements that Australia is a signatory to. Of these, 37 migratory shorebird species (Table 3) are given special consideration through recently updated guidelines: Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE 2017).

Australia is geographically and ecologically an important location for migratory shorebirds within the East Asian-Australasian Flyway (EAAF) (‘the flyway’). Thirty-six of the 37 Australian migratory shorebird species breed in the northern hemisphere and migrate annually to southern non-breeding areas including Australia. Double-banded plovers migrate between Australia and breeding grounds in New Zealand, rather than north–south through the flyway. The flyway stretches from Siberia and Alaska, southwards through east and south-east Asia, to Australia and New Zealand.

Under the EPBC Act, ‘important habitat’ is a key concept for migratory species (DoE 2013; DoEE 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 (DoEE 2017).

According to that approach:

1. Internationally important habitat regularly supports
  - a. 1% of the individuals in a population of one species or sub-species of waterbird or
  - b. a total abundance of at least 20,000 waterbirds
2. Nationally important habitat regularly supports:
  - a. 0.1% of the flyway population of a single species of migratory shorebird or
  - b. a total abundance of at least 2,000 migratory shorebirds or
  - c. at least 15 migratory shorebird species.

Baseline migratory shorebird surveys conducted for the Proposal (Phoenix 2020) identified that the coastline between Onslow and Cape Preston, where the Proposal is situated, may meet criteria for nationally important shorebird habitat. Further detail is provided in section 1.3.2 and 1.3.3.

**Table 3: The 37 migratory shorebird species listed under the EPBC Act**

Scientific name	Common name (* Species are also listed as threatened under the EPBC Act)
<i>Gallinago hardwickii</i>	Latham's snipe
<i>Gallinago stenura</i>	Pin-tailed snipe
<i>Gallinago megala</i>	Swinhoe's snipe
<i>Limosa limosa</i>	Black-tailed godwit
<i>Limosa lapponica</i>	Bar-tailed godwit*
<i>Numenius minutus</i>	Little curlew
<i>Numenius phaeopus</i>	Whimbrel
<i>Numenius madagascariensis</i>	Eastern curlew*
<i>Tringa totanus</i>	Common redshank
<i>Tringa stagnatilis</i>	Marsh sandpiper
<i>Tringa nebularia</i>	Common greenshank
<i>Tringa glareola</i>	Wood sandpiper
<i>Xenus cinereus</i>	Terek sandpiper
<i>Actitis hypoleucos</i>	Common sandpiper
<i>Heteroscelus brevipes</i>	Grey-tailed tattler
<i>Heteroscelus incanus</i>	Wandering tattler
<i>Arenaria interpres</i>	Ruddy turnstone
<i>Limnodromus semipalmatus</i>	Asian dowitcher
<i>Calidris tenuirostris</i>	Great knot*
<i>Calidris canutus</i>	Red knot*
<i>Calidris alba</i>	Sanderling
<i>Calidris ruficollis</i>	Red-necked stint
<i>Calidris subminuta</i>	Long-toed stint
<i>Calidris melanotos</i>	Pectoral sandpiper
<i>Calidris acuminata</i>	Sharp-tailed sandpiper
<i>Calidris ferruginea</i>	Curlew sandpiper*
<i>Limicola falcinellus</i>	Broad-billed sandpiper
<i>Philomachus pugnax</i>	Ruff
<i>Phalaropus lobatus</i>	Red-necked phalarope
<i>Pluvialis fulva</i>	Pacific Golden plover
<i>Pluvialis squatarola</i>	Grey plover
<i>Charadrius dubius</i>	Little ringed plover
<i>Charadrius bicinctus</i> <sup>1</sup>	Double-banded plover
<i>Charadrius mongolus</i> <sup>1, 2</sup>	Lesser sand plover*

Scientific name	Common name (* Species are also listed as threatened under the EPBC Act)
<i>Charadrius leschenaultii</i> <sup>1</sup>	Greater sand plover*
<i>Charadrius veredus</i> <sup>1</sup>	Oriental plover
<i>Glareola maldivarum</i>	Oriental pratincole

<sup>1</sup>The WA Museum Checklist of Terrestrial Vertebrate Fauna (updated June 2024) recognises the proposed reassignment of this species from the genus *Charadrius* to the genus *Anarhynchus*; however, this change is not yet reflected in the EPBC Act Species Profile and Threats Database (as at August 2024) nor the DBCA Threatened and Priority Fauna List (April 2024), therefore the original nomenclature is retained here.

<sup>2</sup>The WA Museum Checklist of Terrestrial Vertebrate Fauna (updated June 2024) recognised the proposed split of Lesser sand plover into two species, Siberian Sand Plover *Charadrius mongolus* and Tibetan Sand Plover *C. atrifrons*; however, only *C. mongolus* is currently listed under the EPBC Act and BC Act (as at August 2024).

### 1.3.2 Baseline surveys

Mardie Minerals commissioned a series of baseline surveys of the OMP area and surrounds for migratory shorebirds. Phoenix Environmental Sciences (Phoenix) conducted the surveys between 2017 and 2020 (Phoenix 2020).

The migratory shorebird sampling took place within the Migratory Shorebird Study Area (MSSA; Figure 4) associated with the coast and coastal habitats. The aims of the baseline survey program were to:

- record estimates of the number of migratory shorebirds in the MSSA, including overall abundance and individual species
- determine which areas/habitats in the MSSA contained the largest congregations of migratory shorebirds, and
- determine the times of year in which the numbers of migratory shorebirds were highest in the MSSA
- determine if the MSSA met the criteria for nationally significant migratory shorebird habitat.

The baseline surveys for the original Mardie Salt Project were conducted aerially with the use of a helicopter over four phases (Table 4). The additional area associated with the OMP to the north of the original Development Envelope was surveyed in 2021 as part of a baseline monitoring survey. The sampling comprised of a ‘local program’ and a ‘regional program’ where the local program was within and adjacent to the Development Envelope and the regional program was south and north of the Development Envelope within the MSSA (Figure 4). Similar habitats were sampled in the local and regional programs; these habitats (described in Phoenix 2020) (Figure 5) included;

- samphire wetland
- coastal mudflat and sandbar
- mangal forest stand
- mangal forest fringing tidal creeks
- non-vegetated inland mudflat, and
- beach.

Sampling entailed aerial transects that were typically three hours in duration (sample events), centred on the peak low and high tide each day. For each sample event, 3-4 ‘transects’ were flown the length of the survey area. On high tides, they commenced on the landward side of the MSSA and on low tides they commenced on the coast over the exposed tidal mudflats, reefs and near-shore islands, finishing over the inland mudflats. The flight path transects for one phase of the survey, as an example of the coverage achieved by each phase, are presented in Figure 6.

Where large congregations were encountered, the helicopter hovered or slowly circled so that the full complement of a flock could be identified and counted. Care was taken to track flocks to avoid double-counting birds. The helicopter was also landed so that ground counts could be conducted, for example in areas of high foraging/roosting density/activity. Care was taken to avoid disturbance of feeding or roosting activity, primarily

by flying low and slow toward any congregations identified. This typically resulted in the birds taking to the wing for short periods of time before landing back in the same/similar location.

While conducting the surveys, a primary observer was positioned in the front of the helicopter who called out species names and numbers, these were recorded by a secondary observer who also made other observations, identified and tracked flocks, as required. Due to the very large size of the survey area, abundance estimates for the entire MSSA were extrapolated from sample data.

**1.3.3 Baseline survey results**

A total of 20 of the 37 species listed under EPBC Act Policy Statement 3.21 (DoEE 2017) were recorded during the surveys, 19 of which were present in the local program (see Figure 7), therefore meeting criterion 2c for nationally important habitat (section 1.3.1). Six species were recorded in nationally significant numbers (>0.1% of the flyway population; criterion 2a).

The highest numbers of migratory shorebirds were recorded during Phases 2 and 4 which occurred during January and February. All 20 species were recorded in the summer sample events, and 18 were recorded overwintering; no species were confined to the overwintering survey (Phase 3).

The highest densities of birds were detected along the coast directly to the west of the Development Envelope and at the southern extent of the MSSA. The total number of migratory shorebirds recorded inside the Development Envelope represented just 6.0% of the total number recorded in the MSSA, despite the Development Envelope being 32% of the size of the MSSA. This was largely due to the habitat inside the Development Envelope being less suitable for migratory shorebirds than the adjacent tidal areas where most of the birds were detected. Full details of the baseline survey results and extrapolations of populations across the survey areas is provided in the final baseline survey report (Phoenix 2020).

**Table 4: Baseline survey details and results**

Phase	Survey dates	Number of replicates	Median number of migratory shorebirds recorded	Total number of migratory shorebird species
Phase 1	5-7 Dec. 2017	6	322	18
Phase 2	13-15 Jan. 2018	6	737	17
Phase 3	24-26 Jul. 2018	10	436	18
Phase 4	21-25 Feb. 2019	4	731	20

**1.3.4 Migratory shorebird habitats at Mardie**

Phoenix (2020) describes six key migratory shorebird habitats in and around the Proposal: Saphire wetland, Coastal mudflat and sandbar, Mangal forest stand, Mangal forest fringing tidal creeks, Non-vegetated inland mudflat and Beach (Figure 5).

**1.4 CONDITION REQUIREMENTS**

The table below references the MS 1211 conditions of approval for the OMP, relevant for the context of this MSMMP. If required, this table will be updated further as per the Conditions of Approval from DCCEEW for the OMP.

**Table 5: Condition requirements for the MSMMP**

Condition section	Condition requirement	How condition will be met	Where addressed
B6-1	The proponent must ensure the implementation of the Proposal achieves the following environmental outcomes: (1) no change in the abundance and diversity of migratory shorebirds utilising coastal samphire and mudflat habitats <sup>1</sup>	Track and compare the relative abundance and richness of migratory shorebirds at impact and control sites.	Section 2.2
		Determine and track shorebird activity/use type in the ponds (e.g. feeding or roosting/loafing) (impact areas).	Section 2.2
		Record any threats to shorebirds in impact and control areas (e.g. feral or native predators, human influences).	Section 2.3
B6-4	The proponent must, in consultation with DWER, DCCEEW and a biostatistician who is nominated or approved by the CEO, prepare a Migratory Shorebird Monitoring and Management plan (environmental management plan) that satisfies the requirements of condition C4 and demonstrates how achievement of the Terrestrial Fauna environmental outcomes in condition B6-1(1) will be monitored and substantiated, and submit it to the CEO.	Review of MSMMP by biostatistician. Biostatistician input into statistical analysis methods for monitoring data.	Section 3.2 Section 2.2.7
C4-3 (1)	The environmental management plan required under condition B6-4 is also required to:  be conducted at the ponds and in proximity to the trestle jetty (impact areas) and in representative habitats in control areas, as per the requirements of the EPBC Act Policy Statement 3.21 – Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species;	Annual monitoring program includes impact sites at the ponds and trestle jetty, and control sites.	Section 2.2.3, Figure 9, Figure 10
C4-3 (2)	continue for a minimum of five (5) years to capture construction and post construction phases of the project;	The monitoring program will be run for a minimum of 10 years post-construction.	Section 3.4
C4-3 (3)	include a commitment and timing for the results of each completed survey to be submitted to the	Provide annual survey reports to Birdlife, DCCEEW and DBCA within one month of being finalised each year.	Section 4.5

Condition section	Condition requirement	How condition will be met	Where addressed
	'Shorebirds 2020' initiative, DCCEE and DBCA;		
C4-3 (4)	include trigger and threshold criteria and management actions to be implemented if change in the richness and abundance of migratory shorebirds and other birds are identified; and	Preliminary trigger values and management responses identified in Table 8 noting that given the natural variance in migratory shorebird assemblage in any given year, it is difficult to establish a statistically meaningful trigger or threshold criteria without adequate data collected over multiple years. Trigger and threshold criteria are scheduled to be further developed once the first 5 years of monitoring data have been collected.	Section 2.2.6
C4-3 (5)	unless otherwise agreed by the CEO, the proponent shall not commence any construction of evaporation ponds, crystalliser ponds, intertidal causeway or trestle jetty until the CEO has confirmed by notice in writing that the Migratory Shorebird Monitoring Program (environmental management plan) meets the requirements of condition B6-4	The annual monitoring program will be undertaken in accordance with requirements as per the EPBC Act Policy Statement 3.21 (DoEE 2017) and will continue for a minimum of 10 years post construction.	Appendix 2
		Once the monitoring objectives have been met, it is the CEO discretion to when the annual monitoring program will cease.	Appendix 2

<sup>1</sup> 'no change in the abundance and diversity' in this condition is interpreted in this plan as 'no relative decline in the abundance and richness'.

## 1.5 RATIONALE AND APPROACH

### 1.5.1 Management objectives

The management objectives for migratory shorebirds are:

1. Ensure there is no decline in the relative abundance or richness of migratory shorebirds utilising the coastal samphire and mudflat habitats in the Development Envelope attributable to the Proposal; and
2. Ensure that fatalities, injuries or other loss of condition to individual migratory shorebirds are avoided or minimised.

