



Native Vegetation Clearing Permit (Purpose): Supporting Documentation

GMA Garnet



Prepared for GMA Garnet Pty Ltd

8 December 2023

Project Number: TE23063

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1 Introduction

1.1 Background

Talis Consultants have been commissioned by GMA Garnet Pty Ltd (GMA) to prepare a Native Vegetation Clearing Permit (NVCP) application for clearing associated with the Port Gregory Mine (the Project).

The Site is approximately 100 km north of Geraldton in the Midwest region of Western Australia (WA), near the township of Gregory. The operations consist of two main mining areas: the Hose mining area to the north (Figure 1-1), and the Lynton mining area to the south (Figure 1-2). Currently all ore processing operations are undertaken at the Hose plant site where the garnet concentrate is produced. This concentrate is then sent to GMA's Narngulu facility in the Geraldton industrial area, where it is further refined to >97% garnet. This product is stored on site before being transported in packaged form or to bulk storage facilities at Geraldton wharf for shipment.

Garnet International Resources is the registered tenement holder for all the Project tenements. GMA is a wholly owned subsidiary company of Garnet International Resources and currently operates the Project. A summary of the relevant project tenements to the NVCP application, held by Garnet Resources International, are listed in Table 1-1.

Table 1-1: Project tenements held by Garnet Resources International

Tenement	Tenement Area (ha)	Date Granted	Expiry Date	Status	Mining Area
M70/204	510.15	13/12/1983	08/12/2028	Live	Lynton
M70/1330	92.525	07/08/2014	16/11/2035	Live	Lynton

Under Section 51C of the *Environmental Protection Act 1986* (EP Act), the clearing of any native vegetation requires an approved clearing permit, unless an exemption applies. Exemptions for mining generally apply to areas of low impact mining and exploration, or for proposals that have already been assessed by the Environmental Protection Authority (EPA), Department of Water, Environment and Regulation (DWER) or Department of Mines, Industry Regulation and Safety (DMIRS) through a separate process. Sufficient exemptions do not apply for vegetation within the Site as it falls within a Schedule 1 area; a clearing permit is therefore required.

The NVCP application is to clear up to up to 25.42 hectares (ha) of native vegetation within the Development Envelope of approximately 25.42 ha (Figure 1-3).

1.2 Purpose of Clearing Permit Application

The purpose of this NVCP supporting document is to present the results of an assessment of the clearing aspects of this proposal against the ten clearing principles as outlined in the (then) Departments of Environment Regulation (DER)'s *A guide to the assessment of applications to clear native vegetation* (2014) under Part V Division 2 of the EP Act. This report identifies the potential environmental impacts associated with the proposal based on the best available data.

This report and accompanying NVCP Purpose Permit application form will be submitted to DMIRS for assessment.

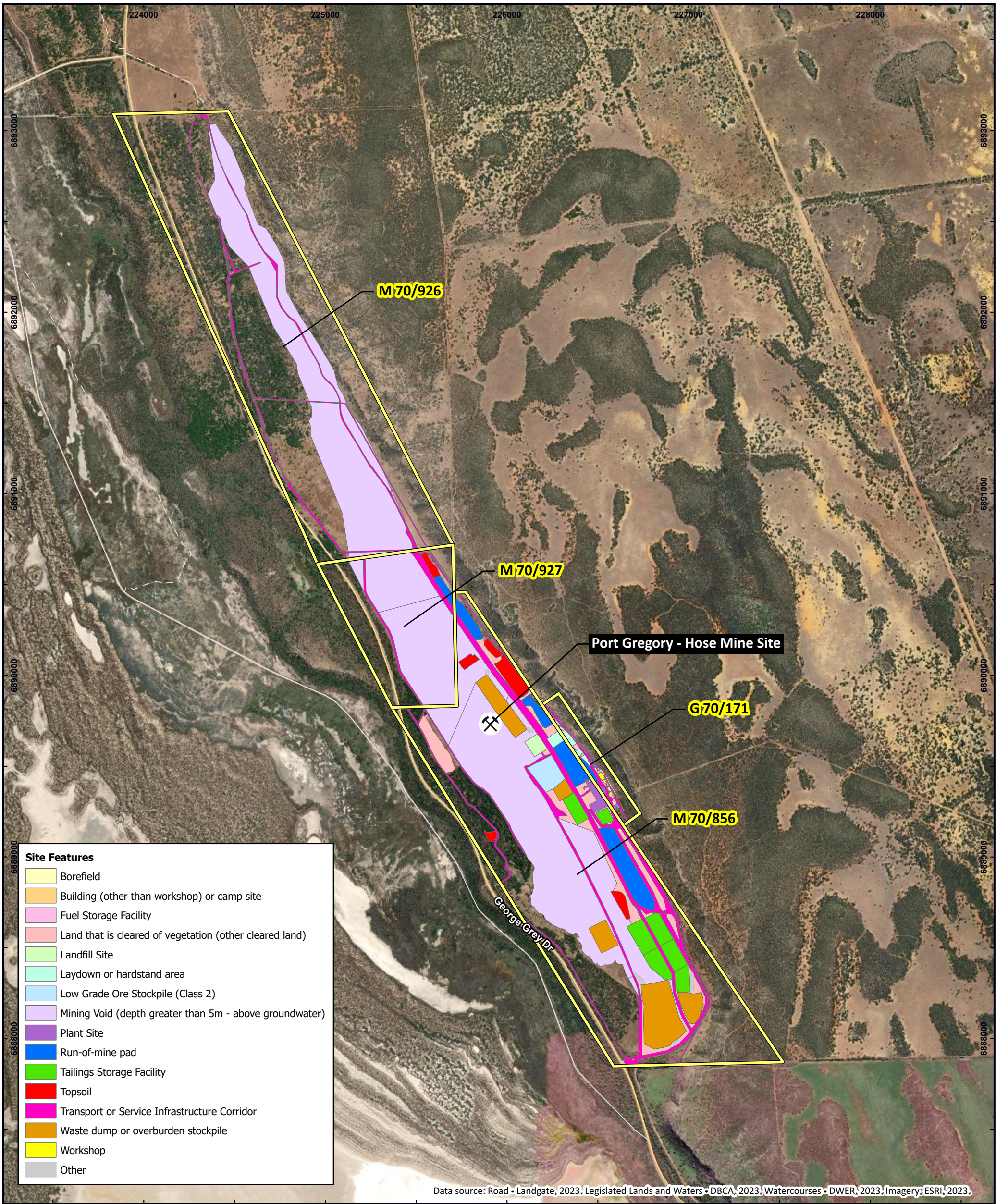
1.3 Proposed Timeframe

Clearing is proposed to commence in Q1 2024 with clearing and associated works likely to be completed by 2029.

1.4 Responsible Applicant

GMA Garnet Pty Ltd are responsible for the implementation of the clearing described within this report. Correspondence relating to this NVCP application should be addressed to:

Steven Petts
Environmental Specialist
GMA Garnet Pty Ltd
122 Goulds Roads, Narngulu, Western Australia 6530
0408 548 650
Steven.petts@gmagarnet.com



LEGEND

- Hose Mine Site
- Mining Tenements
- Western Australian Roads**
 - Main Road
 - Minor Road
 - Other

LOCALITY

0 200 400 600 800 1,000

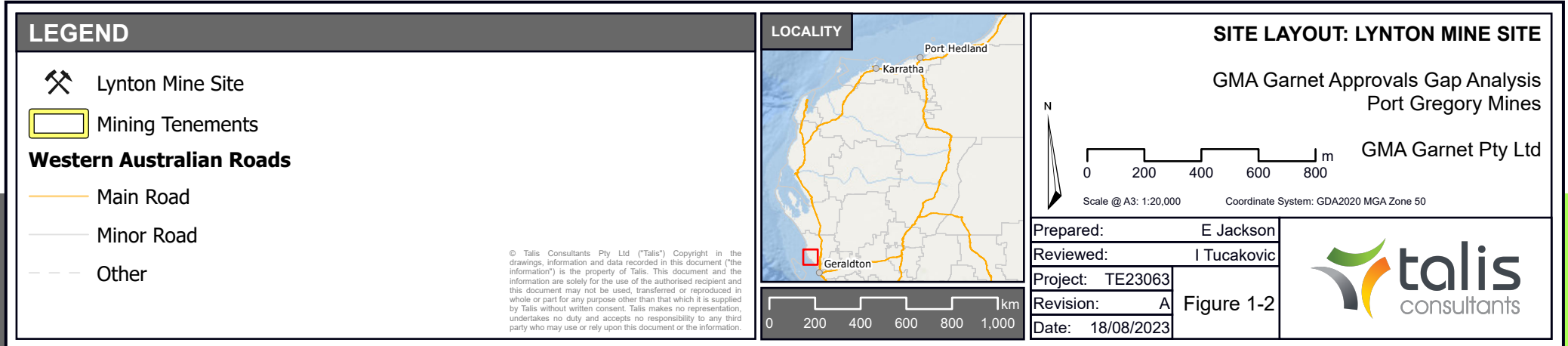
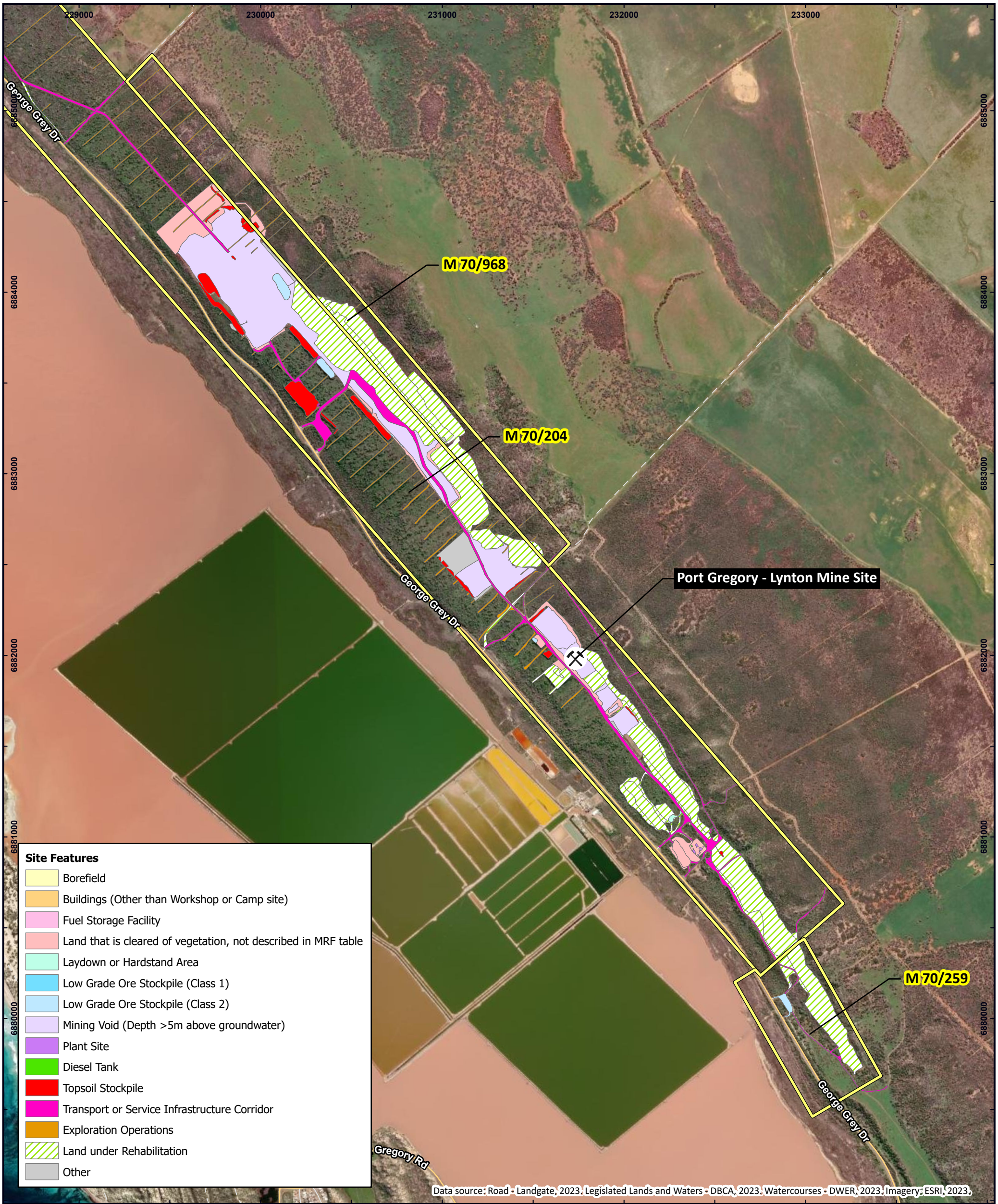
SITE LAYOUT: HOSE MINE SITE

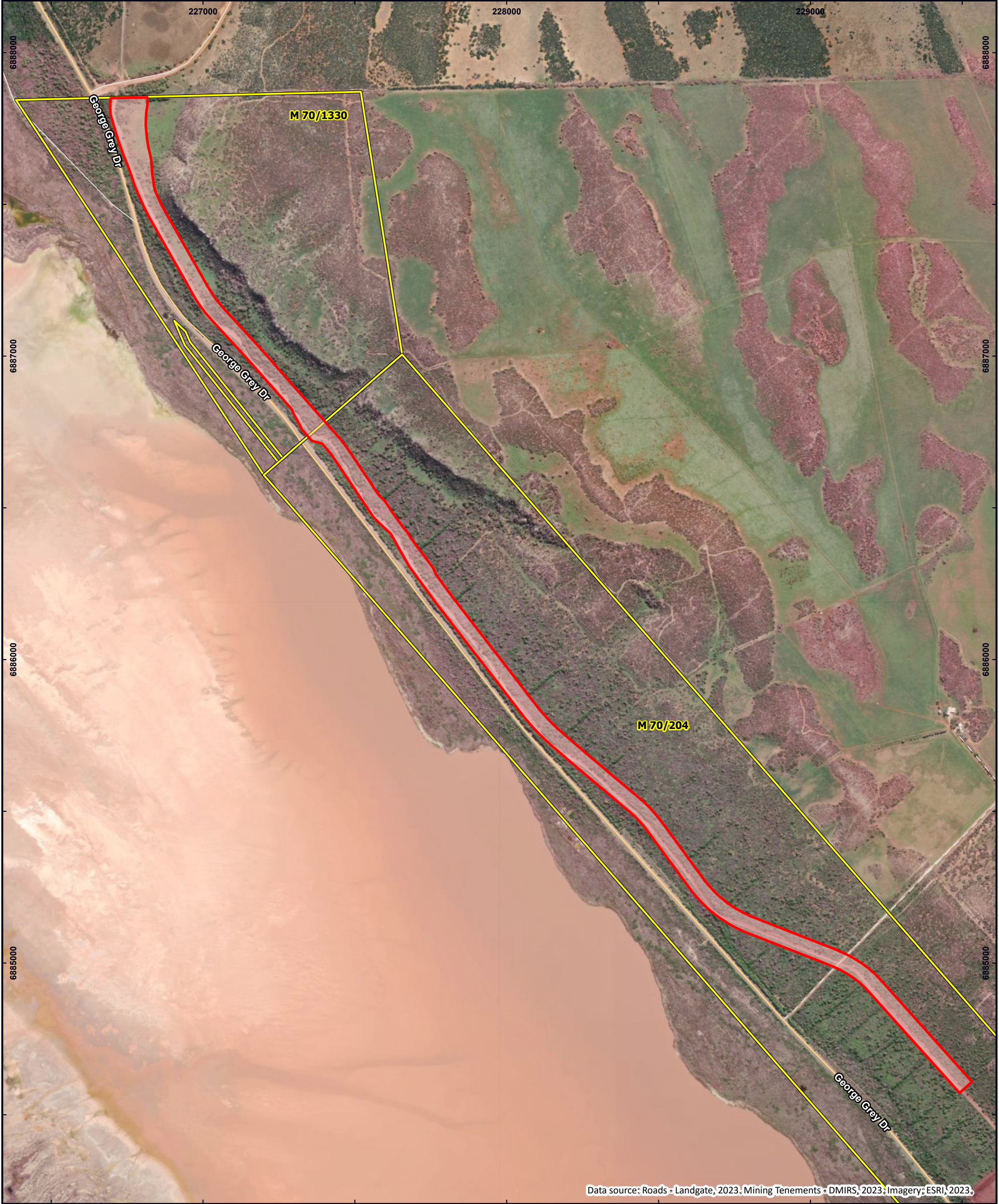
GMA Garnet Approvals Gap Analysis
Port Gregory Mines

GMA Garnet Pty Ltd

Prepared: E Jackson
Reviewed: I Tucakovic
Project: TE23063
Revision: A
Date: 18/08/2023

Figure 1-1





Data source: Roads - Landgate, 2023; Mining Tenements - DMIRS, 2023; Imagery: ESRI, 2023.

LEGEND

- Haul Road Boundary
- Mining Tenement

Western Australian Roads

- Main Road
- Minor Road
- Other

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LOCALITY



PROPOSED DEVELOPMENT ENVELOPE

Port Gregory
Native Vegetation Clearing Permit

GMA Garnet Pty Ltd



Scale @ A3: 1:12,000

Coordinate System: GDA2020 MGA Zone 50

Prepared:	E Jackson
Reviewed:	J Kirke
Project:	TE23063
Revision:	A Figure 1-1
Date:	27/11/2023



2 Site Overview

2.1 Climate

The Project is located within the Mid-West Region of WA. The climate of the Mid-West is considered warm semi-arid to a Mediterranean climate with 400 to 500 mm of rainfall per annum (Desmond and Chant, 2002). The region experiences short, mild, wet winters with the remainder of the year typically hot, dry and windy.

Weather recording stations are located at Lynton (Station 008075), Balline (00804) and Kalbarri, WA. Rainfall data was available from the Lynton and Balline stations, and temperature data was available from the Kalbarri station. The average rainfall at Balline and Lynton is 400.4 mm and 425.4 mm, respectively. The annual evaporation rate in the area is around 2,500 mm (Figure 2-1).

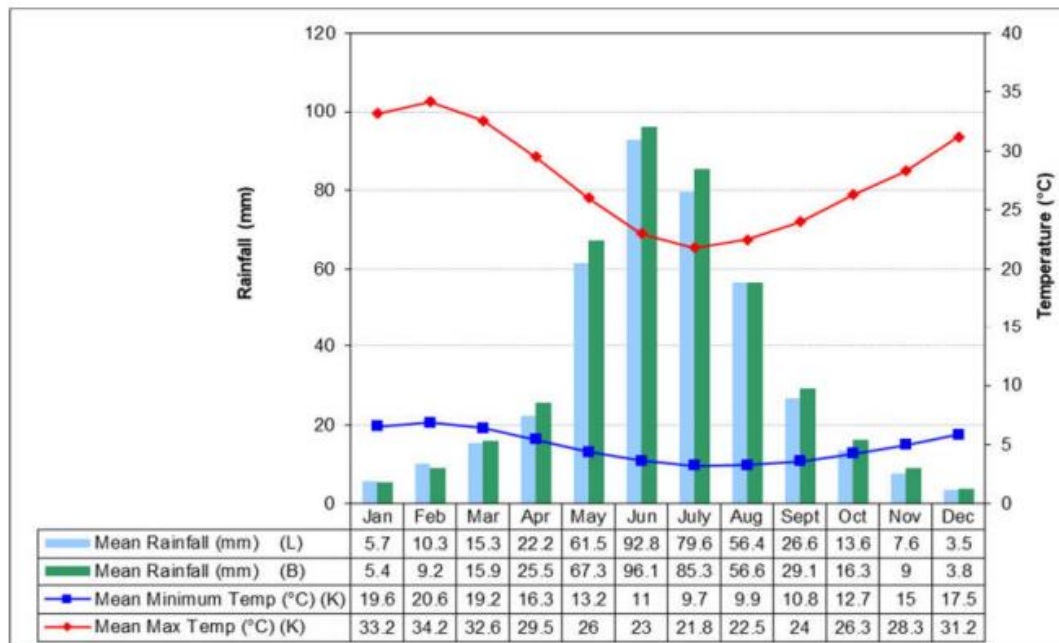
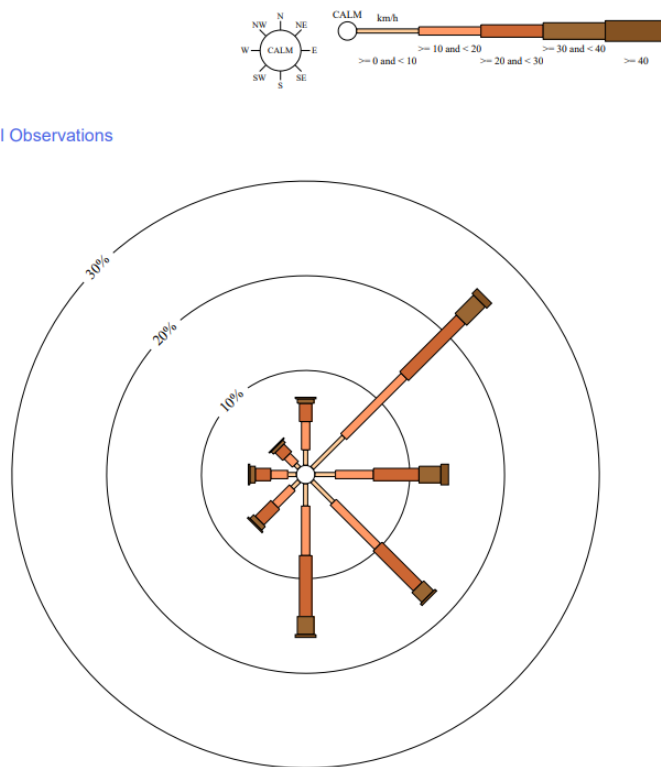


Figure 2-1: Climate Data for Balline, Lynton and Kalbarri (BoM, 2022)

The dominant wind blows from the south and southeast direction, with a prevailing secondary wind from the northeast. Wind speeds from 2 to 6 m per second (m/s) are often observed, with wind speeds reaching 8 m/s from the southeastern direction (Figure 2-2).

9 am
25820 Total Observations

Calm 5%



3 pm
25754 Total Observations

Calm 2%

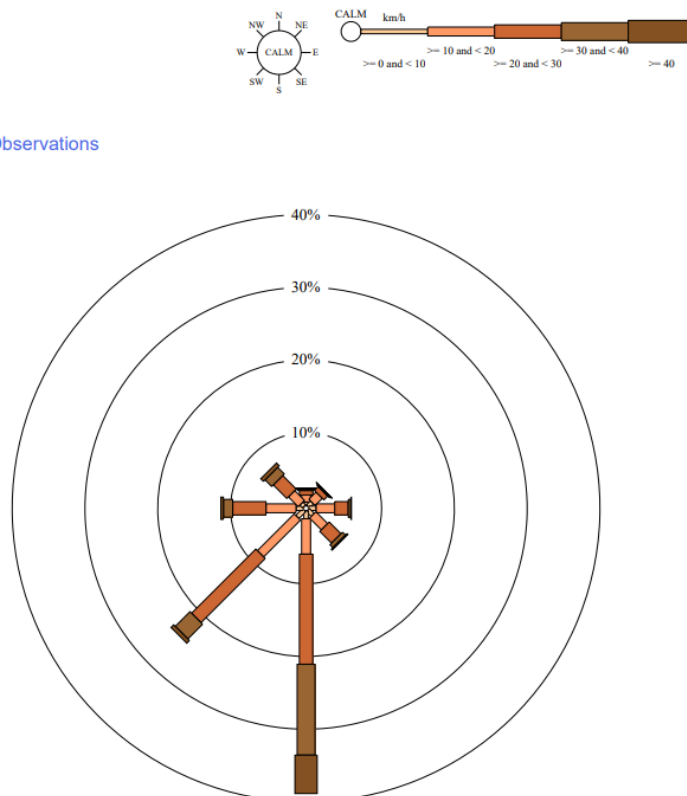


Figure 2-2: Wind rose for Geraldton for August 1941 to June 2014 (9 am and 3 pm) (BoM, 2014)

2.2 Topography

The Project area is characterised by undulating rises and swales associated with parabolic dunes, featuring some limestone outcrop in the east. The western portion of the Project is defined by dune crests and coastal hills with plains and gentle hillslopes. The dunes increase in elevation from the southwest coastal portion to the northeast portion of the survey area where they meet the neighbouring hills and plateaus. (Landloch, 2022). The dunes generally have a relief of 35 m which increases to 40 m as the dunes join the hills.

2.3 Interim Biogeographic Regionalisation of Australia

The Interim Biogeographic Regionalisation of Australia (IBRA) divides Australia into 89 bioregions based on major biological, geographical, and geological attributes. These bioregions are subdivided into 419 subregions as part of a refinement of the IBRA framework (Department of Climate Change, Energy, the Environment and Water, 2021).