### 1.5.2 Baseline study findings

The baseline migratory shorebird surveys assessed the importance of the MSSA for migratory shorebirds in terms of abundance and species richness. They also helped determine which areas/habitats contained the largest congregations of migratory shorebirds, and the times of year in which numbers were highest. The highest counts of migratory shorebirds occurred during January and February, therefore monitoring surveys were scheduled for late January/early February each year.

The largest congregations of birds were recorded along the coastline areas to the north-western extent of the local program outside of the Development Envelope and at the southern extent of the regional program.

The impact sites selected for the monitoring program were chosen based on the areas that had the highest congregations of shorebirds in the local program, while the control sites were selected based on the areas with the highest congregations of shorebirds in the regional program.

No baseline studies have been conducted in relation to shorebird injuries or fatalities for the OMP, or the Pilbara generally. Several studies into shorebird utilisation have been conducted at the Dampier saltworks, which found

generally positive results regarding the provision of foraging habitat as saltworks ponds often contain high abundances of brine shrimp and various benthic prey species (e.g. Estrella *et al.* 2016).

### 1.5.3 Key assumptions and uncertainties

Regarding the primary objective of ensuring no negative impact to migratory shorebirds as a result of the OMP, linking any observed reductions in shorebird numbers and richness to the presence and operations of the OMP, and particularly to specific aspects of the OMP that could be managed better, will be difficult. Shorebirds globally are subject to increasing and cumulative pressures across the full range of their habitat (DoEE 2017), and natural fluctuations will also add to the variability of survey results.

The MSMMP therefore will monitor shorebird species and numbers in comparable habitats at both impact and control sites to assess if the relative change from year to year is attributable to the Proposal. To ensure that changes are identified and understood within the context of natural variability, each year’s survey results will be independently reviewed by a suitable biostatistician following consultation with the Department of Environment and Water Regulation (DWER). The scope of the review will include an assessment of that year’s monitoring data relative to the pre-determined management triggers (Table 8) and provide advice on the refinement of the triggers and thresholds, in line with the objectives of this plan.

### 1.5.4 Rationale for choice of indicators, triggers and management actions

In order to properly assess local changes in migratory shorebird numbers at a species level, data collected over multiple years is required to gauge the extent of natural variability that should be expected and plot the general trend across years. In the interim phase before robust models can be developed, 3 indicators (shorebird richness, species detection rate and relative abundance) have been selected to provide an indication of whether objectives of the MSMMP are being met. The indicators are linked directly to the plan’s management objectives and align with the environmental risk pathways and baseline survey outputs. Being quantitative, the indicators are appropriate to the application of trigger values. At this early stage of the monitoring and management program, preliminary triggers relating to a comparative difference of more than 20% between impact and control sites has been selected. The trigger values, as well as the indicators themselves, will be reviewed each year, as per sections 1.5.3 and 2.2.6 of this document.

The management actions that will be triggered by the results of the monitoring program are based on reliable techniques that are known to achieve the required outcomes in a timely manner, and whose secondary impacts can be managed appropriately.

## 1.6 RESPONSIBILITIES

Table 6 below sets out the responsibilities for ensuring the actions described in the plan are fully implemented.

**Table 6: Responsibilities for implementation of this MMP**

Position/role	Responsibilities
Project Managing Director	<ul style="list-style-type: none"> <li>• Ensure adequate and appropriate measures and resources are in place for the MSMMP to be implemented as described.</li> </ul>
Project Environmental Manager	<ul style="list-style-type: none"> <li>• Implement the MSMMP, including coordination of surveys, independent reviews and external reporting and data sharing.</li> <li>• Ensure all Project Personnel are adequately trained and routinely made aware of the requirements of this plan.</li> <li>• Manage incident responses where required by this plan, in close liaison with appropriate Project Personnel.</li> <li>• Coordinate reviews of the MSMMP as required by the Plan or in response to internal or external advice.</li> </ul>
Project Personnel, including Contractors	<ul style="list-style-type: none"> <li>• Be aware and familiar with the requirements of the MSMMP, particularly in regards to avoiding and reporting any shorebird disturbances, injuries and deaths (section 2.3).</li> </ul>

Mardie Project: Migratory Shorebird Monitoring and Management Plan

Position/role	Responsibilities
Specialist Ornithological Consultant	<ul style="list-style-type: none"> <li>• Conduct annual aerial and ground surveys of migratory shorebirds in accordance with this plan and the guidance referred to within it.</li> <li>• Report on survey findings within timeframes specified in this plan.</li> <li>• Work with the Project Environmental Manager, the External Reviewer and other external stakeholders to continually improve survey methodology and reporting, and to review and refine the MSMMP.</li> </ul>
External Reviewer/Biostatistician	<ul style="list-style-type: none"> <li>• Annually review of survey results as provided by the Project Environmental Manager and provide advice on those results in the context of previous surveys and other relevant information; if any response triggers have been exceeded; if survey methods and management triggers require modification or adjustment; and if the requirements of the MSMMP have been met for a sufficient period to enable the plan to be wound up.</li> </ul>



## 2 EMP COMPONENTS

### 2.1 OUTCOMES

The desired outcomes for migratory shorebirds are:

1. No decline in the relative abundance or richness of migratory shorebirds utilising the coastal samphire and mudflat habitats in the Development Envelope attributable to the Proposal; and
2. Fatalities, injuries or other loss of condition to individual migratory shorebirds are avoided or minimised.

### 2.2 ANNUAL SURVEY PROGRAM

#### 2.2.1 Approach and indicators

Mardie Minerals will continue to implement, on an annual basis, the same survey methodology across the baseline monitoring surveys and the ongoing monitoring so that a long-term record can be generated and to ensure survey results are suitable for determining whether additional avoidance and mitigation measures are required if declining utilisation is attributable to the OMP. The survey program will record the numbers of each species of migratory shorebird at the geographical location observed, the time of the record, and the activity of the birds at the time. Survey effort will also be recorded (tracked), along with weather conditions in the event of survey results require further investigation. Derived information will include:

- relative abundance – total number of birds detected across all species
- species richness – number of species observed
- species abundance – number of birds of each species detected
- detection rate – number of sites in which each bird species is detected
- activity at site – roosting only, foraging only, roosting and foraging
- tide height – high and low tide levels predicted at the nearest weather station location.

Given the variability in detection rates, up to six indicator species will be selected for analysis of relative abundance trends. These will be selected from the species that were recorded in nationally significant numbers during the baseline surveys and with consideration to size classes and habitat utilisation (e.g. mangrove specialist, mudflat specialist).

#### 2.2.2 Study areas

The baseline surveys were conducted and reported across three 'nested' survey areas that related directly to the Proposal (Figure 4 and Figure 6):

1. Development Envelope: the 16 km<sup>2</sup> envelope in which the Proposal is located, and contains terrestrial, intertidal and marine areas;
2. Terrestrial Fauna Study Area (TFSA): a 29 km<sup>2</sup> study area that encompassed the Development Envelope and was intensively surveyed for terrestrial fauna, including birds and shorebirds; and
3. Migratory Shorebird Study Area (MSSA): a 64 km<sup>2</sup> survey area extending to the northeast and southwest of the TFSA over a total distance of 90 km and focussing on the intertidal areas within 2-5 km of the shoreline.

#### 2.2.3 Monitoring locations

The MSMMP uses three study areas that are related to the baseline study areas and defined as follows (Figure 8):

1. The Impact Area (IA) – areas inside and adjacent to the Development Envelope up to a distance of 10 km.
2. The Control Area (CA) – areas to the southwest of the IA away from the Development Envelope that are of similar habitat to those found in the IA. These sites fall within a distance of 10 km to 40 km from the Development Envelope.
3. Regional Area (RA) – areas within the Pilbara of similar habitat that are more than 40 km from the Development Envelope.

For the Impact and Control Areas, fixed sites have been selected to be monitored each year. These sites were selected based on the results of the baseline surveys.

#### 2.2.4 Survey methods

The natural fluctuations in the assemblage of migratory shorebirds that are likely to use the study area and Development Envelope each year make it complicated to monitor whether any change attributable to the project has occurred. The methods outlined below were developed in consultation with BirdLife Australia with consideration for the following factors:

- tidal variation – birds use different habitats at different times of day in accordance with the tides
- seasonality – number of birds present varies dramatically throughout the year
- annual variability – number of birds varies between years depending on weather events and other factors, including international events and development
- remote/difficult to access areas – birds occur in areas with poor access and use a range of habitats where they can be difficult to observe
- detectability – many migratory species can be difficult to identify/detect.

The MSMMP monitoring program will continue to utilise the methods used in the collection of the baseline survey records to enable the record set to be continued.

The goal of the methods outlined below is to provide a robust, spatially explicit dataset that will show whether a change in the migratory shorebird population occurs inside the IA and identify whether that change is attributable to the developments associated with the Project. Consideration has been made to assess changes in the numbers of migratory shorebird species at the local scale (comparing trends involving the IA and CA), the regional scale (trends involving the CA and RA) and national scale (trends involved in national count data collated by BirdLife Australia (BirdData)). If a decline measured at the IA is greater than the trend measured at the CA, or RA, then it will be considered a decline attributable to the Project and the threatening process will need to be identified and managed. If declines measured at the IA are less than those measured at the CA or RA, then they will be considered a reflection of changes in the migratory bird species populations caused by factors other than the Project.

The monitoring program incorporates both aerial (helicopter) and ground-based bird counts (**Table 7**). Aerial surveys were used in the baseline survey as they provide the greatest coverage, get around limitation caused by tides and can be used to survey a range of habitat types that are otherwise inaccessible. Ground-surveys are an effective way of providing additional data at key sites and can also provide a more accurate count of species that occur in mixed flocks of birds that can be difficult to accurately identify.

By using a combination of the two survey methods, and surveying at various spatial scales, it will be possible to assess whether the diversity and number of birds at the IA is increasing, decreasing, or static. In the event that a change is detected, the annual habitat monitoring assessments (BCI and Phoenix 2021) and finer scale location data will be useful in identifying the cause(s). These methods were developed using the baseline data (Phoenix 2020), the *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DoEE 2017), and consultation with Dr. J. Ringma, the WA shorebird project coordinator at BirdLife Australia.

##### 2.2.4.1 Aerial surveys

The baseline surveys for the Proposal that Phoenix completed between 2017-2020 all used an aerial survey technique. Aerial surveys, using a helicopter, are the recommended method for surveying migratory shorebirds in large remote regions where access is a limiting factor (DoEE 2017). Aerial surveys provide a cost-effective and efficient method for sampling large numbers of birds quickly (Kingsford et al. 2020). The survey method used for the monitoring program will be a modified version of the method used during the baseline survey. Adjustments were made to maximise the repeatability of the survey between years, which will aid in the statistical analysis of changes in migratory shorebird occurrence at the IA and CA.

A series of 18 transects across the MSSA (Figure 9) have been selected to be sampled systematically each year. The transects are made up of 1x10 grids that are each 500 m by 500 m. The coordinates of the transects and grids are recorded in a digital dataset.

Transect sites were placed so that nine are in the Impact Area and nine are in the Control Area. The transects were aligned along paths flown during the baseline surveys and to target the range of shorebird habitats, taking into account the habitat-tidal sequence, from ocean mud/sand flats, through beaches, mangrove stands, samphire wetlands and bare mudflats that are barely inundated at the limit of the tide. The transects were placed sufficiently far apart to enable sampling of all sites without the risk of double counting birds that might fly from one site to another. They were also positioned in a circuit so that all sites could be reliably surveyed within 2 hours to capture the whole sample within a single high/low tide event.

The surveys will be repeated at both high and low tide over four consecutive days each monitoring event. Each transect will be surveyed systematically by flying slowly at a low height along the edge of the grid, and recording all birds observed. The surveys will be completed by a two person team with suitable expertise and experience conducting aerial shorebird surveys. Both observers will be positioned on the side of the helicopter facing the transect with the main observer counting birds seated in the front and scribe in the rear. Digital devices (e.g. iPads) will be used to identify start and end points of each quadrat, with the team noting the transition between each cell.

While there is some risk of birds being flushed from quadrats by the helicopter, there is no alternative means of sampling such a vast study area with limited ground access. Birds seen exiting a quadrat will be allocated to the first cell the birds were recorded in. The individual squares aren't treated as statistically independent (i.e. average counts will be per ladder not per cell) so if a bird is allocated to the wrong cell it will not impact the data analysis.

#### 2.2.4.2 Ground surveys

Ground surveys will be conducted at fixed four impact and six control sites (Figure 10) to provide supplementary data to the aerial surveys, for abundance, species richness and habitat utilisation. The ground surveys will also assist in species level designations for the aerial survey data, for example where two species of the same genus cannot be delineated in the aerial surveys.

Three impact sites are located at the evaporation ponds with one additional impact site situated near the jetty. Based on observations at other coastal saltworks (e.g., Bennelongia 2011; Bertzeletos *et al.* 2012; Clemens *et al.* 2009; Estrella *et al.* 2016; Houston *et al.* 2012; Storr 1984), it is anticipated that the first few stages of the evaporation ponds will see an increase in usage once the development has been completed; the two pond sites will provide additional trend data to the aerial surveys to monitor this potential change.

Control sites have been selected in both the Control Area and the Regional Area in similar shorebird habitats to those of the MSSA (Figure 10). Data from the regional survey sites, and/or other regional shorebird studies (where available) will be used to calibrate for annual variation in migratory shorebird numbers. Ground survey site selection considered accessibility to sites in addition to habitats present.

Ground surveys will be carried out by the same team that complete the aerial surveys, either during the days leading up to or after the aerial surveys have been completed. The survey team will spend 20 minutes recording all bird species they can detect (both visually and by bird call) within 100 m of the point with the aid of binoculars and a tripod. Each site will be visited once at high tide and once at low tide per survey, as tidal variation in the surrounding area will likely influence the birds.

While completing the ground surveys, any evidence of predation pressure from cats and/or dogs or disturbances caused by humans will be recorded. Relevant weather conditions (rain), approximate wind speed, and tide height data will also be recorded.

**Table 7: Summary of long-term monitoring program coverage**

Method	Location	No. of replicates	Total area of coverage (ha)
Aerial Survey (Figure 9)	Impact Area	9	2,250
	Control Area	9	2,250
<b>Total aerial survey</b>		<b>18</b>	<b>4,500</b>
Ground Survey (Figure 10)	Impact Area	4	n/a
	Control Area	3	n/a
	Regional Area	3	n/a
<b>Total ground survey</b>		<b>10</b>	

### 2.2.5 Survey schedule

The migratory shorebird survey will be conducted annually during the summer season in late January/early February when the highest numbers of migratory shorebirds are present. Surveys will ideally be conducted during or close to spring tides, align with tide times that enable the helicopter to fly at both high and low tides, and avoid major weather events (e.g. cyclones).

### 2.2.6 Trigger levels and response actions

As identified in section 1.5.3, identifying if a change in the abundance or richness of shorebirds on a year-by-year basis is attributable to the OMP is unlikely to be successful without concurrent reference site data. For example, Phoenix (2020) reports that the passage of ex-tropical cyclone Joyce in January 2019 resulted in shorebird abundance indices for that survey that were over 80% lower than the combined average of the other two summer surveys. Accordingly, a strong focus will be on comparing survey results between the Impact Area and the Control and Regional Areas. Changes in relative abundance and richness numbers within the Impact Area and the Development Envelope itself will also be factored into the assessment.

Identifying if changes in survey results and utilisation patterns are attributable to the proposal with confidence will be difficult, and a precautionary approach will be taken once the potential influences of external factors (e.g. severe storms, seasonal variations/events,) have been accounted for.

At this early stage of the monitoring program, it is considered that the triggers and responses set out in Table 8 will be sufficient and appropriate to the limitations of the monitoring data.

**Table 8: Triggers and management responses**

Preliminary trigger	Management response	Monitoring	Timing	Reporting
<p>Any reduction in the relative abundance, detection rate and/or richness of migratory shorebirds across the Impact Area is not statistically different (P=0.05) to the corresponding metric in the Control Area.</p>	<p>Investigate reasons for the difference. Respond as appropriate to the findings so that the objectives of the MSMMP are achieved. If the survey results are not adequate to determine a cause, refine the survey methodology to ensure the opportunity to identify the contributing factor/s is maximised in future surveys.</p> <p>Note this result will be expected during construction and perhaps in the season following.</p>	<p>Indicators: relative abundance, detection rate, and richness estimates.</p> <p>Data collected during the annual shorebird monitoring program will be used to assess changes in the avian assemblage in the context of the MSMMP objectives. In the event that a statistically significant change is detected, additional works will be scheduled to identify the cause of the change.</p>	<p>Shorebird monitoring will occur annually between late January and early February. Timing moves slightly each year to align with Spring tides.</p> <p>Data will be analysed within 2 weeks of the monitoring survey being completed so that additional works can be scheduled (if a trigger is met) within the window when migratory shorebirds are present.</p>	<p>In the event of an exceedance of a trigger, the proponent will report the exceedances to DWER within one week of the detected exceedance. In the absence of exceedances, monitoring reports will be submitted by the proponent to the Compliance Branch at DWER annually.</p>
<p>No statistically significant (P=0.05) decline in detection rate in coastal samphire and mudflat habitats in the Impact Area relative to corresponding habitats in the Control Area.</p>	<p>Consider if health or productivity of that habitat type has been affected and is contributing or causing the reduction in values and respond through BCHMMP.</p>	<p>Indicators: detection rate</p> <p>Data collected during the annual shorebird monitoring program will be used to assess changes in the detection rate in coastal samphire and mudflat habitats.</p> <p>If a statistically significant change is detected, additional works will be scheduled to identify the cause of the change.</p>	<p>Shorebird monitoring will occur annually between late January and early February. Timing moves slightly each year to align with Spring tides.</p> <p>Data will be analysed within 2 weeks of the monitoring survey being completed so that additional works can be scheduled (if a trigger is met) within the window when migratory shorebirds are present.</p>	<p>In the event of an exceedance of a trigger, the proponent will report the exceedances to DWER within one week of the detected exceedance. In the absence of exceedances, monitoring reports will be submitted by the proponent to the Compliance Branch at DWER annually.</p>
<p>Within the Development Envelope, there are congregations of shorebirds observed foraging, roosting or nesting.</p>	<p>Investigate reason/s for high utilisation and review operations and other management options to continue to encourage the behaviour pattern if it poses no danger to the shorebird populations or the shorebirds themselves, and is consistent with the proposal's operational objectives. Amend MSMMP (and other relevant EMPs) to recognise behaviour/areas and describe additional or altered management</p>	<p>Indicators: relative abundance and detection rate</p> <p>Data collected during the annual shorebird monitoring program will be used to assess changes in the migratory shorebird assemblage inside the Development Envelope.</p>	<p>Shorebird monitoring will occur annually between late January and early February. Timing moves slightly each year to align with Spring tides.</p> <p>Data will be analysed within 2 weeks of the monitoring survey being completed.</p>	<p>In the event of an exceedance of a trigger, the proponent will report the exceedances to DWER within one week of the detected exceedance. In the absence of exceedances, monitoring reports will be submitted by the proponent to the Compliance Branch at DWER annually.</p>

Preliminary trigger	Management response	Monitoring	Timing	Reporting
	measures to ensure the objectives of the MSMMP are achieved.			

In terms of management responses, and on the basis that the ponds, stockyard and jetty are constructed and operated consistent with the requisite approvals, responses will focus on reviewing and refining operational aspects, including lighting, the timing and/or course of vehicle movements, operational noise (particularly night-time noise). All of these influences are very location-specific and it is expected that, if fewer shorebirds are recorded in one particular area, identifying operational features that may influence the utilisation of that area by shorebirds should be reasonably straight forward and the appropriate management response will be taken to mitigate or nullify that influence.

To ensure that BCI's interpretation of monitoring results as they relate to the impact of the Proposal on shorebird numbers and utilisation, survey results will undergo an independent expert review immediately after collection, as set out in section 1.5.3. Any follow-up responses implemented by BCI will also be forwarded to the reviewer for their consideration.

### 2.2.7 Data analysis

To assess changes in the migratory shorebird assemblage over time, a series of hypotheses will be tested that relate to specific trigger values. If the data shows any of the alternative hypotheses are supported (i.e. statistically significant declines measured in the Impact Area relative to the Control Area) then the preliminary trigger will have been met and a management response will be required.

The following section outlines the statistical methods that will be used to test the monitoring data, and Table 9 provides the relevant terminology and descriptions for the analysis. All analysis will be conducted in R, a software environment for statistical computing.

**Table 9 Terminology/definitions**

Term	Description
Indicator species	<p>A subset of the species present in the study area. Species selected for this group were chosen based on their detection rate and relative abundance, as well as biological factors relating to body size and feeding niche (see Appendix 3).</p> <p>Selecting species with a high detection rate and/or relative abundance improves confidence in the statistical tests as it improves the statistical power in the analysis. Additionally, species that occur in the largest numbers are the most likely to be impacted by the Project.</p> <p>In addition to detection rate/relative abundance, the indicator species were selected from a range of different size classes (small, medium, large), and who occupy different feeding niches (e.g. visual, tactile, water surface), to provide a representative suite of the migratory shorebirds present near the Project.</p> <p>Proposed list includes the following 6 species (with abbreviations for example table at end of section):</p> <ul style="list-style-type: none"> <li>• Common Sandpiper (Abbreviation = CoSa)</li> <li>• Bar-tailed Godwit (Abbreviation = BTGo)</li> <li>• Red-necked Stint (Abbreviation = RNSt)</li> <li>• Grey-tailed Tattler (Abbreviation = GTTa)</li> <li>• Common Greenshank (Abbreviation = CoGr)</li> <li>• Whimbrel (Abbreviation = Whim)</li> </ul>
Monitoring transects	10 x (500 m <sup>2</sup> ) quadrats aligned in a row that extends 5 km through a range of habitats, most of which contain habitats suitable for migratory shorebirds (see Figure 9 for map of monitoring transects).
Sampling event	A single flight in which all Impact and Control monitoring transects are visited. Annual monitoring includes 8 sampling events across both Control and Impact transects made up of 4 high tide and 4 low tide counts over 4 consecutive days during a spring tide period between late January and early February.

Term	Description
Relative abundance	Mean number (SUM) of all indicator species birds detected per sampling event.
Relative richness	The number (COUNT) of migratory shorebird species detected (based on the current EPBC list) per year.
Detection rate	The number (COUNT) of monitoring transects the species was detected in, divided by the total number of transect lines (18) per sampling event.
Impact Area (site type)	Monitoring transects inside or within 10 km of the DE.
Control Area (site type)	Monitoring sites between 10 km and 40 km from the DE.
Regional site	Monitoring sites >40 km from the DE.

### ***Preliminary trigger assessment protocols***

An analysis of covariance (ANCOVA) will be used to assess whether any reduction in the relative abundance, detection rate, or richness of migratory shorebirds across the Impact area relative to the Control area has occurred. ANCOVA is a general linear model that combines analysis of variance (ANOVA) and regression. It is designed to compare one or more means while controlling for the effects of one or more variables (called covariates).

ANOVA is used to analyse the difference (variance) between group (e.g. between Impact and Control areas). Regression is a statistical process for estimating the relationships between a dependent/response variable (e.g. abundance, richness, detection rate) and one or more independent/predictor variables (e.g. year and site type [Impact and Control]).

### ***The variables that will be used in the analysis are as follows:***

Dependent Variables (DV):	Relative abundance, relative richness and detection rate
Independent Variables (IV):	Site type (Impact and Control), survey year
Covariates (CV):	Tide state (high or low) and proportion of transect made up of either coastal samphire or coastal mudflat habitats

### ***The hypothesis that will be tested are as follows:***

Null hypothesis (H0) <sub>1</sub> =	The mean relative abundance is no lower across the Impact areas than the Control areas across years after adjusting for the covariates.
Alternative hypothesis (H1) <sub>1</sub> =	The mean relative abundance is lower across the Impact area than the Control area across years after adjusting for the covariates.
Null hypothesis (H0) <sub>2</sub> =	The mean relative richness is no lower across the Impact areas than the Control areas across years after adjusting for the covariates.
Alternative hypothesis (H1) <sub>2</sub> =	The mean relative richness is lower across the Impact areas than the Control areas across years after adjusting for the covariates.
Null hypothesis (H0) <sub>3</sub> =	The mean detection rate for each indicator species is no lower across the Impact areas than the Control areas across years after adjusting for the covariates.
Alternative hypothesis (H1) <sub>3</sub> =	The mean detection rate for each indicator is lower across the Impact areas than the Control areas across years after adjusting for the covariates.



### ***Presentation of results***

Results will be presented with p-values given to determine whether a statistically significant difference has been found. These are broken up into each component part, meaning that the results can be interpreted on each individual factor to gain a better understanding of where any significant differences have been found. The following findings will all have p-values which can be tested for significance and used to accept or reject their respective null and/or alternative hypotheses:

#### Treatment effect (Impact vs Control) -

Whether there is a statistically significant difference in any of the DVs between Impact and Control sites. This will either support or reject the hypothesis that the treatment (Impact) affects said DV compared to the Control.

#### Year effect -

Whether there is an effect of Year on each DV, indicating whether a temporal trend may be occurring.

#### Significant / non-significant covariates (tides and habitat types) -

Whether dominance of key habitat types or tidal variation are important factors affecting any of the DVs which may be informative for identifying management responses or changes to survey design.

#### Significant / non-significant interaction -

Whether the effect of Treatment on each DV does or does not significantly vary by Year. This will be used to determine whether the difference between Impact and Control does or does not change between years.

The alpha ( $\alpha$ ) value will be set at ( $p \leq 0.05$ ) for a result to be significant, noting that for the null hypothesis to be rejected, the abundance, richness or detection rate must be **lower** at the Impact than Control sites after adjusting for covariates as a statistically significant increase is not sufficient to reject the null hypothesis.

As ANCOVA uses two-tailed tests, both an increase or decrease between DV will result in a significant result. Given there is a directional component to our hypotheses (i.e. only a decline in Impact relative to Control will result in the rejection of the null hypothesis), any significant results will be further interrogated to determine whether our results support the null hypothesis or the alternative hypothesis.