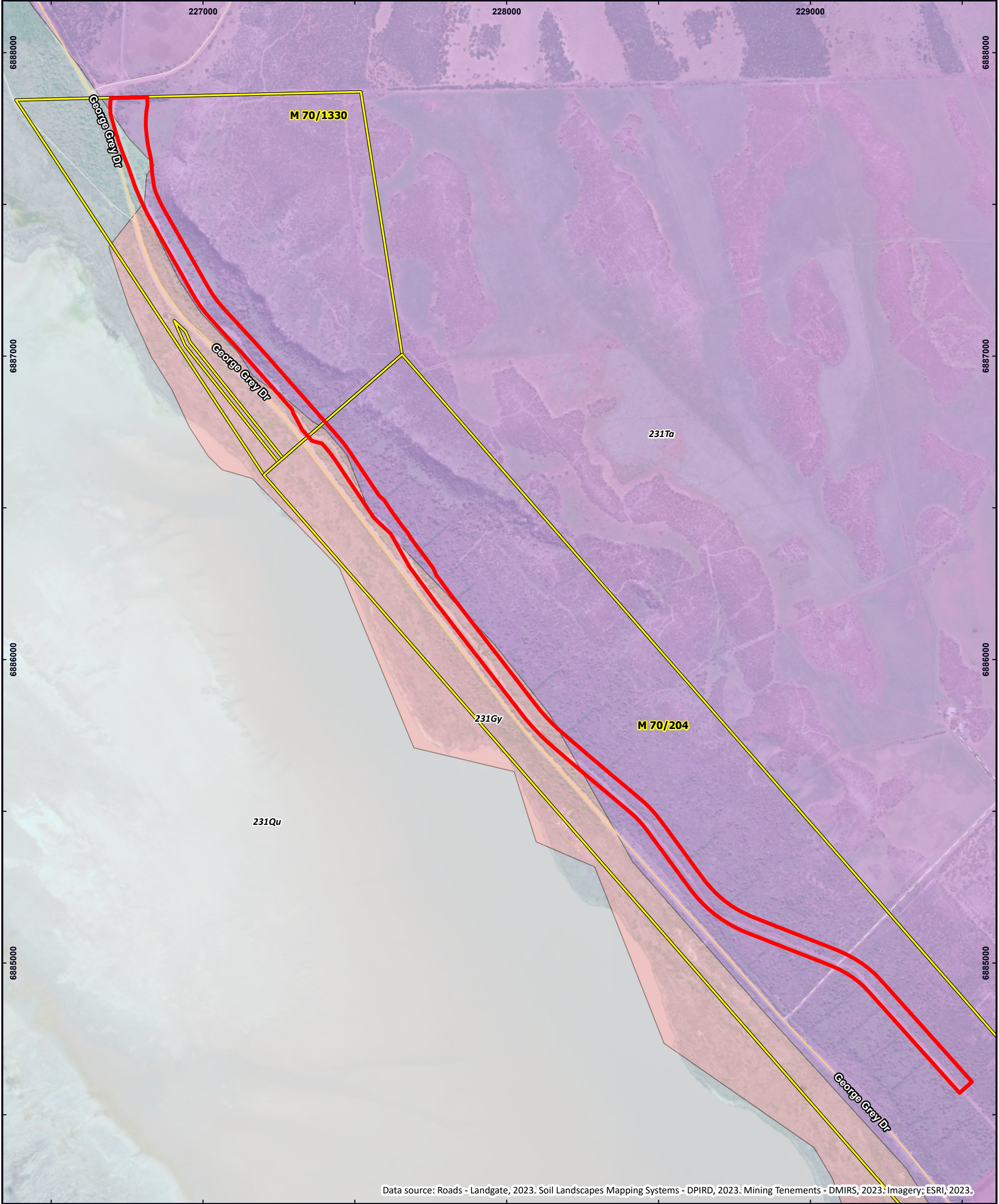
The Project is located within the Geraldton Sandplains bioregion which is characterised by the presence of mainly proteaceous scrub-heaths, rich in endemics, on the sandy earths of an extensive, undulating, lateritic sandplain mantling Permian to Cretaceous strata. Extensive York Gum and Jam woodlands occur on outwash plains associated drainage (DCCEW, 2022). Geraldton Sandplains consists of two subregions: Geraldton Hills and Lesueur Sandplain. The project area falls wholly within the Geraldton Hills subregion.

2.4 Soil Landscape Systems

Desktop assessment and data from soil and vegetation surveys (Landloch, 2022 & GHD, 2020A) determined three soil landscape systems are present within the proposed development envelope (Figure 2-3). These are summarised in Table 2-1 below:

Table 2-1: Soil Landscape systems identified within the Haul Road DE

Land System	Description	Area (ha)	% of DE
Grey Land System (231Gy)	River beds, terraces and alluvial flats, includes dissected margins of relic alluvial plains	5.46	21.48
Tamala North System (231Ta)	Low hills parallel to the coast. Western units are moderately inclined to steep. Generally comprised of leached sands over limestone	18.55	72.97
Quindalup North System (231Qu)	Coastal dune system. No fixed drainage	1.23	4.83
Total		25.42	100



Data source: Roads - Landgate, 2023. Soil Landscapes Mapping Systems - DPIRD, 2023. Mining Tenements - DMIRS, 2023. Imagery: ESRI, 2023.

LEGEND

Haul Road Boundary

Mining Tenement

Soil Landscape Mapping

Grey System (231Gy): River beds, terraces and alluvial flats, includes dissected margins of relic alluvial plains.

Quindalup North System (231Qu): Coastal dune system, no fixed drainage.

Tamala North System (231Ta): Low hills with relic dunes and some limestone outcrop. Forms a coastal band 3 to 7 km wide.

Western Australian Roads

Main Road

Minor Road

Other

LOCALITY

0200400600800

km

SOIL LANDSCAPE SYSTEMS

Port Gregory
Native Vegetation Clearing Permit

GMA Garnet Pty Ltd

N

0100200300400500

m

Scale @ A3: 1:12,000

Coordinate System: GDA2020 MGA Zone 50

Prepared: E Jackson

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Revision: A

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Figure 2-3

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2.5 Hydrology and Wetlands

The Project lies in the northwestern region of the Greenough River Basin, which covers an area of approximately 13,200 km². It is bordered by the Murchison River Basin to the North, the Yarra Yarra River Basin to the east and the Moore-Hill Rivers Basin to the south (AECOM, 2022).

The Greenough River Basin is made up of many catchments and include the Greenough River, Bowes River and Hutt River catchments. At a regional catchment classification scale, the Port Gregory Mine site is largely assigned to the coastal catchment of the Hutt River system (AECOM, 2022).

The nearest major river is Hutt River that originates approximately 40 km inland of the Lynton and Hose mines between the towns of Northampton and Binu. The closest waterways to the site are Bishop Gully and Urina Creek, approximately 4 km and 5.5 km east of the Project, respectively (AECOM, 2022).

Surface water drainage in the vicinity of the site is dominated by the Hutt Lagoon, 250 m to the southwest, and the adjacent Utcha Well Nature Reserve, 3 km to the northwest. Both of these regional scale water features receive runoff from the adjacent escarpment and landform that formed the paleo shorelines.

The Utcha Well Nature Reserve is listed as a category 1a by the International Union for Conservation of Nature (IUCN), which specifies the strict protection of areas that are outstanding natural ecosystems (AECOM, 2022). None of the waterways or wetlands in the coastal catchment are currently listed as an Australian Ramsar Wetland, with the closest Ramsar listed wetland being Forrestdale Lake over 450 km from the DE.

The Hutt Lagoon System is categorised as a wetland of national importance on the Directory of Important Wetlands in Australia, meeting two of the six criteria originally agreed to by the ANZECC Wetlands Network in 1994 (AECOM, 2022 & GHD, 2020A).

No surface water features in the vicinity of the site are used to supply potable water for consumption and the nearest public drinking water source is the Kalbarri Water Reserve, 32 km from the DE. The Project does not lie in a Proclaimed Surface Water Area or Surface Water Irrigation District as defined under the *Rights in Water and Irrigation Act 1914*, with the closest being Greenough River located 88 km from the DE (Figure 2-4) (AECOM, 2022).

2.6 Conservation Features

There are no conservation reserves or estates located within or immediately adjacent to the proposed DE. The closest conservation reserve, the Utcha Well Nature Reserve (R 640), is located approximately 3 km northwest of the DE boundary (Figure 2-5) (GHD, 2020A).

An Environmentally Sensitive Area (ESA) is located approximately 250 m west of the DE, the Hutt Lagoon, but it does not intersect with the proposed clearing boundary (Figure 2-6) (GHD, 2020A). The area covered by vegetation within 50 m of a rare/threatened flora, to the extent to which the vegetation is continuous with the vegetation in which threatened flora is located, is an ESA. In this instance, the 50 m radius area surrounding the record of *Caladenia elegans* is considered an ESA and is located within 27 m of the DE. The accuracy of this record location is discussed further in Section 3.2.2.1 and Appendix A.

No threatened or priority ecological communities (TEC/PEC) were identified as occurring within the proposed DE. The nearest PEC is Kalbarri Ironstone Community (Priority 1), located approximately 8 km east of the survey area (Figure 2-7) (GHD, 2020A).



Data source: Roads • Landgate, 2023, Proclaimed Surface Water Areas • DWER, 2023, Mining Tenements • DMIRS, 2023, Imagery: ESRI, 2023,

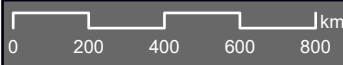
LEGEND

- Haul Road Boundary
- Mining Tenement
- RIWI Act Surface Water Areas and Irrigation Districts**
- Proclaimed Surface Water Area

Western Australian Roads

- Freeway / Highway
- Main Road

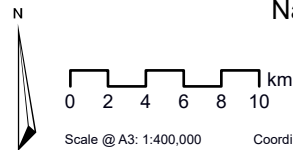
LOCALITY



PROCLAIMED SURFACE WATER AREAS

Port Gregory
Native Vegetation Clearing Permit

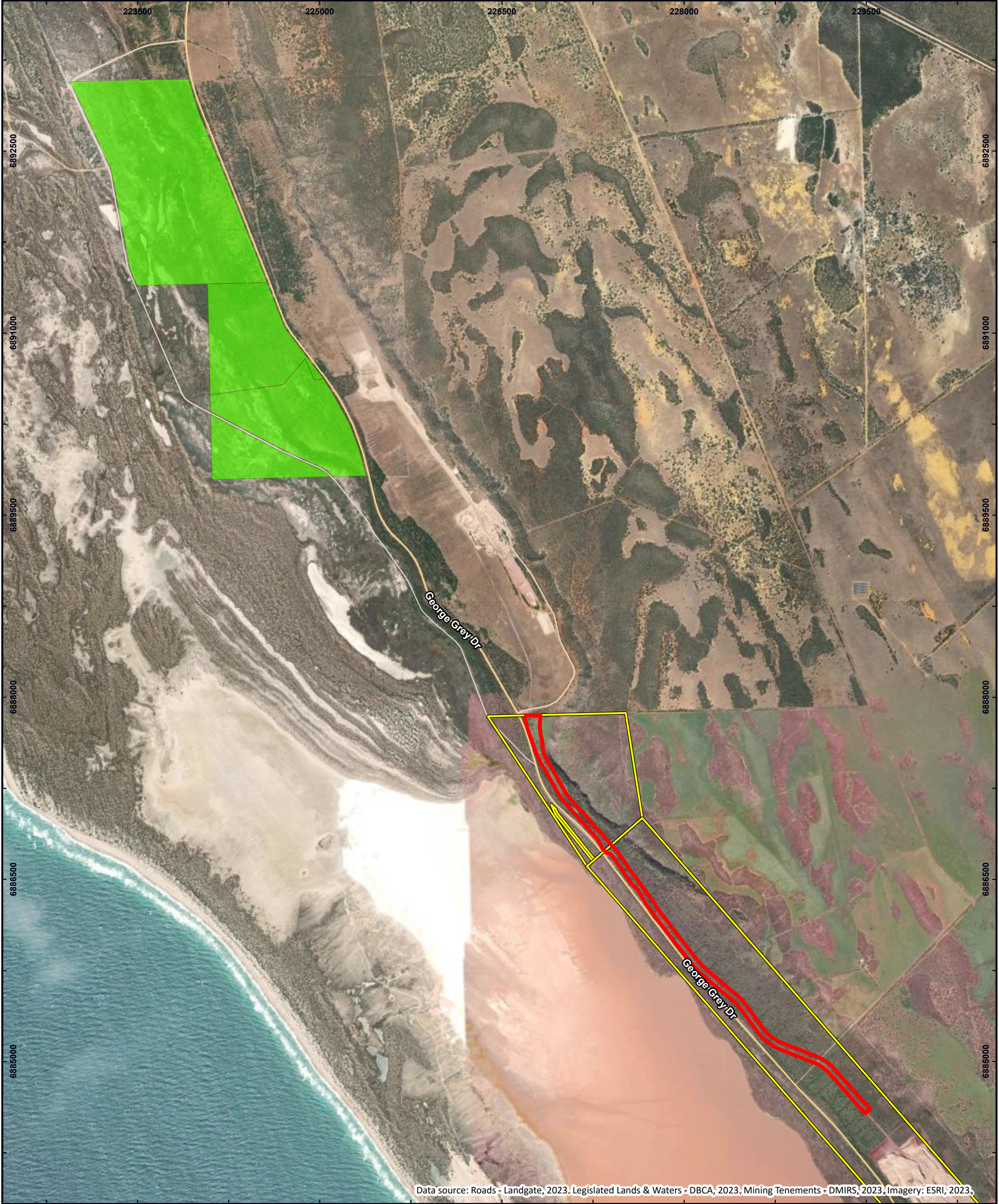
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Data source: Roads - Landgate, 2023. Legislated Lands & Waters - DBCA, 2023. Mining Tenements - DMIRS, 2023, Imagery: ESRI, 2023.