In addition to presenting the data with p-values to indicate statistical significance, R can also be used to generate ggplot2 diagrams that help to visualize the data and show relationships between variables. These will be included in reports and may prove helpful in the event that trigger values are met and management responses are required.

Lastly, in the event that the Treatment effect is found to be significant, additional post-hoc tests or pairwise comparisons to understand more about specific group differences may be required, as well as model diagnostics to check residual plots and other diagnostics to ensure that the model assumptions are met and to validate the robustness of the findings.

### ***Data structure***

The data will be formatted in a frame format where each row represents either the mean relative abundance for that transect, the total count for relative richness, or the mean detection rate for the and each column represents a variable. A general outline for how the data will be structured is presented in Table 10. Each dependent variable will be analysed separately against all independent variables and covariates.

**Table 10: Example data structure for inputting into statistical analytic software (NB table contains dummy data only)**

Variable	Dependent Variables								Independent Variables		Covariates		
Transect code	Relative abundance	Relative richness	Detection rate (CoSa)	Detection rate (BTGo)	Detection rate (RNSt)	Detection rate (GTTa)	Detection rate (CoGr)	Detection rate (Whim)	Site type	Year	Tide height	Coastal samphire (% cover)	Coastal mudflat (% cover)
A	30	10	0.30	0.10	0.09	0.47	0.25	0.4	Impact	2022	High	20	50
A	25	9	0.10	0.09	0.47	0.25	0.4	0.30	Impact	2022	Low	20	50
A	45	8	0.30	0.10	0.09	0.47	0.25	0.4	Impact	2023	High	20	50
A	30	12	0.10	0.09	0.47	0.25	0.4	0.30	Impact	2023	Low	20	50
A	20	10	0.30	0.10	0.09	0.47	0.25	0.4	Impact	2024	High	20	50
A	15	9	0.10	0.09	0.47	0.25	0.4	0.30	Impact	2024	Low	20	50
B	45	8	0.30	0.10	0.09	0.47	0.25	0.4	Control	2022	High	15	45
B	40	12	0.10	0.09	0.47	0.25	0.4	0.30	Control	2022	Low	15	45
B	60	10	0.30	0.10	0.09	0.47	0.25	0.4	Control	2023	High	15	45
B	45	9	0.10	0.09	0.47	0.25	0.4	0.30	Control	2023	Low	15	45
B	40	8	0.30	0.10	0.09	0.47	0.25	0.4	Control	2024	High	15	45
B	60	12	0.10	0.09	0.47	0.25	0.4	0.30	Control	2024	Low	15	45
C	30	10	0.30	0.10	0.09	0.47	0.25	0.4	Impact	2022	High	70	5
C	25	9	0.10	0.09	0.47	0.25	0.4	0.30	Impact	2022	Low	70	5
C	45	8	0.30	0.10	0.09	0.47	0.25	0.4	Impact	2023	High	70	5
C	30	12	0.10	0.09	0.47	0.25	0.4	0.30	Impact	2023	Low	70	5
C	20	10	0.30	0.10	0.09	0.47	0.25	0.4	Impact	2024	High	70	5
C	15	9	0.10	0.09	0.47	0.25	0.4	0.30	Impact	2024	Low	70	5

## 2.2.8 Reporting

Reports will include the following information (taking into account the guidance presented in DoEE 2017):

1. Introduction to Proposal and survey program
2. Feedback from the previous report
3. Overview of methods employed during survey(s)
4. Additional survey information including:
  - Survey personnel and experience level, tidal phase, weather conditions and other relevant observations
  - Date, time of day
  - Tide phase and height, and
  - Weather conditions, including temperature, precipitation, wind, and prior/forecast weather conditions, if changed.
5. Summary of survey limitations (e.g. access restrictions, accuracy of counts)
6. Shorebird statistics, including:
  - a. Total abundance – total number of birds present across all species
  - b. Species richness – number of species observed, and
  - c. Species abundance – number of birds of each species present.
  - d. Shorebird behaviour, including activity at site – roosting only, foraging only, roosting and foraging.
7. Comparison with the previous record set
8. Outcomes and changes to management at the Proposal, including timing.
9. Outcomes of Expert Review.

## 2.3 THE TIMING AND DISTRIBUTION OF SURVEY RESULTS IS DISCUSSED IN SECTION 4 OF THIS PLAN. SHOREBIRD INCIDENTS

### 2.3.1 Recording of wildlife encounters

Any encounter with, or observation of, a dead, injured or visibly unhealthy/distressed shorebird will be recorded as an incident in the ESMS. All personnel conducting activities on the proposal site will be made aware of this requirement as part of their site inductions. The incident will be reviewed by site environmental advisors, acted on in accordance with this plan, and entered on to permanent record. Where the encounter has resulted in an injury, e.g. vehicle strike, entrapment, etc, personnel on site will be advised, through training and awareness measures, to contact environmental staff directly. A similar process will be followed for the reporting of feral animals, including cats and foxes, particularly when observed in known shorebird habitat, including ponds and infrastructure.

### 2.3.2 Management response

All shorebird deaths, injuries and duress that can be attributed to the proposal, both directly and indirectly, will be responded to as per Table 11. The table will be added to as more encounters are recorded and reviewed.

**Table 11: Shorebird incidents and appropriate response**

Potential incident	Initial response	Review
Dead shorebirds on other project areas.	Collect photographic evidence with view to determining cause and timing of death.	Check for predation, ingestion of plastics, entanglement, etc.
Shorebirds landing on ships or jetty and distressed or at obvious risk from operations, and unable or unwilling to take-off.	Designated bird carer to recover bird if safe to do so and isolate/relocate, releasing it when appropriate and safe to do so. Refer to IAATO Field Operations Manual (see References).	What caused the bird to become distressed or disoriented? Check lighting, other birds, etc.
Feral animals observed near or in shorebird habitat areas.	Respond as per Feral Animal Management Plan.	Review Feral Animal Control Plan, including timing and effectiveness of control programs/measures.

Potential incident	Initial response	Review
Non-migratory shorebirds nesting in operational areas.	Examine options to isolate area from activities. Note that as a minimum permits will be required from DBCA before nests can be relocated or removed.	Consider bird-scaring devices and/or increase frequency of activity in those areas. Look at opportunities to encourage nesting elsewhere.
Shorebird roosts causing excessive fouling of equipment.	Install measures to prevent birds from roosting at that location.	Consider providing alternative roosts.
Site personnel are observed feeding, harassing or otherwise disturbing shorebirds.	Advise personnel involved of the illegality/inappropriateness of their actions.	Review training procedures and awareness tools, such as signage.

### 2.3.3 Reporting

All incidents managed through the ESMS are reported internally as part of the ESMS continuous improvement program. Incidents involving migratory shorebirds will be reported annually to DWER as part of the proposal's compliance reporting obligations.

### 3 ADAPTIVE MANAGEMENT AND REVIEW OF EMP

#### 3.1 ADAPTIVE MANAGEMENT

Mardie Minerals is committed to improving environmental results and management practices throughout the implementation of the Proposal (including closure) and accordingly will use an adaptive management approach to ensure the objectives of the MSMMP are achieved as consistently as possible. Adaptive management practices will include:

- Annual review of monitoring data and information gathered, including feedback from public and interested parties;
- Annual evaluation of survey results against management targets set out in Table 8 and the objectives of the MSMMP; and
- Review of management actions throughout the implementation of the Proposal, and identification of potential new management measures and technologies that may be more effective.

#### 3.2 REVIEW REQUIREMENTS

In accordance with condition B6-4, version 3 of this MSMMP was subject to review by a biostatistician, Joanne Potts of Analytical Edge, as well as independent review by John Graff of Biota Environmental Sciences. Reviewer comments have been addressed in this version of the MSMMP (V4).

The results of the migratory shorebird monitoring will be reviewed annually by a practitioner with suitable expertise in migratory shorebirds. This review will also consider the program efficacy and recommend changes, if suitable.

The MSMMP will be reviewed annually through the construction phase and every two years during operation. Amongst other things, the review will take into account whether management targets are being achieved/ are likely to be achieved and if additional information or indicators are required to inform needed refinements.

In addition to the above, as the shorebird monitoring program is a component of the Mardie Minerals Monitoring and Adaptive Management Plan (MAMP), required under MS 1211, where any BCHMMP triggers or thresholds are exceeded (as they relate to shorebird habitat), a review of the MSMMP will be immediately initiated. The review will determine whether the shorebird monitoring program methods, replication and timing are still appropriate and/or, whether additional surveys are required to document and gauge the degree (if any) of impact/change to the shorebird assemblage (abundance and diversity) resulting from changes detected in shorebird habitat condition and extent based on the outcomes of the BCHMMP.

#### 3.3 APPROVAL REQUIREMENTS FOR REVISIONS TO PLAN

The MSMMP has been developed as part of the response to submissions that were made to the EPA. It is anticipated that the requirement for the MSMMP will be included within the Ministerial Conditions for the Proposal. Therefore, formal approval will be sought from DWER for any significant revisions to the MSMMP as a result of information gained through adaptive management. Approvals, or at least informed responses regarding the proposed changes, may also be required from other stakeholders, including DCCEEW.

#### 3.4 CLOSE-OUT OF THE PLAN

The intended timeframe of this plan is for it to continue for a minimum of 10 years post-construction, so that any impacts to shorebird populations and individuals arising from the Proposal activities can be identified and responded to where practicable. After that time, and on approval from DWER, the annual monitoring component of this plan will be closed out and the management actions, both proactive and responsive, will remain as part of the Mardie Project ESMS.

## 4 STAKEHOLDER CONSULTATION AND REPORTING

### 4.1 RECORD-KEEPING

As part of its ESMS, the Company records and retains all stakeholder consultation activities, including meetings and written/electronic correspondence, as well as the resultant actions and/or outcomes. Stakeholder inputs are also recorded, where valid.

### 4.2 EIA PROCESS

The original Mardie Project public environmental review was published for a period of 10 weeks (June - September 2020), in which a number of submissions relating to migratory shorebirds were received from the public and also from government departments, including DWER, DAWE (now DCCEEW) and DBCA. As a consequence, this MSMMP was prepared and subsequently distributed to those agencies for feedback and assessment. The main points arising from these processes have been addressed in this version of the plan.

### 4.3 INCIDENTS, REPORTS AND COMPLAINTS

On-site incidents and near-misses, as well as workforce and public complaints and suggestions, are managed through the project ESMS. Likewise, directions, warnings and appropriate recommendations received from government agencies, community organisations or arising from consultant's reports are all managed as incidents through the ESMS. This ensures that they are recorded, investigated and acted on, if necessary, with the outcomes of the process communicated to the originator.

### 4.4 TRADITIONAL OWNERS

The Company maintains Cultural and Heritage Management Plans and formal working agreements with the two traditional owner groups that have involvement with the Proposal. Through these avenues, operational matters and environmental monitoring information is reported to the members; who may also ask specific questions or raise concerns.

### 4.5 AVAILABILITY AND REPORTING

The latest approved version of the Mardie MSMMP will be made available on the corporate website, along with annual shorebird survey reports. On completion of each survey, Mardie Minerals will liaise with Birdlife Australia, DWER, DCCEEW and DBCA to confirm reporting and data provision requirements, so that raw shorebird counts can be provided directly to those entities, in addition to the survey and performance reports. The annual survey reports will be provided to these entities within one month of being finalised, by the end of March each year.

## 5 CHANGES TO THE EMP

**Table 12: EMP Changes**

<b>Complexity of changes</b>		<b>Minor revisions</b> <input type="checkbox"/>	<b>Moderate revisions</b> <input type="checkbox"/>	<b>Major revisions</b> <input type="checkbox"/>
<b>Number of Key Environmental Factors</b>		<b>One</b> <input type="checkbox"/>	<b>2-3</b> <input type="checkbox"/>	<b>&gt; 3</b> <input type="checkbox"/>
<b>Date revision submitted to EPA: DD/MM/YR</b>				
<b>Proponent's operational requirement timeframe for approval of revision</b>		<b>&lt; One Month</b> <input type="checkbox"/>	<b>&lt; Six Months</b> <input type="checkbox"/>	<b>&gt; Six Months</b> <input type="checkbox"/>
<b>Reason for Timeframe:</b>				
<b>Item no.</b>	<b>EMP section no.</b>	<b>EMP page no.</b>	<b>Summary of change</b>	<b>Reason for change</b>
1.				
2.				
3.				

## 6 REFERENCES

- Bennelongia. 2011. *Port Hedland migratory shorebird survey report and impact assessment*. Bennelongia Environmental Consultants Pty Ltd, Jolimont, WA. Unpublished report prepared for BHP Billiton Iron Ore.
- Bertzeletos, D., Davis, R. & Horwitz, P. 2012. Importance of Lake MacLeod, northwestern Australia, to shorebirds: a review and update. *Journal of the Royal Society of Western Australia* **95**: 115.
- Clemens, R., Oldland, J., Berry, L. & Purnell, C. 2009. *Shorebirds 2020: migratory shorebird population monitoring project*. Birds Australia, Floreat, WA. Unpublished report prepared for Australian Government Department of Environment, Water, Heritage and the Arts and World Wildlife Fund.
- DoE. 2013. *Matters of National Environmental Significance. Significant impact guidelines 1.1. Environment Protection and Biodiversity Conservation Act 1999*. Australian Government, Department of the Environment, Canberra, ACT.
- DoEE. 2017. *EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*. Department of Environment and Energy, Canberra, Australia.
- EPA. 2016. *Environmental Factor Guideline: Terrestrial fauna*. Environmental Protection Authority, Perth, WA. Available at: [http://www.epa.wa.gov.au/sites/default/files/Policies\\_and\\_Guidance/Guideline-Terrestrial-Fauna-131216\\_3.pdf](http://www.epa.wa.gov.au/sites/default/files/Policies_and_Guidance/Guideline-Terrestrial-Fauna-131216_3.pdf)
- Estrella, S. M., Davis, R. A. & Horwitz, P. 2016. *Shorebird foraging ecology in northwestern Australian saltworks*. Centre for Ecosystem Management, Edith Cowan University.
- Houston, W., Black, R., Elder, R., Black, L. & Segal, R. 2012. Conservation value of solar salt ponds in coastal tropical eastern Australia to waterbirds and migratory shorebirds. *Pacific Conservation Biology* **18**: 100-122 <https://doi.org/10.1071/PC120100>.
- Kingsford, R. T., Porter, J. L., Brandis, K. J. & Ryall, S. 2020. Aerial surveys of waterbirds in Australia. *Scientific data* **7**: 1-6.
- Lei, W., Masero, J. A., Dingle, C., Liu, Y., Chai, Z., Zhu, B., Peng, H. B., Zhang, Z. W. & Piersma, T. 2021. The value of coastal salt pans for migratory shorebirds: conservation insights from a stable isotope approach based on feeding guild and body size. *Animal Conservation* **24**: 1071-1083.
- Ntiamoa-Baidu, Y. A. A., Piersma, T., Wiersma, P., Poot, M., Battley, P. & Gordon, C. 1998. Water depth selection, daily feeding routines and diets of waterbirds in coastal lagoons in Ghana. *Ibis* **140**: 89-103.
- Phoenix. 2020. *Level 2 targeted terrestrial fauna survey for the Mardie Project*. Phoenix Environmental Sciences, Osborne Park, WA. Unpublished report prepared for BCI Minerals Ltd.
- Phoenix. 2021. *Shorebirds survey of Mardie NE (expansion area)*. Phoenix Environmental Sciences, Osborne Park, WA.
- Storr, G. M. 1984. Birds of the Pilbara region, Western Australia. *Records of the Western Australian Museum, Supplement* **16**: 1–63.



FIGURES



Figure 1: Regional location of the Optimised Mardie Project

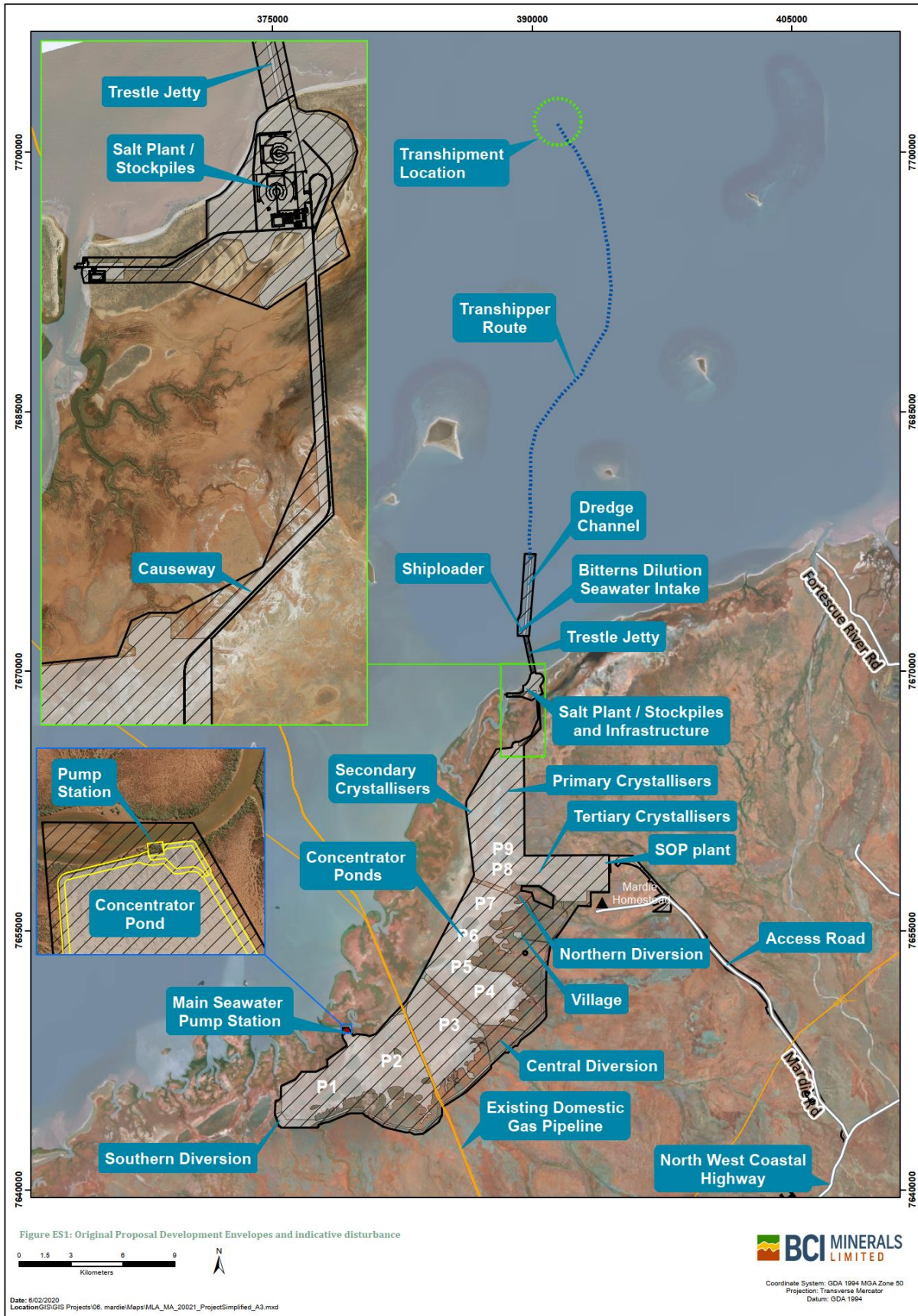


Figure 2: Original Mardie Proposal Development Envelope and Indicative Disturbance Footprint



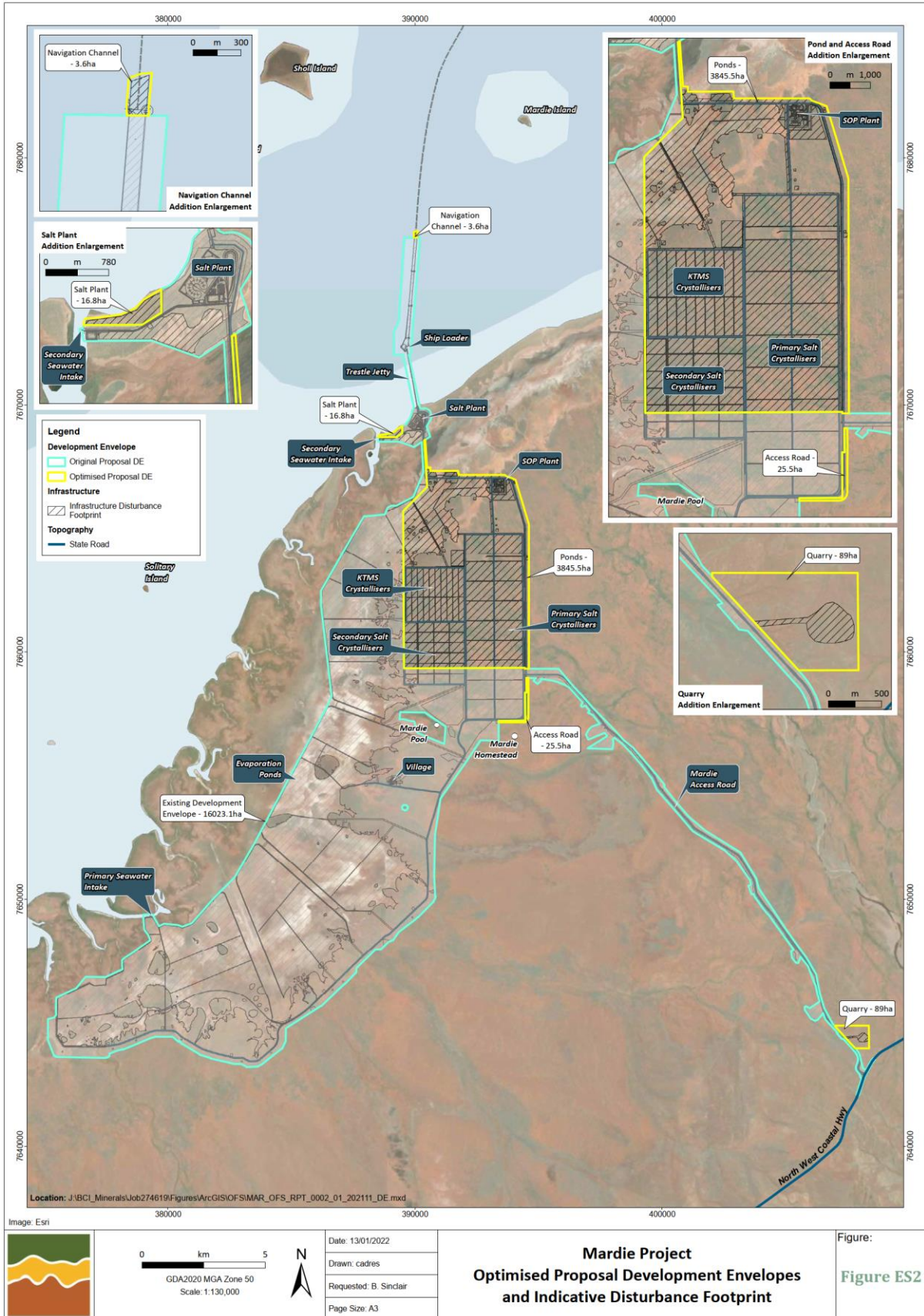


Figure 3: Optimised Mardie Project Development Envelope and Indicative Disturbance Footprint

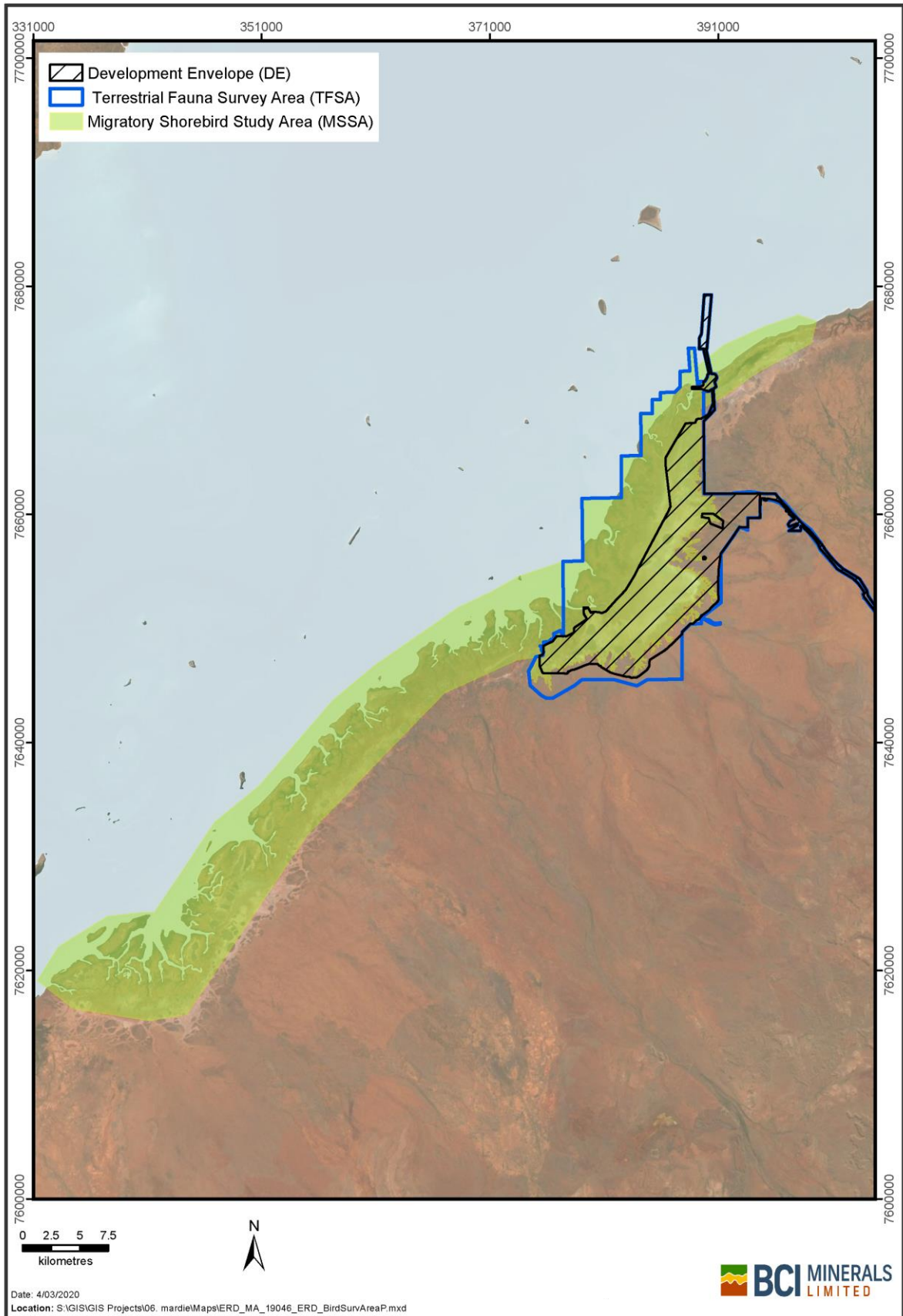
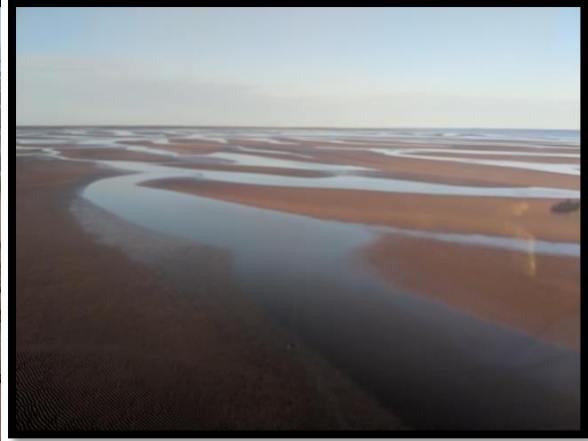