LEGEND

- Haul Road Boundary
- Mining Tenement
- Nature Reserve

Western Australian Roads

- Main Road
- Minor Road

LOCALITY

0 200 400 600 800 km

RESERVES

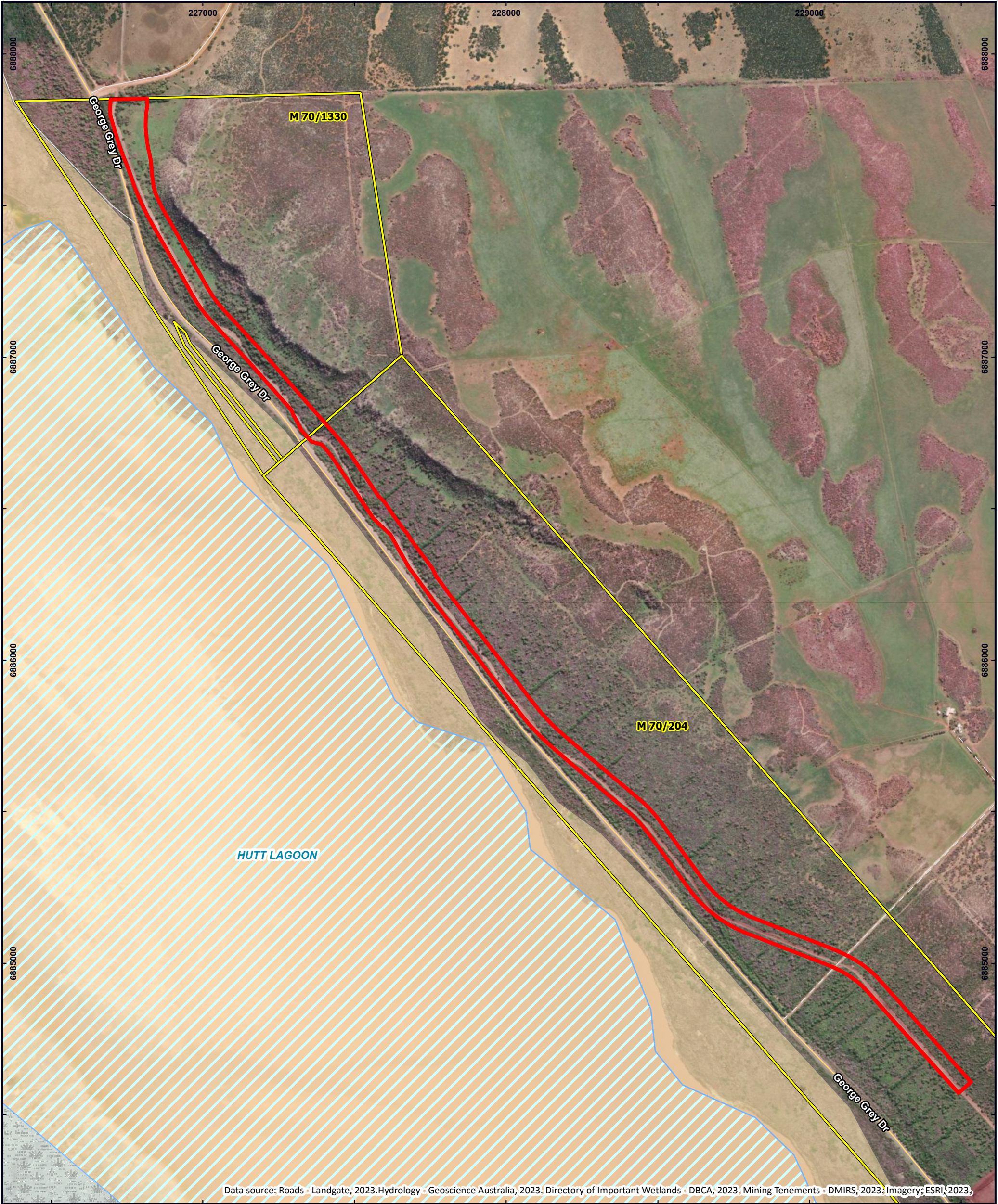
Port Gregory
Native Vegetation Clearing Permit

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Scale @ A3: 1:30,000 Coordinate System: GDA2020 MGA Zone 50

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LEGEND

- Haul Road Boundary
- Mining Tenement

Hydrology

- Lake
- Swamp

Directory of Important Wetlands

- Hutt Lagoon System

Western Australian Roads

- Main Road
- Minor Road
- Other

LOCALITY



HYDROLOGY & WETLANDS

Port Gregory
Native Vegetation Clearing Permit

GMA Garnet Pty Ltd



Scale @ A3: 1:12,000

Coordinate System: GDA2020 MGA Zone 50

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Reviewed: J Kirke

Project: TE23063

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Figure 2-6



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Data source: Roads - Landgate, 2023; Threatened & Priority Ecological Communities - DBCA, 2023; Mining Tenements - DMIRS, 2023; Imagery: ESRI, 2023.

LEGEND

- Haul Road Boundary
- Mining Tenement

Threatened Ecological Communities

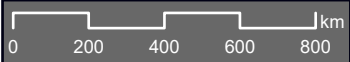
- Priority

Western Australian Roads

- Main Road
- Minor Road

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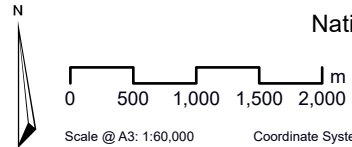
LOCALITY



THREATENED & PRIORITY ECOLOGICAL COMMUNITIES

Port Gregory
Native Vegetation Clearing Permit

GMA Garnet Pty Ltd



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Reviewed:	J Kirke
Project:	TE23063
Revision:	A
Date:	27/11/2023

Figure 2-7



3 Flora and Vegetation Assessment

A detailed flora and vegetation survey has been undertaken by GHD Pty Ltd (GHD) of tenements M70/204, M70/1330 and M70/259 in 2019. This survey determined a targeted flora survey was required for the threatened orchid species *Caladenia bryceana* subsp. *cracens* (Vulnerable under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act)). A second flora and vegetation survey was undertaken by Earth Stewardship in 2020 of the most northern extent of the DE within tenement M 70/1330. This survey did not include a desktop assessment. The breakdown of the surveyed areas and how they relate to the proposed clearing area is detailed in Figure 3-2. The following summary and the assessment against the clearing principles is based on the reports provided by GHD and Earth Stewardship.

3.1 Desktop Assessment

A desktop assessment was undertaken by GHD prior to the field survey to identify relevant environmental information pertaining to the survey area and potential flora species expected to occur within the survey area. Searches of online databases, such as the Department of Climate Change, Energy, the Environment and Water (DCCEEW) Protected Matters Search Tool and Department of Biodiversity Conservation and Attractions (DBCA) TEC and PEC lists, were collated with data from previous flora and vegetation reports for the area.

3.1.1 Flora Assessment

Database searches identified 455 flora taxa as being previously recorded within the survey area (85 families and 235 genera). Of these, 403 were classed as native flora taxa and 52 as naturalised (introduced) taxa. Myrtaceae was the dominant family, having 48 taxa represented, followed by Asteraceae and Fabaceae with 36 and Poaceae with 30 taxa (GHD, 2020A).

Forty-eight conservation significant flora were identified as potentially occurring within the survey area from the desktop assessment. Thirteen were listed under the EPBC Act and/or *Biodiversity Conservation Act 2016* (BC Act) as Threatened flora and one was listed as Threatened under the EPBC Act and Priority (P) 4 by DBCA. The remaining 34 conservation significant flora identified were listed as Priority species by the DBCA, with six being listed as P1, seven as P2, 14 as P3 and seven as P4 (GHD, 2020A).

3.1.2 Vegetation Assessment

3.1.2.1 Broad Vegetation Types

Mapping of pre-European broad vegetation within Western Australia was completed on a broad scale (1:1,000,000) by Beard (1976). These vegetation types were later re-assessed by Shepherd et. al (2002) with some larger vegetation units divided into smaller units. Together, this pre-European database contains a total of 819 vegetation types within Western Australia.

Two of Beard's pre-European vegetation associations are mapped within the survey area (Figure 3-1):

- 17 Shrublands; *Acacia rostellifera* thicket: wattle, casuarina and teatree acacia-allocauarina melaleuca alliance (a23Sc); and
- 371 Low forest; *Acacia rostellifera*: Acacia, Rottnest pine, coastal moort or mixed tropical forest, *Acacia rostellifera*, *Calliutris preissii*, *Eucalyptus lehmanii*, *E. cornuta* (a23Lc).

As shown in Table 3-1, the current extent of vegetation association 17 is above 30% of its pre-European extent at the State, IBRA bioregion, IBRA subregion and Local Government Authority (LGA) levels. Vegetation association 371 is below the 30% of the pre-European extents at all levels except for the LGA.

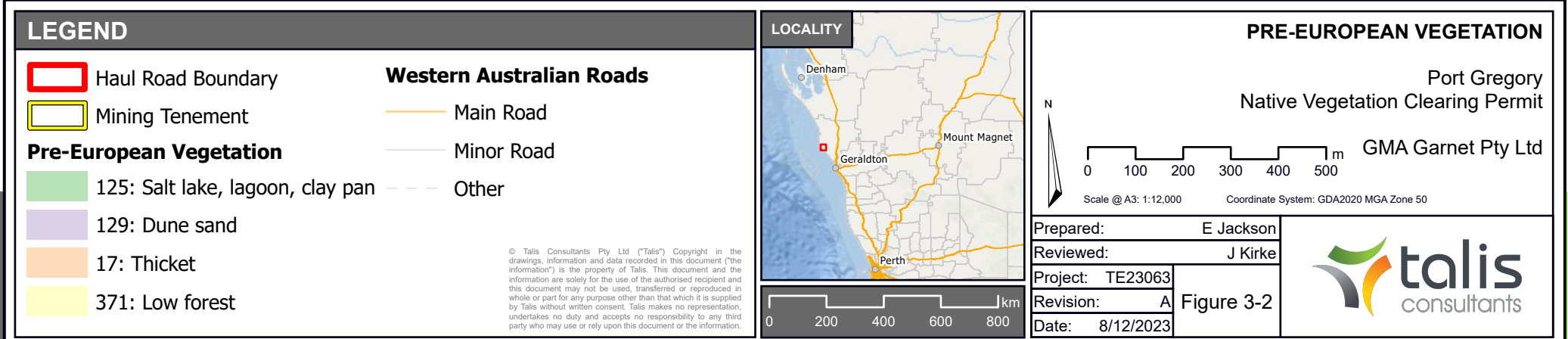
Table 3-1: Extents of vegetation associations mapped within the Haul Road development envelope (Beard and Burns, 1976)

Vegetation Association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Remaining within DBCA Managed Lands (%)	Hectares (ha) within DE	% of current extent within DE
17	State: WA	76,633.84	67,605.49	88.22	13.06	0.45	0.0006
	IBRA Bioregion: Geraldton Sandplains	54,087.08	45,159.85	83.51	13.44		0.0009
	Sub-region: Geraldton Hills	49,605.04	42,016.28	84.70	13.26		0.001
	LGA: Shire of Northampton	49,549.89	41,939.33	84.64	13.29		0.001
371	State: WA	32,816.04	3,499.60	10.66	6.92	24.97	0.713
	IBRA Bioregion: Geraldton Sandplains	32,807.53	3,499.10	10.67	6.92		0.713
	Sub-region: Geraldton Hills	32,807.53	3,499.10	10.67	6.92		0.713
	LGA: Shire of Northampton	5,749.92	2,142.08	36.94	10.69		1.16

Figure 3-1: Pre-European vegetation mapped within the proposed DE and survey area



Data source: Roads - Landgate, 2023; Pre European Vegetation - DPIRD, 2023; Mining Tenements - DMIRS, 2023; Imagery: ESRI, 2023.



3.1.2.2 Ecological Communities

No TECs listed under the EPBC Act are within the survey area. The DBCA TEC/PEC database identified two P1 PECs in proximity to the survey area (GHD, 2020A):

- Kalbarri Ironstone Community (P1 PEC); 8 km east from the survey area; and
- Shrubland of the Northampton Area, dominated by *Melaleuca* species over exposed Kockatea Shale (P1 PEC); 5 km southeast of the survey area.

No part of the PECs intersects the proposed DE (Figure 2-7).

3.2 Field Survey Assessment

The GHD field survey was conducted over four days in December 2019 with survey methodology employed referencing the *Environmental Protection Authority (EPA) Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (GHD, 2020A). Seasonal timing did not allow for targeted searches for key conservation significant flora species. As such, the targeted flora survey for *Caladenia bryceana* subsp. *cracens* was conducted in September 2020.

Earth Stewardship undertook a Level 1 field survey over one day in August 2020. Survey methodology referenced the *EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment*.

The extent of the two survey areas within the DE are mapped in Figure 3-2.



Data source: Roads - Landgate, 2023. Mining Tenements - DMIRS, 2023. Imagery: ESRI, 2023.

LEGEND

- Haul Road Boundary
- Earth Stewardship Survey Area
- GHD Survey Area
- Mining Tenement

Western Australian Roads

- Main Road
- Minor Road

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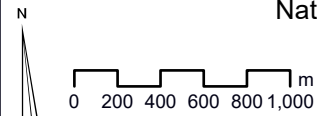
LOCALITY



SURVEY AREAS

Port Gregory
Native Vegetation Clearing Permit

GMA Garnet Pty Ltd



Prepared:	E Jackson
Reviewed:	J Kirke
Project:	TE23063
Revision:	A Figure 3-1
Date:	8/12/2023



3.2.1 Vegetation

3.2.1.1 Vegetation Condition

The condition of the vegetation within the GHD survey area ranged from Good to Completely Degraded. Just under 50% of vegetation within the survey area was classified as being in Good condition (GHD, 2020A). Areas mapped as Good had vegetation that was largely intact with native species present across each structural layer but also had high weed cover and signs of heavy grazing impacts from pigs and kangaroos (GHD, 2020A). The area has been historically cleared for exploration activities, with some of these areas having undergone rehabilitation (GHD, 2020A). There were areas that had been recently cleared or disturbed due to the progression of the Project. Details of the vegetation condition within the survey area are provided in Table 3-2.

Table 3-2: Vegetation condition summary for the GHD survey area (GHD, 2020A)

Vegetation Condition	Extent of survey area (ha) (%)
Cleared	69.83 (16.9)
Completely Degraded	34.34 (8.3)
Degraded	105.15 (25.4)
Good	203.54 (49.3)

The condition of vegetation within the Earth Stewardship survey area was noted to be predominantly Degraded to Completely Degraded, with the minor portion that was noted as Good being rehabilitation/regrowth and not undisturbed, natural vegetation (Earth Stewardship, 2020).