Figure 4: Baseline migratory shorebird study area





a) Samphire wetland



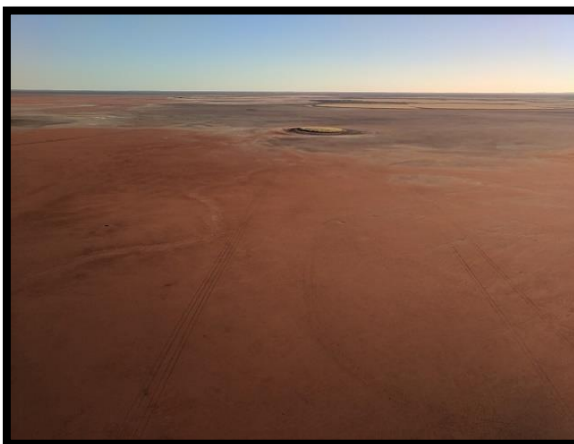
b) Coastal mudflat and sandbar



c) Mangal forest stand



d) Mangal forest fringing tidal creeks



e) Non-vegetated inland mudflat



f) Beach

**Figure 5: Typical migratory shorebird habitats in the Development Envelope**

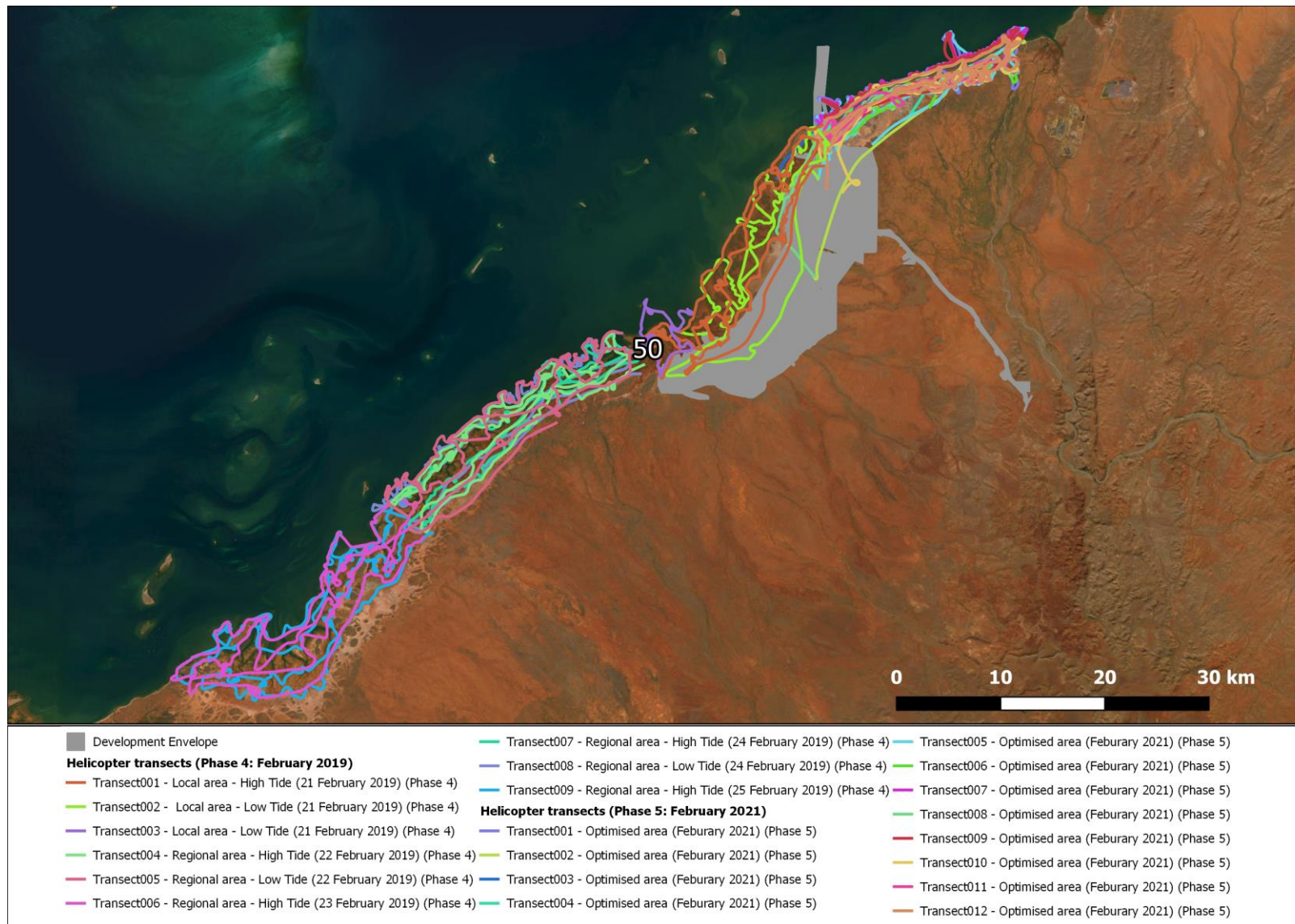


Figure 6: MSA baseline survey effort (flight paths)



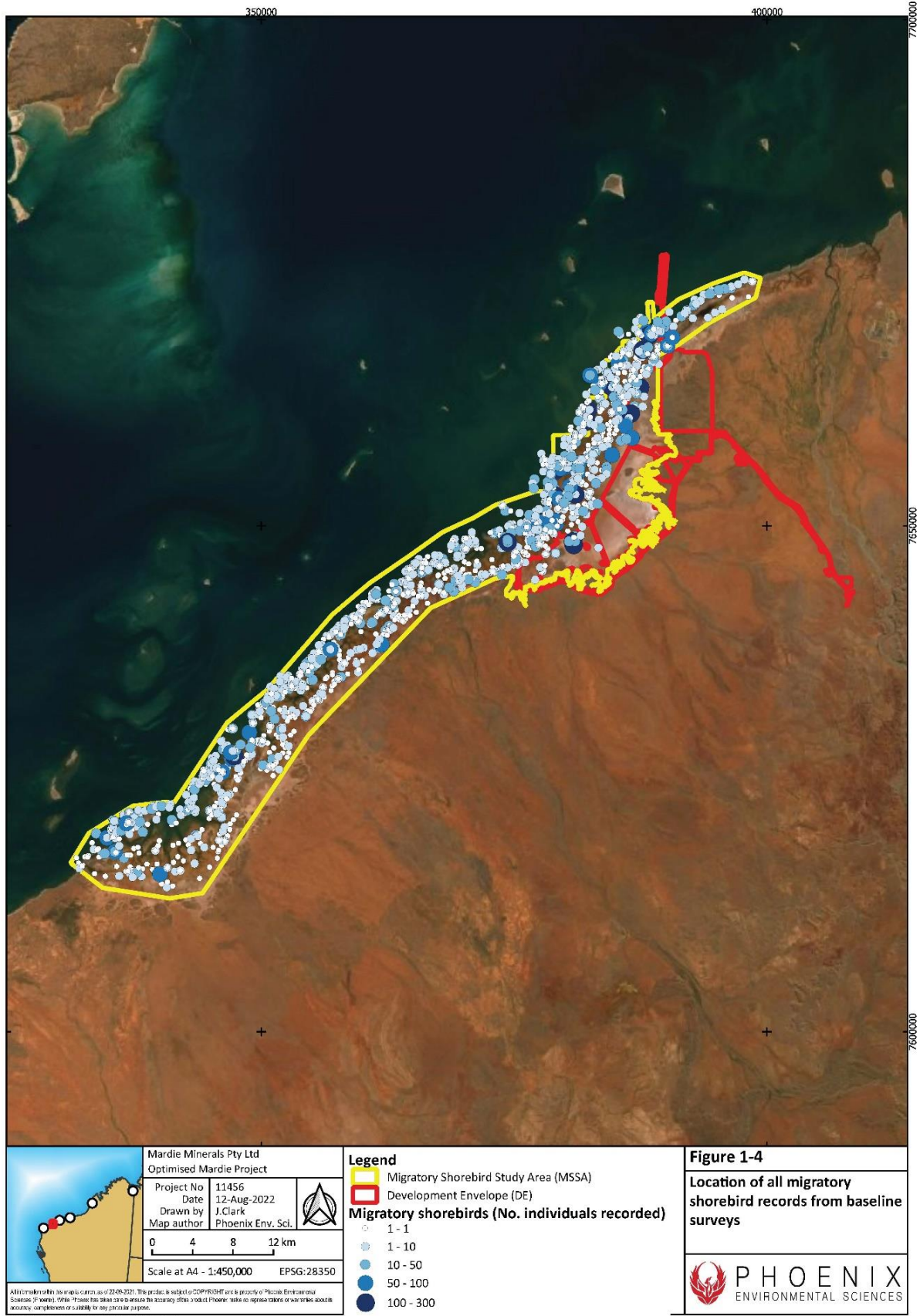


Figure 7: Location of migratory shorebird records from baseline surveys (phase 1-4)

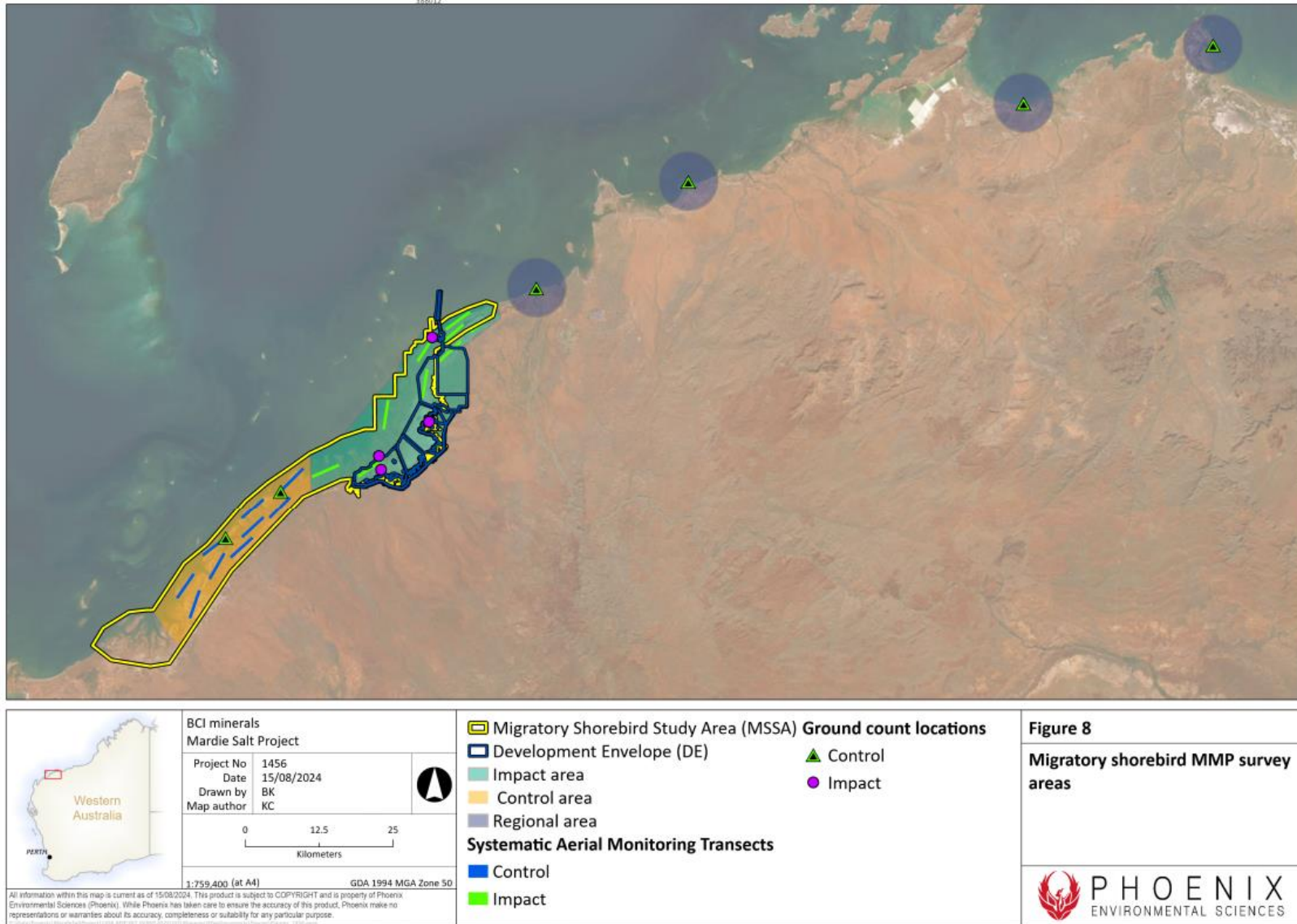


Figure 8: Migratory shorebird MMP survey areas



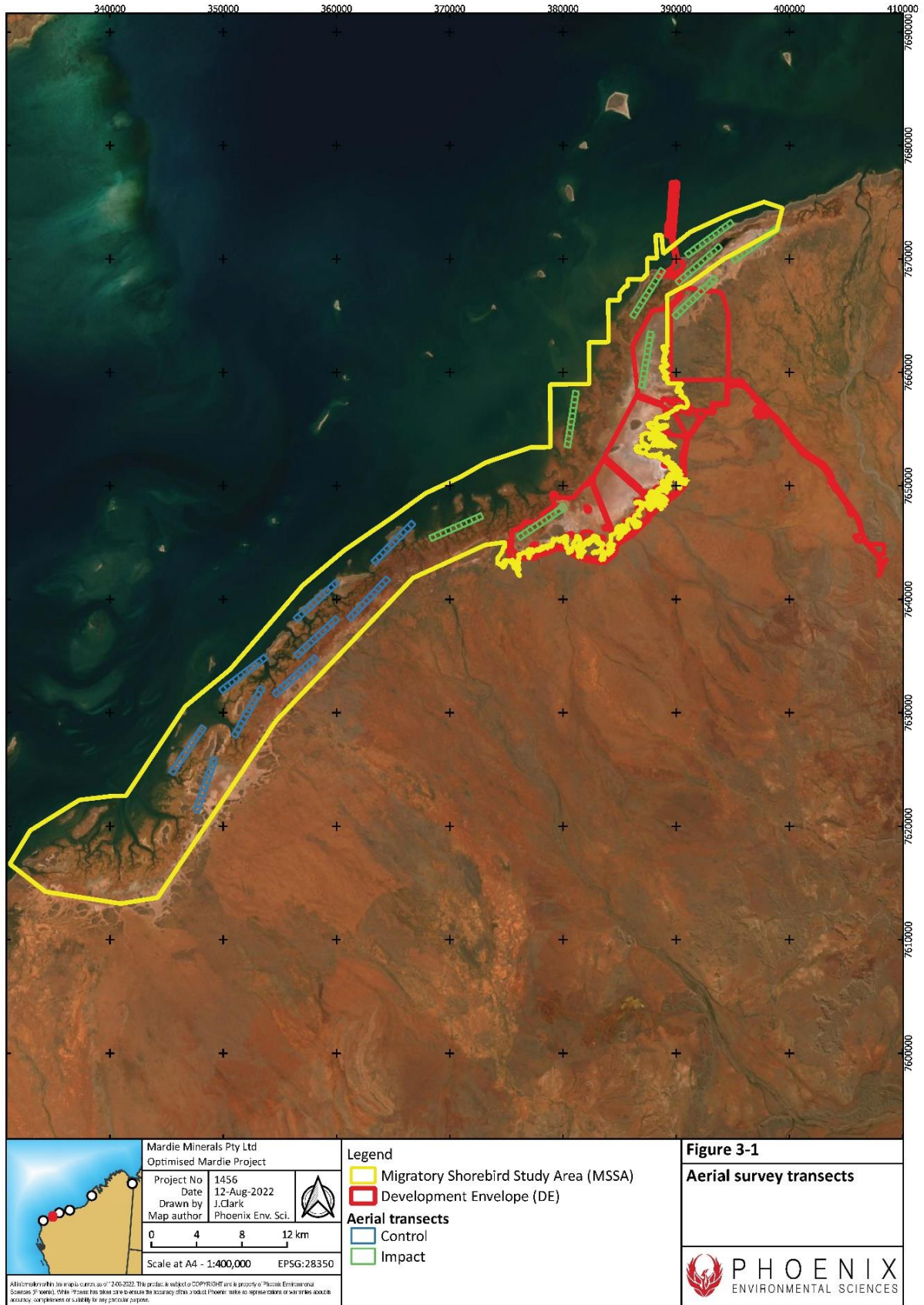


Figure 9: Aerial survey transects

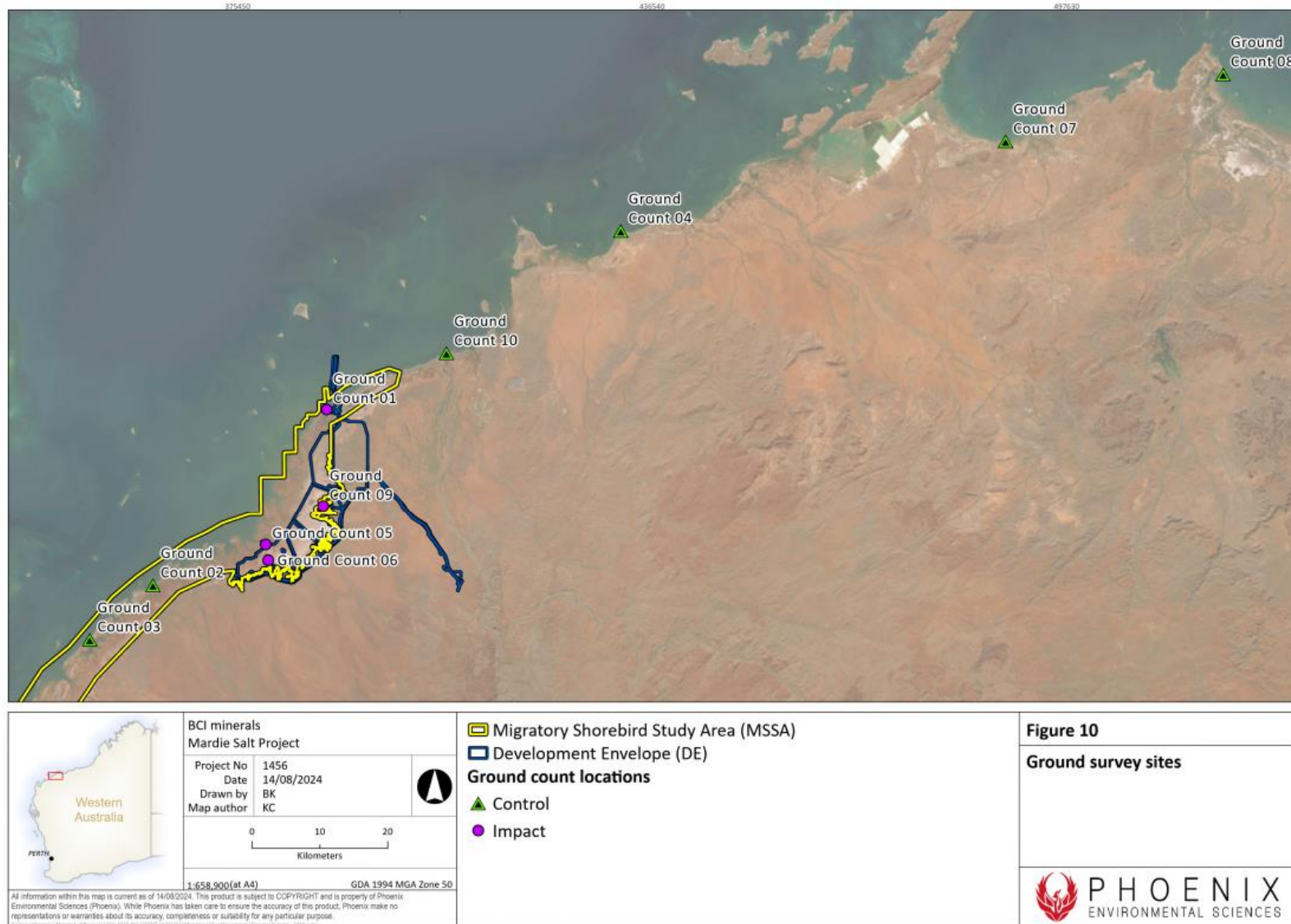
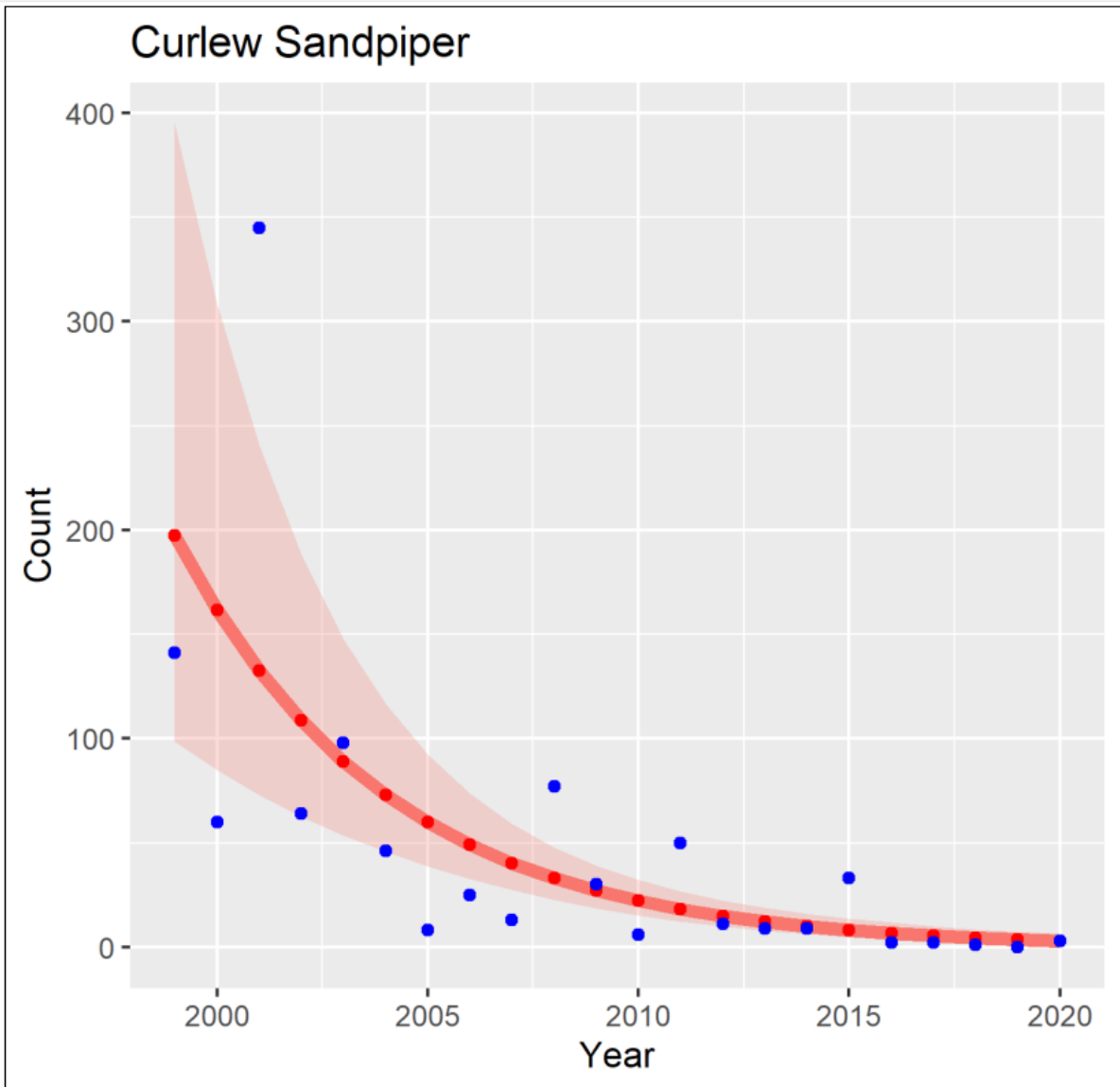


Figure 10: Ground survey sites



**Figure 11: Example generalised logistic model fitted to changes in Curlew Sandpiper numbers from Rottne Island**

Blue dots depict individual counts, the redline is the averaged trend, and the pink fill is one standard deviation from the mean.