3.2.1.2 Vegetation Types

Three vegetation types were identified in the GHD survey area, not including previously cleared areas and regrowth/rehabilitated areas (GHD, 2020A). Three vegetation types were also mapped by Earth Stewardship in the survey area, not including previously cleared areas and regrowth/rehabilitated areas (Earth Stewardship, 2020). A large portion of the survey area has undergone historical clearing and rehabilitation. Rehabilitated areas contained fragmented vegetation resembling *Acacia rostellifera* open woodland, but with an understorey dominated by introduced grasses. Newly cleared and disturbed areas were noted as being prevalent within the surveyed areas (GHD, 2020A and Earth Stewardship, 2020).

Details of the vegetation types mapped by GHD and Earth Stewardship are in Table 3-3 and Figure 3-3.

The comparative assessment of vegetation types within the DE by GHD (2020A) diverged from those vegetation associations described by Beard and Burns (1976). Of the vegetation types identified, it was determined that VT01 and VT02 generally aligned with vegetation association 17, where VT01 contains mostly wooded areas (Lowforest), and VT02 contains Melaleuca shrublands (thicket). VT03 appears to align with association 125 (Saltlake, lagoon, clay pan) (Beard, 1975) that describes the Hutt Lagoon. Vegetation association 371 was determined to

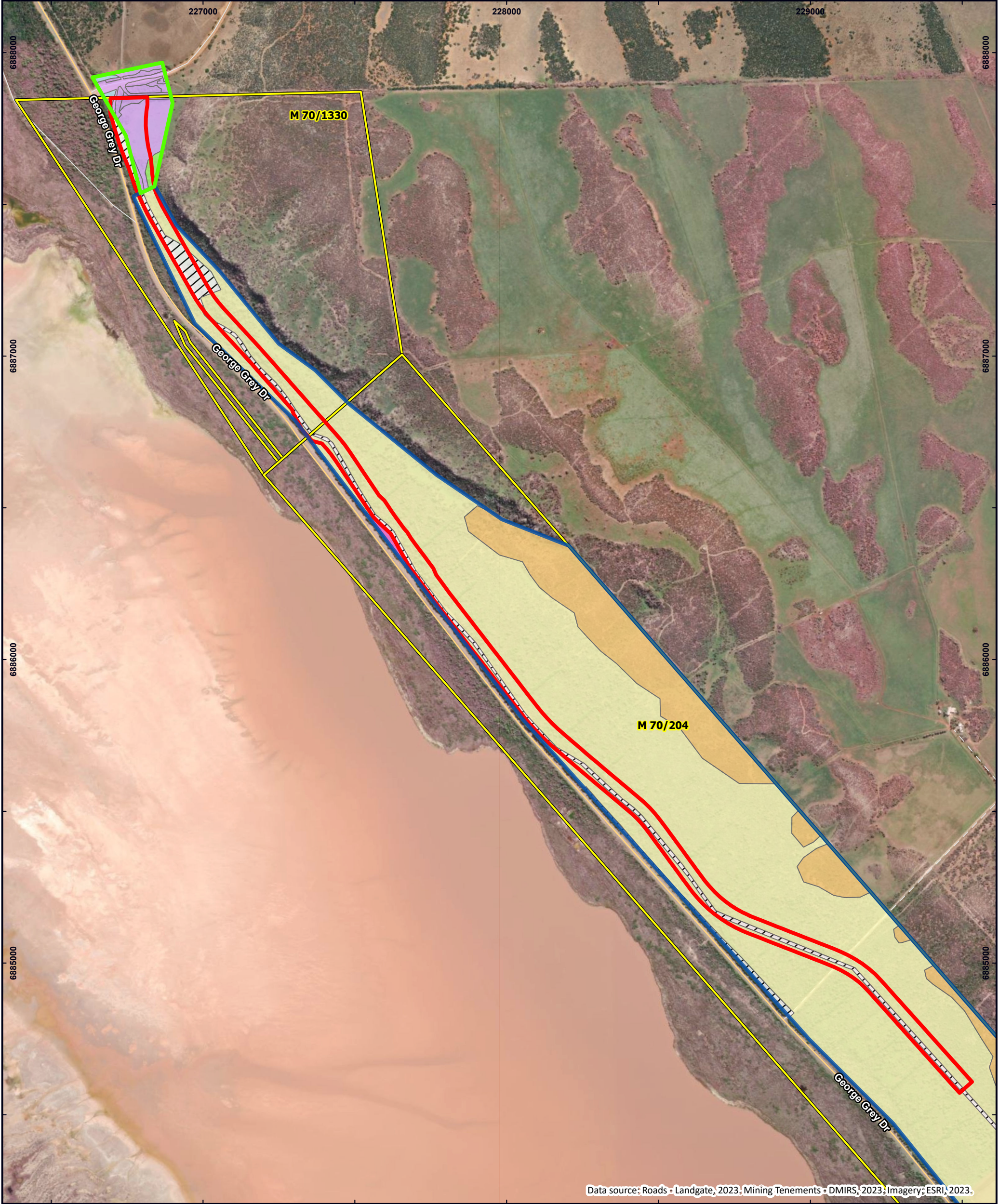
not occur within the GHD surveyed portion of the DE based on the observations and data collected in the field (2020A).

Similar conclusions were reached by Earth Stewardship in their assessment of vegetation types. None of the mapped vegetation types were considered to represent the vegetation association 371 mapped by Beard and Burns (1976) due to the lack of concordant community structure and the high level of degradation (Earth Stewardship, 2020). The vegetation type within the DE mapped as VT5 was considered to be in Good condition but was still unable to be classified as vegetation association 371 due to the young age of the community (< 10 years) (Earth Stewardship, 2020). It was determined that the vegetation within the survey area was broadly comparable to a lower structural version of VT01 described by GHD (Earth Stewardship, 2020).

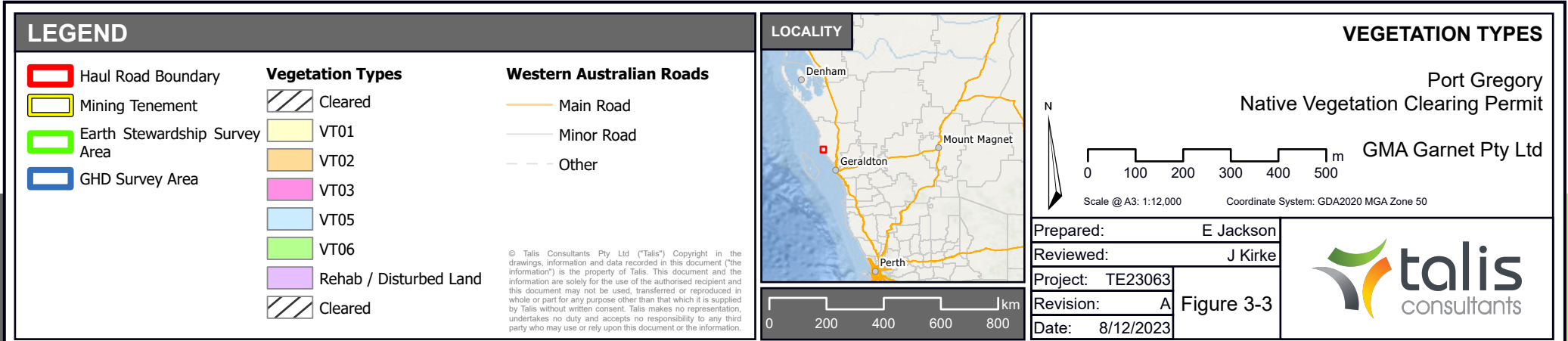
Table 3-3: Vegetation types and their description within the DE (GHD, 2020A and Earth Stewardship, 2020)

Survey Area	Vegetation Type	Description	Landform	Total Area within the DE (ha)
GHD (2020A)	VT01 – <i>Acacia rostellifera</i> open woodland to woodland	<i>Acacia rostellifera</i> open woodland to woodland over <i>Rhagodia preissii</i> subsp. <i>obovate</i> , <i>Pimelea microcephala</i> subsp. <i>microcephala</i> , <i>Olearia</i> sp. Kennedy Range (G. Byrne 66) and <i>Stylobasium spathulatum</i> open shrubland over <i>Austrostipa elegantissima</i> and <i>Ehrharta longiflora</i> open grassland to grassland. Other common species include <i>Alyogyne hakeifolia</i> , <i>Roepera fruticulosa</i> , <i>Commicarpus australis</i> and <i>Euphorbia boophthona</i> .	Occurs over lower and middle slopes on brown to orange sands. Previously disturbed through historic clearing and heavily disturbed by grazing.	17.24
GHD (2020A)	VT02 – <i>Melaleuca cardiophylla</i> shrubland to open shrubland	<i>Melaleuca cardiophylla</i> shrubland to open shrubland over <i>Alyogyne hakeifolia</i> , <i>Pimelea microcephala</i> subsp. <i>obovate</i> open shrubland over <i>Ptilotus divaricatus</i> scattered forbland. Other common species include <i>Roepera fruticulosa</i> , <i>Pimelea gilgiana</i> and <i>Bromus diandrus</i> . Areas that contain deeper soils recorded <i>Acacia rostellifera</i> .	Occurs on upper mid slopes on white-brown sand with limestone outcropping. Disturbances include high grazing impacts from feral pigs and kangaroos.	0.00
GHD (2020A)	VT03 – <i>Myoporum insulare</i> shrubland	<i>Myoporum insulare</i> shrubland over <i>Frankenia pauciflora</i> and <i>Threlkedia diffusa</i> open chenopod shrubland over <i>Sporobolus virginicus</i> open grassland.	Occurs on light brown clay on seasonally wet brackish drainage flats.	0.02

GHD (2020A)	Rehabilitation and cleared areas	Rehabilitation areas consisting of <i>Acacia rostellifera</i> , <i>Alyogyne hakeifolia</i> , <i>Pimelea microcephala</i> subsp. <i>microcephala</i> , <i>Stylobasium spathulatum</i> and <i>Olearia</i> sp. Kennedy Range (G. Byrne 66).	On lower middle slopes on brown to orange sands. The understorey is dominated by introduced grasses including <i>Avena barbata</i> and <i>Ehrharta calycina</i>	5.30
Earth Stewardship (2020)	VT5 – <i>Acacia rostellifera</i> Dense shrublands	Dense shrublands of <i>Acacia rostellifera</i> over <i>Alyogyne hakeifolia</i> over <i>Rhagodia</i> spp., <i>Tetragonia implexicoma</i> , <i>Pimelea microcephala</i> over mixed weed species	Topsoil mounds and an area of regrowth	0.03
Earth Stewardship (2020)	VT6 – <i>Acacia rostellifera</i> Open Shrublands on Limestone	Open Shrubland of <i>Acacia rostellifera</i> over <i>Grevillea argyrophylla</i> with scattered <i>Diplolaena grandiflora</i> , <i>Androcalva gaudichaudii</i> , <i>Scaevola tomentosa</i> and <i>Enchylaena tomentosa</i> over mixed weed species	Lower limestone foot-slopes	0.19
Earth Stewardship (2020)	VT7 – <i>Acacia rostellifera</i> Tall Shrubland	Tall Shrubland to Open Woodland of <i>Acacia rostellifera</i> over <i>Templetonia retusa</i> , <i>Commicarpus australis</i> , <i>Rhagodia</i> spp., <i>Alyxia buxifolia</i> , <i>Enchylaena tomentosa</i> over mixed weed species	-	0.00
Earth Stewardship (2020)	Disturbed areas	Consisting of artificial plantings, regrowth, paddocks and cleared tracks	-	2.15



Data source: Roads - Landgate, 2023; Mining Tenements - DMIRS, 2023; Imagery: ESRI, 2023.



3.2.1.3 Groundwater Dependent Vegetation

There are no known groundwater dependent ecosystems in the study area, with the water table likely too deep (>16 m below ground level) to support the root systems of any species of groundwater dependent vegetation. The proximal Hutt Lagoon is hypersaline and thus incapable of supporting any groundwater dependent ecosystems (AECOM, 2023).

3.2.1.4 Vegetation of Conservation Significance

Based on results of the desktop assessment, and the dominant species and landform features observed in the field, no vegetation communities identified in the survey area were determined to be consistent with any TECs or PECs (GHD, 2020A and Earth Stewardship, 2020). However, advice sought from the DBCA on the *Myporum insulare* shrubland (VT03) suggested that the vegetation type may align with the EPBC listed TEC and WA Priority 3 PEC Subtropical and Temperate Coastal Saltmarsh.

GMA assessed whether VT03 met the requirements to be considered a TEC/PEC using GMA's monitoring information and understanding of the local groundwater conditions. After a review of the available site data, GMA concluded that VT03 does not align with the Saltmarsh TEC/PEC. The conclusion is based on the following:

- The total dissolved solid (TDS) concentration within HM24 groundwater monitoring bore is distinctively different from the Hutt Lagoon. The groundwater within HM24 is more representative of brackish water whilst the Hutt Lagoon is representative of a hypersaline environment;
- The long-term trends and low concentrations of TDS suggest the groundwater beneath VT03 is not subject to any form of tidal influence;
- The hydraulic gradient of local groundwater determined from GMA's monitoring bore network does not suggest tidal influences; and
- The groundwater flow direction is south-westerly into the Hutt Lagoon. The Hutt Lagoon essentially acts as a hydraulic sink creating a barrier between tidal flows and the groundwater system.

The details of this assessment are in Appendix E.

3.2.2 Flora

The GHD field survey recorded the presence of 64 flora taxa representing 26 families and 50 genera (GHD, 2020A). Poaceae and Chenopodiaceae were identified as the dominant families, with 10 and 6 taxa, respectively. It was estimated that the species diversity of the survey area was 14 taxa on average, per 100 m² (GHD, 2020A).

Seventy-three flora taxa were recorded during the Earth Stewardship field survey with the most dominant families including Poaceae (10 taxa), Asteraceae (8 taxa) and Chenopodiaceae (7 taxa) (Earth Stewardship, 2020).

3.2.2.1 Threatened Flora

No Threatened flora listed under EPBC or BC Acts were recorded within the DE during either survey (GHD, 2020A and Earth Stewardship, 2020). Figure 3-6 depicts mapped Threatened flora for the area from database searches. A likelihood of occurrence assessment for all conservation significant flora identified during the desktop assessment was conducted by GHD following mapping of vegetation types in field. It was determined that the Threatened flora species *Caladenia bryceana* subsp. *cracens* could possibly occur in VT02 *Melaleuca cardiophylla* shrubland to open shrubland (GHD, 2020A). In light of these results, the proponent commissioned GHD for a targeted flora survey for *Caladenia bryceana* subsp. *cracens*, which was conducted in September 2020.

C. bryceana subsp. *cracens* is listed as Vulnerable under the EPBC Act and Endangered under the BC Act (GHD, 2020B). It is currently known to persist in 15 populations between Northampton and Kalbarri, growing in low heath in shallow soil on coastal limestone (GHD, 2020B). Areas of potentially suitable habitat within the proposed DE mapped by GHD in earlier surveys (VT02 *Melaleuca cardiophylla* shrubland to open shrubland) were surveyed again, as well as areas adjacent to the proposed DE.

No individuals of *C. bryceana* subsp. *cracens* were recorded during the targeted field survey. This was attributed to habitat type, with the potential habitat within the DE not aligning with the habitat types containing known records of the species (GHD, 2020B). Further, the proposed DE for the expanded haul road follows an existing track with adjacent areas having been previously cleared and observed to be inundated by weeds, reinforcing the unsuitability of habitat within the DE for the threatened flora species (GHD, 2020B).

A record of the Threatened species *Caladenia elegans* was identified during the desktop review as occurring within 35 m of the survey area and 77 m of the DE (Figure 3-4). Likelihood of occurrence assessments performed by GHD (2020A) determined it to be highly unlikely that the species exists within the survey area due to there being no suitable habitat and the record being from 2009, with drastic alterations to the land having occurred since then (Appendix A) (GHD, 2020A). As such, no targeted flora survey for this species was conducted at the time.

The record for the *C. elegans* individual listed on the DBCA Threatened species list (ID 124609) (DBCA, 2023) noted the habitat to be the “base of tall dune - seepage area with brown loamy clay.” This aligns with the habitat detailed in the DCCEEW Interim Recovery Plan, where the species is said to grow amongst winter-wet depressions in *Melaleuca* low scrub in low heath (DCCEEW, 2000). The ESA buffer with a 50 m radius around the identified plant (as per Clearing Regulations – ESAs DWER-046) does not intersect the DE and will not be impacted by the proposed clearing works (Figure 3-4).

Contour mapping of the Project area indicates low points and depressions to lie to the west of the George Grey Drive, outside of the proposed DE (Figure 3-5). Further, the GPS location for the identified individual also appears to lie outside of these depressions and low points, suggesting the potential for error with the accuracy of the identified location of the plant. This, in conjunction with GHDs assessment of the lack of suitable habitat for the species within their survey area, leads to a high degree of confidence that threatened species or its potential habitat will not be impacted by the proposed clearing works and further targeted surveys are not required at this stage.

Aerial photography of the habitat where *C. elegans* was identified and imagery of adjacent areas which appear to be more representative of suitable habitat for the threatened species can be found in Appendix A. Habitat on the western side, which falls outside of the DE and GHD survey area (2020) is more representative of what is described by DCCEEW as suitable habitat for the species. It is also concordant with the habitat described in the DBCA list for the individual plant (ID124609) when it was initially identified.



LEGEND

- Haul Road Boundary
- Mining Tenement

Threatened & Priority Flora (DBCA)

- Caladenia elegans
- Separation Distance
- 50m Buffer

Western Australian Roads

- Main Road
- Minor Road

LOCALITY



THREATENED & PRIORITY FLORA:
CALADENIA ELEGANS

Port Gregory
Native Vegetation Clearing Permit

GMA Garnet Pty Ltd



Scale @ A3: 1:1,500

Coordinate System: GDA2020 MGA Zone 50

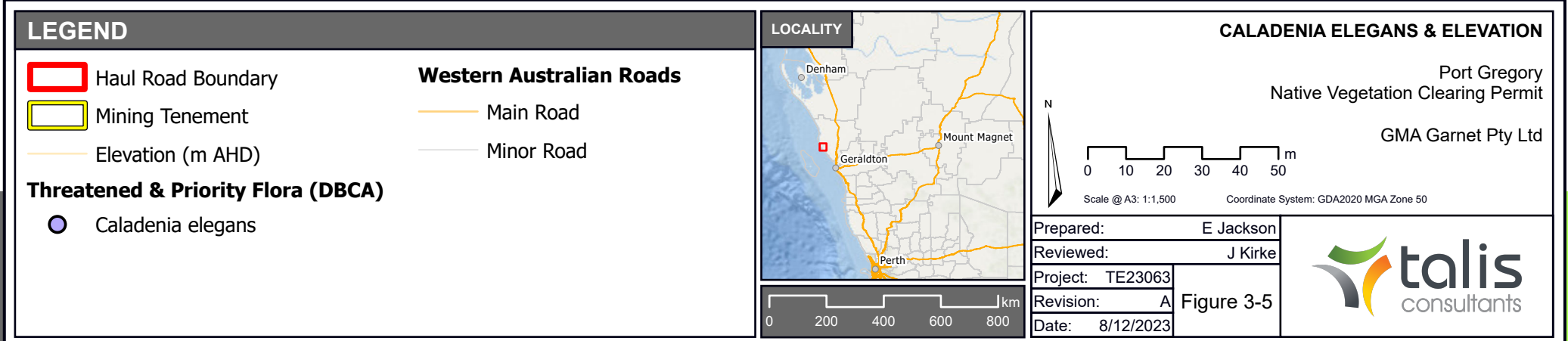
Prepared:	E Jackson
Reviewed:	J Kirke
Project:	TE23063
Revision:	A
Date:	8/12/2023

Figure 3-4





Data source: Roads, Elevation - Landgate, 2023, Flora Data - DBCA, 2023, Mining Tenements - DMIRS, 2023, Imagery: ESRI, 2023.



3.2.2.2 Priority Flora

No Priority flora listed by DBCA were recorded within the survey area during either survey (GHD, 2020A and Earth Stewardship, 2020). A likelihood of occurrence assessment for all conservation significant fauna identified during the desktop assessment was conducted by GHD following mapping of vegetation types in field. It was determined that it was Possible for two P3 flora species to occur within the survey area (GHD, 2020A):

- *Anthrocercis intricate* (P3); and
- *Balladonia aervoides* (P3).

Nearest existing records for these species are 5 km and 3 km from the survey area, respectively. Suitable habitat for the species exists within the DE, however, it was noted as being highly degraded (GHD, 2020A). Figure 3-6 depicts mapped Priority flora for the area from database searches.

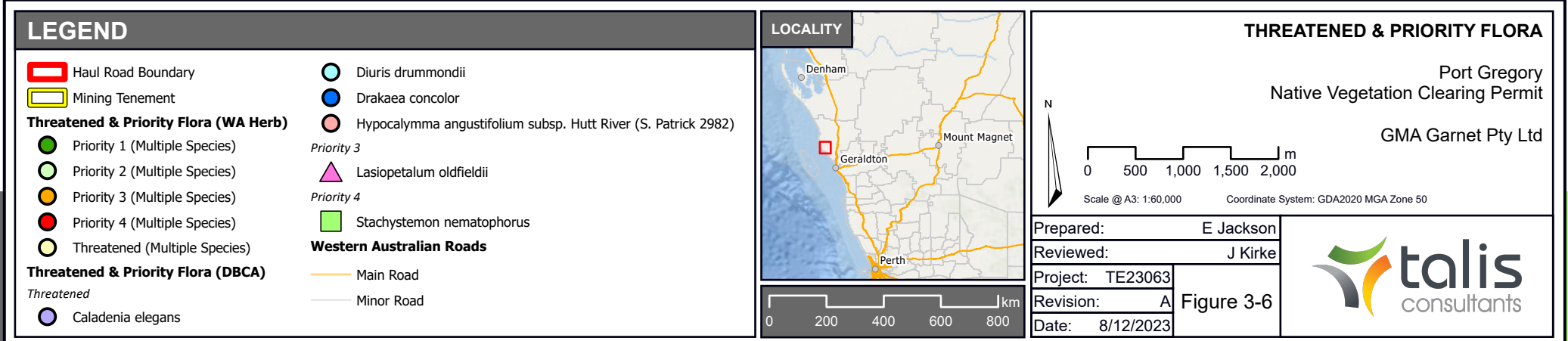
3.2.2.3 Weeds

Fifteen introduced flora species were recorded by GHD within their survey area (GHD, 2020). None of these were identified as being listed Declared Pests or Weeds of National Significance. The species are considered environmental weeds and have all been historically recorded with the Geraldton Sandplains bioregion.

Echium plantagineum (Paterson's Curse) was recorded by Earth Stewardship in the northern most section of the DE (2020). The species is listed as a Declared Pest under s.22(2) of the *Biosecurity and Agriculture Management Act 2007*. A further 28 introduced flora species were recorded within the survey area (Earth Stewardship, 2020).



Data source: Roads - Landgate, 2023. Flora Data - DBCA, 2023. Mining Tenements - DMIRS, 2023. Imagery: ESRI, 2023.



4 Terrestrial Fauna Assessment

A Level 1 fauna survey has been undertaken by GHD Pty Ltd (GHD) of tenements M70/204, M70/1330 and M70/259 in 2020. This survey assessed the fauna habitat types present, identified the fauna species within the survey area during the field portion of the survey, and the potential for conservation significant fauna to occur within the proposed DE. The following summary and the assessment against the clearing principles is based on the report provided by GHD in 2020.

4.1 Desktop Assessment

A desktop assessment was undertaken prior to the field survey to identify relevant environmental information pertaining to the survey area and potential fauna species expected to occur within the survey area. Searches of online databases, such as *NatureMap* and EPBC Protected Matters Search Tool, were collated with data from previous fauna studies for the area.

4.1.1 Vertebrate Fauna

The desktop assessment returned a result of 176 terrestrial fauna having previously been recorded within the survey area, and/or within 10 km of the survey area (GHD, 2020A). This comprised:

- Amphibians – 4;
- Birds – 151;
- Reptiles – 14; and
- Mammals – 7.

Four of the total number of fauna recorded are considered introduced species (GHD, 2020A).

Searches for the potential presence of conservation significant fauna potentially occurring within the survey area identified 33 terrestrial species (GHD, 2020A):

- 25 Threatened species under the EPBC and/or BC Acts;
- 5 Migratory bird species under the EPBC Act and/or Schedule 5 of the BC Act;
- Two Priority 4 species listed by DBCA; and
- One species listed as Schedule 7 (specially protected) under the BC Act.

Previous fauna surveys of proximal tenements by GHD have not identified any conservation significant fauna (GHD, 2020A).

Figure 4-1 maps the conservation significant fauna within and in proximity to the survey area, identified from database searches.



LEGEND

- Haul Road Boundary
- Mining Tenement

Threatened and Priority Fauna

- 4 Priority 4
- Specially protected species
- Threatened species

Western Australian Roads

- Main Road
- Minor Road

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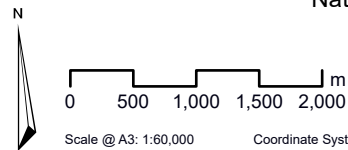
LOCALITY



THREATENED & PRIORITY FAUNA

Port Gregory
Native Vegetation Clearing Permit

GMA Garnet Pty Ltd



Prepared:	E Jackson
Reviewed:	J Kirke
Project:	TE23063
Revision:	A
Date:	8/12/2023

Figure 3-7



4.2 Field Survey Assessment

The field survey was undertaken over four days in December 2019, with methodology derived from the EPA *Technical Guidance – Sampling methods for terrestrial vertebrate fauna* and *Technical Guidance – Terrestrial Fauna Surveys* (GHD, 2020A).

4.2.1 Habitat Types

Five broad habitat types (including rehabilitated and cleared areas) were recorded during the survey:

- Acacia woodlands;
- Melaleuca shrublands on limestone;
- Shrublands on seasonally wet brackish drainage flats;
- Rehabilitation areas; and
- Cleared areas.

The identified habitat types are described in detail in Table 4-1.