## GLOSSARY AND ABBREVIATIONS

Term	Definition/Description
<b>Abundance</b>	The number of birds of each species recorded during a survey
<b>AHD; mAHD</b>	Australian Height Datum; broadly equivalent to mean sea level
<b>AS/NZS ISO14001</b>	Australian Standard for Environmental management systems - Requirements with guidance for use (2016)
<b>BCH</b>	Benthic Community Habitat
<b>BCHMMP</b>	Benthic Community Habitat Monitoring and Management Plan
<b>BCI</b>	BCI Minerals Limited
<b>Brine</b>	A high concentration of salt in water, from seawater (3.5% salt) to full saturation (typically 26% salt)
<b>CA</b>	Control Area
<b>Concentrator Pond</b>	The initial series of ponds where seawater is evaporated close to the level of saturation where salt (halite) precipitates
<b>Crystalliser Pond</b>	Ponds where brine is further evaporated to result in the precipitation (crystallisation) of halite and other salts, including SOP
<b>DAWE</b>	Department of Water and Environment (Cth) now DCCEEW
<b>DBCA</b>	Department of Biodiversity Conservation and Attractions
<b>DCCEEW</b>	Department of Climate Change, Energy, the Environment and Water (Cth)
<b>DoEE</b>	Department of Energy and the Environment (Cth) now DCCEEW
<b>DWER</b>	Department of Water and Environment Regulation (WA).
<b>EAAF</b>	East Asian-Australasian Flyway
<b>EP Act</b>	<i>Environmental Protection Act 1986</i> (WA)
<b>EPA</b>	Environmental Protection Authority (WA)
<b>EPBC Act</b>	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth.)
<b>ERD</b>	Environmental Review Document
<b>ESMS</b>	Environmental and Social Management System
<b>IA</b>	Impact Areas
<b>IBAs</b>	Important Birds Area
<b>km</b>	Kilometer
<b>km<sup>2</sup></b>	Square kilometers
<b>KTMS</b>	kainite type mixed salt
<b>Mardie Minerals</b>	A proprietary company (ACN 152 574 457) wholly controlled by BCI Minerals Limited
<b>Migratory shorebird</b>	37 listed species of birds that inhabit the shorelines of coasts and inland water bodies during most of their life cycles and migrate annually to and from Australia.
<b>MS</b>	Ministerial Statement (WA)
<b>MSMMP</b>	Migratory Shorebird Monitoring and Management Plan
<b>MSSA</b>	Migratory Shorebird Study Area
<b>NaCl</b>	Sodium Chloride
<b>PPT or ppt</b>	Parts per thousand; equivalent to grams per litre

<b>Term</b>	<b>Definition/Description</b>
<b>RA</b>	Regional Area
<b>Richness</b>	The number of species of migratory shorebirds observed during a survey
<b>SoP</b>	Sulfate of Potash
<b>TFSA</b>	Terrestrial Fauna Study Area
<b>WA</b>	Western Australia

## APPENDICES

**Appendix 1: Abundance of EAAF Migratory shorebird species for each of the 26 sample events (from Phoenix 2020)**



Table 5-7 Abundance of EAAF Migratory shorebird species for each of the 26 sample events

Species <sup>1,2,3</sup>	Summer																				Winter					
	Phase 1						Phase 2						Phase 4								Phase 3					
	5/12/17		6/12/17		7/12/17		13/01/18		14/01/18		15/01/18		21/02/19		22/02/19		23/02/19		24/02/19		25/02/19		24/07/18	25/07/18		26/07/18
	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	LT	HT	LT	HT
Bar-tailed Godwit ( <i>Limosa lapponica</i> )	173	130	164	144	46	11	82	112			710	682	457	161	33	97	446	118	51	78	235	151	71	79	82	86
Black-tailed Godwit ( <i>Limosa limosa</i> )														1												
Common Greenshank ( <i>Tringa nebularia</i> )	6	4	8	5	8	10	26	21	7	26	12	19	15	15	36	10	32	18	35	15	43	38	2	6	1	8
Common Sandpiper ( <i>Actitis hypoleucos</i> )	2	2	1			1	3	4	7	17	6	1	2	4	26	7	10		33	6	5	1		6	8	2
Curlew Sandpiper ( <i>Calidris ferruginea</i> ) (CR EPBC Act; VU BC Act)			23	40								5	1	12			20									
Eastern Curlew ( <i>Numenius madagascariensis</i> ) (CR EPBC Act; VU BC Act)	2	2	3	4	12		20	43	7	5	58	3	7	5	22	10	51	6	39	24	39	24		2		28
Great Knot ( <i>Calidris tenuirostris</i> ) (CR EPBC Act; VU BC Act)			1								82		47			6	16	20								
Greater Sand Plover ( <i>Charadrius leschenaultii</i> ) (VU EPBC & BC Acts)		3		4		9	29	5		5	1	6		1	3		5		3				106	25	28	
Grey Plover ( <i>Pluvialis squatarola</i> )												1			3							1	1			
Grey-tailed Tattler ( <i>Tringa brevipes</i> ) (P4 DBCA list)	2	11	3	9	9	42	143	4	4	17	345	264	115	77	221	116	330	171	235	258	314	404	10	19	29	26
Lesser Sand Plover ( <i>Charadrius mongolus</i> ) (EN EPBC & BC Acts)		1					24											2								
Oriental Plover ( <i>Charadrius veredus</i> )					40								190		8	20	32		8	56	5					



Species <sup>1,2,3</sup>	Summer																					Winter				
	Phase 1						Phase 2						Phase 4									Phase 3				
	5/12/17		6/12/17		7/12/17		13/01/18		14/01/18		15/01/18		21/02/19		22/02/19		23/02/19		24/02/19		25/02/19		24/07/18	25/07/18		26/07/18
	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT	
Oriental Pratincole ( <i>Glareola maldivarum</i> )	61		4								20		<b>607</b>	5	34				3							
Pacific Golden Plover ( <i>Pluvialis fulva</i> )	<b>59</b>		45	12		4													2							
<b>Red Knot (<i>Calidris canutus</i>)</b> <b>(EN EPBC Act)</b>	40		100			51					90	<b>100</b>	12	50				15	2				1			
Red-necked Stint ( <i>Calidris ruficollis</i> )	95	1	176	61	195	61	101	<b>355</b>	3	71	252	105	151	77	3	57	14	64	43	23	102	15	10		4	1
Ruddy Turnstone ( <i>Arenaria interpres</i> )		9	20	12	2	101	42	1			128	<b>230</b>	53	34	125	36	22	29	120	62	17	64	1		5	
Sanderling ( <i>Calidris alba</i> )	1										<b>31</b>	3									4					
Terek Sandpiper ( <i>Xenus cinereus</i> )	5			3			<b>36</b>	13	2	1	1	8	11	1	17	10	8	1	5	13	1	6	3			
Whimbrel ( <i>Numenius phaeopus</i> )	25	3	38	13	24	6	<b>284</b>	125	64	47	159	166	27	44	53	22	75	38	119	29	59	65				18
<b>Total</b>	<b>471</b>	<b>166</b>	<b>586</b>	<b>307</b>	<b>336</b>	<b>296</b>	<b>790</b>	<b>683</b>	<b>94</b>	<b>189</b>	<b>1895</b>	<b>1593</b>	<b>1695</b>	<b>487</b>	<b>578</b>	<b>397</b>	<b>1071</b>	<b>474</b>	<b>693</b>	<b>567</b>	<b>824</b>	<b>769</b>	<b>205</b>	<b>137</b>	<b>157</b>	<b>169</b>

1 – Species names in **bold** are also listed as Threatened Fauna under the EPBC Act and/or BC Act, or Priority Fauna by DBCA.

2 – Cells highlighted in grey with values in **bold** indicate the maximum event abundance for that species.

3 – rows in green indicate species abundance was >0.1% of the national flyway population in any one sample event.

**Appendix 2: Letter from DWER allowing commencement of the Project pending update to the MSMMP**

OFFICIAL



Government of Western Australia  
Department of Water and Environmental Regulation

Our ref: DWERT10946  
Enquiries: Dr Capri Beck Ph 6364 7960

Dr Shaun Meredith  
Head of Approvals and Government Affairs  
BCI Minerals  
Level 2, 1 Altona Street  
West Perth WA 6005

Via email: [shaun.meredith@bciminerals.com.au](mailto:shaun.meredith@bciminerals.com.au)

Dear Dr. Meredith

**MINISTERIAL STATEMENT (MS) 1211 – OPTIMISED MARDIE PROJECT –  
MIGRATORY SHOREBIRD MONITORING AND MANAGEMENT PLAN**

Thank you for your letter of 6 May 2024 regarding the Migratory Shorebird Monitoring and Management Plan (MSMMP) that is required under condition B6-4 of MS 1211.

I note that the letter highlights the Migratory Shorebird Monitoring Plan (MSMP) that was required under MS 1175 and approved by the delegate of the CEO on 16 February 2022. The MSMP was subsequently implemented, and data has been collected under this plan since 2022.

In its assessment of the Optimised Mardie Project, the Environmental Protection Authority considered that whilst there was an approved monitoring plan, there was no approved plan that contained management actions should impacts to migratory shorebirds be detected. Throughout the response to submissions process for Optimised Mardie Project, BCI was requested to submit a Migratory Shorebird Monitoring and Management Plan (MSMMP) that covered both monitoring and management aspects. Despite several meetings held between internal experts, Phoenix Environmental and BCI to discuss monitoring and management approaches, the MSMMP was not submitted as part of the assessment process.

Consequently, the EPA recommended condition B6-4 that requires preparation of the MSMMP in consultation with technical experts including a biostatistician. The requirement for consulting a biostatistician was because the MSMP prepared under MS 1175 included monitoring trends in shorebird populations but did not propose a quantitative method to calculate significant changes in populations (richness and abundance) between the impact and control sites.

Prime House, 8 Davidson Terrace Joondalup Western Australia 6027  
Locked Bag 10 Joondalup DC WA 6919  
Telephone: 08 6364 7000 Facsimile: 08 6364 7001  
[www.dwer.wa.gov.au](http://www.dwer.wa.gov.au)

OFFICIAL

While we note Dr Floyd Holme's experience, the requirement to consult with a biostatistician was based on DWER's technical review of the plan prepared by Dr Floyd Holmes indicating that the approach was not suitably quantitative to ensure a high level of statistical significance and scientific rigour. Hence it is requested an independent biostatistician or relevant expert be engaged to review the plan prior to resubmission to the DWER.

Once published, MS 1211 superseded MS 1175. Consequently, the development of a MSMMP as outlined in condition B6-4 of MS 1211 remains a requirement. Despite ongoing consultation, Department of Water and Environmental Regulation (DWER) is of the view that a suitable MSMMP that contains all of the required elements of a management plan has not yet been provided. Specifically, the MSMMP will need to contain robust triggers and threshold values, actionable management responses and be prepared in accordance with [EPA's instructions](#) on how to prepare an environmental management plan under Part IV of the *Environmental Protection Act 1986*.

Please address the comments in the attached Document Review and Comments Table and submit a revised MSMMP accompanied by a peer review report for approval by the DWER, no later than the 19 August 2024.

While preparing this revised Plan, BCI may progress with construction and filling of the ponds, pending the Plan is approved by mid-September 2024, as this is the time that migratory shorebirds return to Pilbara Coast.

Yours sincerely



**Dr Tania Liaghati**  
Manager  
EIA NORTH BRANCH  
for the Chief Executive Officer under authorisation dated 7 October 2022

22 May 2024

Attachment 1 - Document Review and Comments Table

**Appendix 3: Proposed indicator species based on 2022-2024 survey data**

Species	Status	Total proportion of cells detected (2022-2024)	Average detection rate per cell (2022-2024)	Mean annual total count	Weight class*	Feeding niche*
Common Sandpiper ( <i>Actitis hypoleucos</i> )	Mig (EPBC & BC Acts)	0.57	0.30	137	Small	Visual surface foraging
Bar-tailed Godwit ( <i>Limosa lapponica</i> )	Mig (EPBC & BC Acts)	0.25	0.10	292	Large	Tactile Surface foraging
Red-necked Stint ( <i>Calidris ruficollis</i> )	Mig (EPBC & BC Acts)	0.25	0.09	224	Small	Tactile Surface foraging
Grey-tailed Tattler ( <i>Tringa brevipes</i> )	Mig. (EPBC & BC Acts; P4 DBCA list)	0.63	0.47	1719	Medium	Visual surface foraging
Common Greenshank ( <i>Tringa nebularia</i> )	EN/Mig.; Mig. (EPBC Act; BC Act)	0.37	0.25	198	Medium	Water surface foraging
Whimbrel ( <i>Numenius phaeopus</i> )	Mig. (EPBC & BC Acts)	0.53	0.40	393	Large	Visual surface foraging

\*Based on information from (Lei *et al.* 2021) and (Ntiamoa-Baidu *et al.* 1998).