Table 4-1: Fauna habitat types identified within the survey area

Habitat Type	Description	Extent within survey area (ha)
Acacia woodlands	This habitat type was recorded over the majority of the survey area and associated with lower and middle slopes on brown to orange sands. The vegetation type comprises <i>Acacia rostellifera</i> over chenopod shrubs (<i>Rhagodia preissii</i> subsp. <i>obovate</i>) and other mixed low shrubs, native and introduced grasses. The habitat contains a high level of wood and branches through previously cleared Acacia trees providing suitable habitat for reptiles and birds. There is evidence of high grazing impacts, including from feral pigs.	280.43
Melaleuca shrublands on limestone	This habitat type was restricted to the shallow limestone upper mid slopes on white-brown sand with limestone outcropping on the eastern side of the survey area. Dominated by <i>Melaleuca cardiophylla</i> on shallow limestone and in areas of deeper soils, scattered <i>Acacia rostellifera</i> is present. The environment had areas of good ground cover, litter and debris. Some areas of outcropping with exfoliating rock and ccs was present and would provide excellent cover for a range of species. There is evidence of high grazing impacts from feral pigs.	28.30

Habitat Type	Description	Extent within survey area (ha)
Shrubland on seasonally wet brackish drainage flats	This habitat type occurred over a small area on the western boundary of the survey area. This habitat type was dominated by <i>Myoporum insulare</i> , <i>Frankenia pauciflora</i> and <i>Threlkeldia diffusa</i> shrubs with native marine couch grass. Occurs on light brown clay on seasonally wet brackish drainage flats. The dense vegetation provides ideal habitat for reptiles and birds.	0.45
Rehabilitation areas	Rehabilitation areas consisting of mixed trees and shrubs of <i>Acacia rostellifera</i> , <i>Alygoyne hakeifolia</i> , <i>Pimelea microcephala</i> subsp. <i>microcephala</i> , <i>Stylobasium spathulatum</i> and <i>Olearia</i> sp. Kennedy Range (G. Byrne 66) on lower and middle slopes on brown to orange sands. The understorey is dominated by introduced grasses including <i>Avena barbata</i> and <i>Ehrharta calycina</i> . The habitat contains moderate levels of wood and branches with more open areas. There is evidence of high grazing impacts from feral pigs.	34.52
Cleared areas	Associated with previously cleared areas, access tracks and firebreaks. Much of the cleared, degraded areas were comprised of introduced grasses.	69.83

None of the identified habitat types were considered suitable for the conservation significant species that could potentially occur within the survey area (GHD, 2020).

Much of the survey area consists of remnant vegetation, much of which has been previously disturbed, cleared land for mine exploration and activity, and cleared agricultural land (GHD, 2020A). The land surrounding the survey area is primarily cleared for paddocks or has been developed by GMA for their processing area and transport corridors, resulting in minimal stretches of continuous vegetation across the landscape (GHD, 2020A). Despite areas having undergone rehabilitation or exhibiting signs of regrowth, there is evidence of extensive grazing by feral pigs, European rabbits and sheep. It is also likely that the proximity of the road and drive tracks is increasing the likelihood of feral species inhabiting the area (GHD, 2020A).

4.2.2 Recorded Species

The field survey identified 31 fauna species within the survey area, 24 native and seven introduced (GHD, 2020A). Of the 31 fauna species, 21 were birds, 8 mammals and two were reptiles (GHD, 2020A).

4.2.3 Conservation Significant Species

No threatened fauna listed under the EPBC Act and/or BC Act were recorded during the survey. No Priority fauna listed by DBCA were recorded within the survey area (GHD, 2020A). A listed Migratory marine bird species (EPBC Act) was identified in the southwestern portion of the survey area – the Eastern Osprey (*Pandion cristatus*). A pair was observed feeding a chick in a nest (GHD, 2020A).

A likelihood of occurrence assessment for all conservation significant fauna identified during the desktop assessment was conducted following mapping of habitat types in field. Of the 35 conservation significant fauna identified as potentially occurring, one was identified as present, two are considered likely to occur and the remainder were considered unlikely or highly unlikely to occur within the survey area (Table 4-2) (GHD, 2020A). No species of conservation significance are considered likely to be solely dependent on the habitats present within the survey area (GHD, 2020A).

Table 4-2: Conservation significant fauna present or likely to occur within the survey area

Species (Common Name)	EPBC Act	BC Act/DBCA	Likelihood of occurrence
<i>Pandion cristatus</i> (Osprey)	MI	IA	Present – observed nesting within survey area
<i>Apus pacificus</i> (Fork-tailed Swift)	MI	IA	Likely – Number of records along coast and near Hutt Lagoon. The species is almost exclusively aerial and likely to only utilise the survey area opportunistically
<i>Falco peregrinus</i> (Peregrine Falcon)		OS	Likely – Records of species occurring around Port Gregory area. The species may occur as an infrequent visitor, only foraging within the survey area.

4.2.3.1 Carnaby's Black Cockatoo

In the south-west of Western Australia, the Carnaby's Black Cockatoo (*Calyptrorhynchus latirostris*) mostly occurs in the Wheatbelt, where the species breeds between July/August to January/February. The Carnaby's Black Cockatoo is highly mobile and displays a seasonal migratory pattern that is linked to breeding, with the majority of birds moving to the higher rainfall coastal areas to forage during the non-breeding season (DSEWPac, 2012).

The DE falls within the non-breeding range of the Carnaby's Black-cockatoo (DSEWPac, 2012) and there is marginal foraging habitat within the DE.

The habitat within the DE is at the outer (northern) non-breeding range for the presence of the Carnaby's Black Cockatoo. As indicated in Table 4-3, the recorded habitat types within the survey area do not support roosting habitat for the Carnaby's Black Cockatoo. A review of the DBCA (2011) *Plants Used by Carnaby's Black Cockatoo* further indicates that no potential foraging species occur within the DE.

Table 4-3: Summary and extent of Carnaby's Black Cockatoo habitat within the proposed DE

Habitat Type	Presence within survey area	Evidence
Foraging	There is no suitable foraging habitat within the DE.	Nil
Breeding	The DE falls outside the modelled breeding range.	Nil
Roosting	The fauna habitat types do not support roosting habitat.	Nil

There is one reported moderately certain sighting of the Carnaby's Black Cockatoo within the local area approximately 2 km west of the survey area and located at Port Gregory, Western Australia (DBCA 2007).

Anecdotally the Carnaby's Black Cockatoo is known to breed and roost within the Kalbarri National Park, which is approximately 40 km north of the survey area (pers. com. Birdlife Australia 2019). Success in breeding is dependent on the quality and proximity of feeding habitat within 12 km of nesting sites (Johnstone *et al.* 2011, DEC 2012). There is no suitable habitat within the DE.

5 Environmental Management Measures

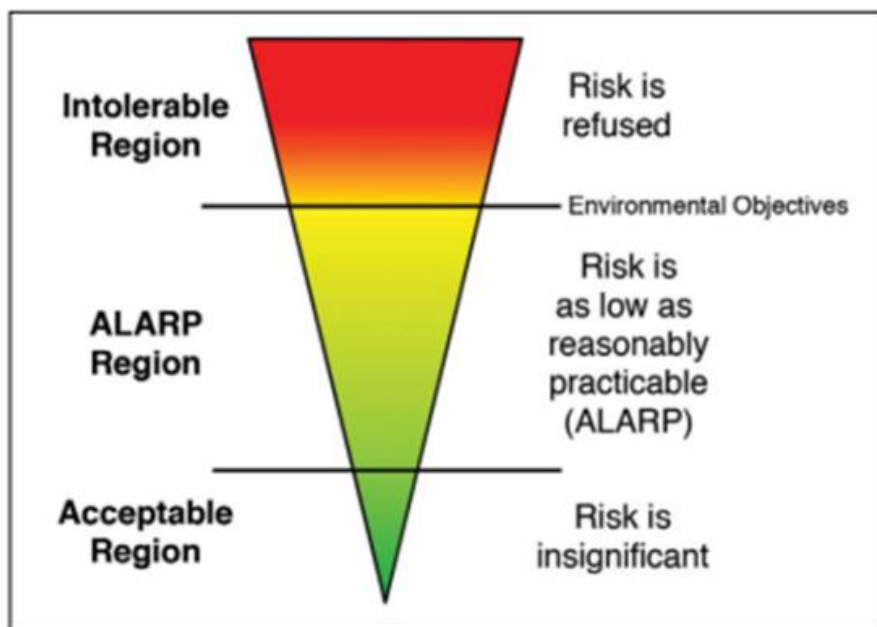
5.1 Risk Assessment Strategy

A risk assessment was undertaken to identify risk, risk pathways and likely impacts which may arise from the proposed clearing. Environmental risk was based on an understanding of the existing environment and experience at the Port Gregory site.

GMA has established a risk assessment utilising the as Low as Reasonably Practicable (ALARP) principle. The following definition is to be used to determine whether a risk has been lowered to ALARP:

The ALARP Principle in relation to risk levels is show in **Figure 5-1: ALARP and Risk**.

Figure 5-1: ALARP and Risk



This allows for proactive risk management strategies to be developed during planning and operation. A standard risk matrix (AS/NZS ISO 31000:2009) was utilised to evaluate the likelihood and consequence of potential risks:

- Likelihood - The likelihood of an impact on the surrounding environment or other receptors; and
- Consequence - The scale or magnitude of the potential impact (i.e., severity/extent) if it were to occur.

The likelihood and consequence tables are provided in Table 5-1 and Table 5-2, respectively. Table 5-3 provides the risk ratings associated with each of the potential environmental impacts for each Project area before and after management strategies have been implemented. Table 5-3 also provides the risk ranking criteria tables used to determine these ratings.

Table 5-1: Likelihood of Risk Occurring

Likelihood of Risk Occurring		
Level	Likelihood	Description
A.	Almost Certain	The event is common or frequent occurrence or an ongoing impact (e.g. daily)
B.	Likely	The event is expected to occur under some conditions or has occurred more than once
C.	Possible	The event will probably occur, or has occurred under some conditions (e.g. yearly)
D.	Unlikely	Known to have occurred but not often
E.	Rare	Very unlikely/may occur in exceptional circumstances

Table 5-2: Consequence of a Risk Occurring

Consequence of a Risk Occurring		
Level	Likelihood	Description
1.	Catastrophic	Severe environmental impact, extensive clean up and recovery period, requires internal and external resources
2.	Major	Major environmental impact, extends beyond mine, considerable clean up using internal and external resource
3.	Moderate	Impact confined to the mine, clean up may require external assistance, moderate environmental damage
4.	Minor	Confined to an isolated area, rapid clean up using internal resources, minimal environmental damage
5.	Insignificant	Confined to the immediate area, rapid clean up, no environmental damage

The risk matrix detailed in Table 5-3 combines the level of likelihood and consequence to determine the associated level of risk. The impact of each identified risk is then categorised as extreme (red), high (orange), medium (yellow) and low (green). Management measures for each identified risk is then included and the risk rating re-categorised.

A risk priority is assigned to each of the 25 possible outcomes.

Table 5-3: Risk Matrix and Rankings

Risk Matrix		Consequence				
		5. Insignificant	4. Minor	3. Moderate	2. Major	1. Catastrophic
Likelihood	A. Almost Certain	Medium 14	High 19	Extreme 22	Extreme 24	Extreme 25
	B. Likely	Medium 10	Medium 13	High 18	Extreme 21	Extreme 23
	C. Possible	Low 6	Medium 9	Medium 12	High 17	Extreme 20
	D. Unlikely	Low 3	Low 5	Medium 8	Medium 11	High 16
	E. Rare	Low 1	Low 2	Low 4	Medium 7	High 15

	20-25 Extreme risk; immediate action required
	15-19 High risk; senior management attention needed
	7-14 Medium risk; management responsibility must be specified
	1-6 Low risk; manage by routine procedures

5.1.1 Risk Treatment

The risk assessment conducted for the proposed Project documents measures applied to each risk, documenting the raw and residual risks. The residual risk is then evaluated to ensure it is meeting the ALARP principle and is consistent with identified environmental objectives.

Risk treatment options may consult relevant Australian Standards, Guidance Notes, Codes of Practice, and other established industry best practice to assess and determine appropriate outcomes.

The following hierarchy is used for treating residual risk with each chosen method adaptable to the type of risk being controlled:

1. **Elimination** – Where practicable, the risk is eliminated completely;
2. **Substitution** – The original activity, substance or equipment may be substituted for a different activity, substance or equipment that lowers the risk;
3. **Isolation** – The risk is isolated;
4. **Engineering controls** – The risk may be mitigated using engineering controls to reduce the risk; and
5. **Administrative controls** – Include training, implementation of policies, procedures, and introduction of behavioural expectations to reduce risk.

5.2 Risk Assessment

A risk assessment was completed to consider those activities conducted as part of the proposed Project elements and the relevant controls and management practices that are utilised to minimise the associated environmental risks. The risks are outlined in Table 5-4 and discussed in detail in Section 6 Assessment Against the Ten Clearing Principles.

Table 5-4: Risk Assessment

ASPECT	IMPACT	LIKELIHOOD	CONSEQUENCE	RAW RISK	TREATMENT	LIKELIHOOD	CONSEQUENCE	TREATED RISK
Native flora and vegetation	Clearing of supporting habitat for threatened flora	Unlikely	Minor	Low 5	<ul style="list-style-type: none"> Qualified environmental consultants engaged to conduct flora and vegetation assessment Surveys indicated that none of the vegetation within the DE aligns with the habitat requirements of the threatened flora <i>Caladenia elegans</i> and <i>Caladenia bryceana</i> subsp. <i>cracens</i> Targeted surveys for threatened flora <i>Caladenia bryceana</i> subsp. <i>cracens</i> identified no individuals within the development envelope The record of <i>Caladenia elegans</i> (ID124609) and the corresponding 50 m radius ESA buffer lies outside the DE Proposed clearing area has been minimised by widening an existing road 	Rare	Minor	Low 2
Native flora and vegetation	Clearing of threatened flora	Unlikely	Minor	Low 5	<ul style="list-style-type: none"> Targeted surveys for threatened flora <i>Caladenia bryceana</i> subsp. <i>cracens</i> identified no individuals within the development envelope The record of <i>Caladenia elegans</i> (ID124609) and the corresponding 50 m radius ESA buffer lies outside the DE Proposed clearing area has been minimised by widening an existing road 	Rare	Minor	Low 2
Native flora and vegetation	Fugitive dust from cleared areas degrading adjacent native vegetation	Possible	Minor	Medium 9	<ul style="list-style-type: none"> Dust management will be undertaken in accordance with GMA's Dust Management Procedure Hose mine weather station will inform wind conditions and requirements for dust suppression Vehicle speed limits along the haul road 	Unlikely	Minor	Low 5
Environmentally Sensitive Areas (Hutt Lagoon)	Clearing of vegetation causing erosion and sedimentation from surface water runoff impacting Hutt Lagoon	Unlikely	Moderate	Medium 8	<ul style="list-style-type: none"> Proposed clearing area has been minimised by widening an existing road Qualified environmental consultant engaged to conduct surface water assessment Highly porous sandy, limestone soils allow for rapid infiltration of water Lack of surface water structures within the DE to provide pathway for deposition of excess sediments in Hutt Lagoon Rehabilitation of cleared areas will involve recontouring of landscape to reestablish any surface water flows 	Rare	Moderate	Low 4

ASPECT	IMPACT	LIKELIHOOD	CONSEQUENCE	RAW RISK	TREATMENT	LIKELIHOOD	CONSEQUENCE	TREATED RISK
TEC/PEC	Clearing of EPBC listed TEC and WA Priority 3 PEC Subtropical and Temperate Coastal Saltmarsh (VT03)	Rare	Minor	Low 2	<ul style="list-style-type: none"> Analysis of vegetation assessment and site groundwater data to confirm whether VT03 meets criteria to be classified as TEC/P3 PEC Results indicated that VT03 do not meet the classification criteria and is not considered a TEC/PEC 	Rare	Insignificant	Low 1
Native vegetation	Clearing of vegetation association 371 which is below the minimum threshold of retention of 30% of pre-European extent set in EPA's Guidance Statement No. 33	Rare	Minor	Low 2	<ul style="list-style-type: none"> Environmental consultant conducted in field vegetation type assessment of proposed clearing area Results were compared to original vegetation mapping by Beard and Burns (1976) It was determined that the vegetation within the DE was not concordant with vegetation association 371 and was more aligned with vegetation association 17 Vegetation association 17 is well above the minimum threshold of retention, at >80% at State, regional, subregional and local levels 	Rare	Minor	Low 2
Fauna	Clearing of native vegetation results in removal of significant habitat for threatened fauna species such as Carnaby's Black Cockatoo	Rare	Minor	Low 2	<ul style="list-style-type: none"> Assessment of potential foraging, breeding and roosting habitat for Carnaby's Black Cockatoo within the DE conducted It was determined that there is no habitat for Carnaby's Black Cockatoo within the DE Desktop assessment conducted by Environmental consultants did not indicate that it was likely for Carnaby's Black Cockatoo to occur within the DE or surrounding area 	Rare	Insignificant	Low 1
Rehabilitation	Unsuccessful rehabilitation delays re-establishment of native vegetation communities	Possible	Moderate	Medium 12	<ul style="list-style-type: none"> Rehabilitation will be conducted in accordance with GMA's Rehabilitation Management Plan 	Unlikely	Moderate	Medium 8

5.3 Avoid

The design of the haul road minimizes clearing, by widening an existing track that lies within a previously disturbed area, avoiding creating an entirely new area of disturbance.

5.4 Mitigation

GMA has designed engineering controls to minimise clearing impacts but still ensure safe operation on site.

Examples of environmental management measures which can be implemented to mitigate clearing impacts and management on site include, but are not limited to the following:

- Clearing area will be demarcated prior to the commencement of project activities and prior to the commencement of native vegetation clearing;
- Clearing will be undertaken in accordance with the site Ground Disturbance Permitting Procedures; and
- Induction of all contractors and/or internal personnel undertaking the clearing in accordance with GMA's internal procedures.

6 Assessment Against the Ten Clearing Principles

The proposed clearing activities have been assessed against the ten clearing principles as defined in the Department of Environment Regulation (DER) Guide to Assessment: Clearing of Native Vegetation under the EP Act, considering the current extent and condition of the native vegetation on the site. This assessment is presented in Table 6-1.

Table 6-1: Assessment Against Clearing Principles

Principle	Assessment
Principle (a) – Native vegetation should not be cleared if it comprises a high level of biological diversity.	<p>Assessed Outcome: Within the clearing area there are no threatened flora or threatened ecological communities.</p> <p>A targeted survey for threatened flora species <i>Caladenia bryceana</i> subsp. <i>cracens</i> was conducted following identification of potential habitat of the species in earlier surveys (GHD, 2020B). No individuals were identified within the DE or survey area, with more detailed analysis of the habitat revealing it to be unsuitable for the species and highly degraded. A record of the threatened species <i>Caladenia elegans</i> was identified during the desktop survey within 77 m of the proposed clearing (GHD, 2020A), however, no targeted survey was conducted as species was regarded as highly unlikely to occur due to the habitat within the survey area was deemed unsuitable for the species (GHD, 2020A).</p> <p>The proposed clearing area of up to 25.42 ha is not considered to comprise a high level of biological diversity according to field work conducted by GHD and Earth Stewardship (GHD, 2020A and Earth Stewardship, 2020). Targeted surveys for threatened flora indicate there to be no threatened flora species within the proposed clearing area. Therefore, the proposed clearing is unlikely to be at variance with this Principle. Refer to Section 3 and Section 4 for further detail.</p>

Principle	Assessment
Principle (b) – Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significant habitat for fauna indigenous to Western Australia.	<p>Assessed Outcome: Based on the gathered information (Section 4), none of the identified species in the proposed clearing area are considered solely dependent on any of the terrestrial habitat types identified. Disturbance within the proposed clearing area is unlikely to significantly impact any of the species listed due to the presence of similar habitat within the vicinity of the area.</p> <p>The DE is not considered necessary for the maintenance of a significant habitat for fauna indigenous to Western Australia and therefore the proposed clearing of up to 25.42 ha is unlikely to be at variance with this Principle.</p>
Principle (c) – Native vegetation should not be cleared if it includes, or is necessary for the continued existence of rare flora.	<p>Assessed Outcome: No Threatened or Priority Flora were identified by GHD (2020A) or Earth Stewardship (2020) during the initial flora and vegetation survey. One Threatened flora species, <i>Caladenia bryceana</i> subsp. <i>cracens</i>, was considered likely to be present due to the presence of suitable habitat within the survey area. A targeted flora survey was conducted in 2020 to identify any individuals potentially within the DE and survey area (GHD, 2020B). No representatives of the threatened flora species were identified during the targeted survey, determined to likely due to the level of degradation of, and unsuitability of, the habitat within the DE (GHD, 2020B).</p> <p>Given the results of GHD's (2020B) targeted flora survey for <i>Caladenia bryceana</i> subsp. <i>cracens</i>, native vegetation within the proposed clearing area does not include and is not necessary for the continued existence of this threatened species. GHD determined it to be highly unlikely for <i>Caladenia elegans</i> to occur within the proposed clearing area due to the unsuitability of the habitat, further the 50 m radius buffer of the identified individual does not intersect with the proposed clearing area. It is therefore unlikely that the native vegetation to be cleared includes and is necessary to the continued existence of the species.</p> <p>As such, the proposed clearing is unlikely to be at variance with this principle.</p>

Principle	Assessment
Principle (d) – Native vegetation should not be cleared if it comprises the whole or a part of or is necessary for the maintenance of a Threatened Ecological Community (TEC).	<p>Assessed Outcome: No Threatened or Priority Ecological Communities were identified by GHD (2020A) or Earth Stewardship (2020) during the commissioned studies.</p> <p>The potential for the GHD mapped <i>Myporum insulare</i> shrubland (VT03) to be P3 PEC Subtropical and Temperate Coastal Saltmarsh was evaluated by GMA using site data and previous consultant reports. As detailed in Section 3.2.1.4, it was determined that VT03 does not meet the criteria to be classified as the P3 PEC.</p> <p>Given that there are no TECs or PECs present within the proposed clearing footprint, the clearing of up to 25.42 ha is unlikely to be at variance with this Principle.</p>
Principle (e) – Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	<p>Assessed Outcome: The development envelope falls within vegetation associations 17 and 371, as mapped by Beard and Burns (1976), both of which are dominated by <i>Acacia rostellifera</i>. The EPA's Guidance Statement No. 33 has identified a minimum threshold of retention of 30% of pre-European extent of each community (Environmental Protection Authority, 2008). Vegetation association 17 is well above this threshold, representation of this associations within the Geraldton Sandplains and Shire of Northampton is 83.51 % and 84.64 %, respectively. Vegetation association 371 is below the 30% threshold, with only 10.6% remaining of the pre-European extent at the State, Region and sub-region level. At the Local level, 371 is above the threshold, with 36.94% remaining.</p> <p>Field assessments of the vegetation associations within the DE by GHD (2020A) and Earth Stewardship (2020) determined that the vegetation mapped did not correspond to that described by Beard and Burns (1976). Within the GHD survey area, the vegetation was evaluated to better align with vegetation association 17 (2020A). Earth Stewardship determined the vegetation within their survey area (northern portion of the DE) to be too heavily degraded to align with vegetation association 371 (2020).</p> <p>It is therefore unlikely that the proposed clearing will have any substantial impacts on the remaining extents of pre-European vegetation as it was determined that the vegetation in the area was either aligned with vegetation 17 (remaining extent well above the minimum threshold of 30%) or highly degraded. The proposed clearing is therefore unlikely to be at variance with this Principle.</p>
Principle (f) – Native vegetation should not be cleared if it is growing in, or in	<p>Assessed Outcome: The Project is not located within any proclaimed Surface Water Areas and has no major fresh waterways or tributaries within its tenements. Surface water channels are ephemeral and do not feature year-round baseflow. Additionally, the small upstream catchments, combined with the potentially high infiltration rate</p>

Principle	Assessment
association with, an environment associated with a watercourse or wetland.	<p>of sandy soils, suggest that these channels are only active for short periods of time during rainfall events (AECOM, 2022).</p> <p>Hutt Lagoon, a wetland of national importance is located approximately 250 m from the proposed haul road DE. However, the proposed DE does not intersect the wetland or any of its tributaries (AECOM, 2022).</p> <p>Given the lack of major rivers and tributaries within the DE and the negligible predicted impacts to the Hutt Lagoon, the proposed clearing is unlikely to be at variance with this Principle.</p>
Principle (g) – Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	<p>Assessed Outcome: The (then) DER has defined land degradation as including the following (Department of Environment Regulation, 2014):</p> <ul style="list-style-type: none"> • The clearing of vegetation; • Decline in vegetation condition; • Soil erosion and soil acidity (caused by wind and water erosion due to vegetation clearing); • Salinity; or • Waterlogging/flooding. <p>The land use surrounding the Project is mostly disturbed, with flora and vegetation studies citing a high proportion of previously cleared and rehabilitated areas. While clearing of vegetation for the haul road will directly impact native vegetation, clearing has been minimised by widening an existing track and utilising previously cleared and/or currently disturbed areas. There is the potential for an increase in fugitive dust from the cleared area and future road traffic, however, it is unlikely to be a significant increase from what is produced from the current road use. Dust suppression of the haul road will be managed using GMA's Dust Management Procedure to minimise potential impacts from dust.</p> <p>The works associated with the clearing are unlikely to cause appreciable land degradation that is different or more significant than what has already occurred within the Project tenements and the surrounding area to date. Therefore, the proposed clearing is unlikely to be at variance with this Principle.</p>

Principle	Assessment
Principle (h) – Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	<p>Assessed Outcome: The Project is not located within any Environmentally Sensitive Areas (ESA), however, there are two ESAs in proximity to the DE: Hutt Lagoon (within 250 m of the DE) and the 50 m radius buffer around the <i>Caladenia elegans</i> record (within 27 m of the DE). Surface water studies conducted by AECOM (2022) determined the proposed clearing did not impact any associated surface water structures of, or key tributaries to, the wetland. There are no reserves within the DE, with the closest reserve being Utcha Well Nature reserve, located approximately 3 km from the tenement boundary.</p> <p>Given the already approved activities in proximity to the reserve (i.e., Hose mine) and that the proposed clearing will not facilitate novel disturbances to the area (widening of existing track), it is unlikely that the clearing will have any impact on the environmental values of the nearby reserve. The Hutt Lagoon is already heavily modified, being dominated by local agricultural operations with the operation of the farm altering the natural hydrology of the lagoon. The proposed clearing is unlikely to add further impacts to the nearby ESA, reinforced by the lack of surface water tributaries within the DE. It is therefore unlikely that the proposed clearing is at variance with this principle.</p>
Principle (i) – Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	<p>Assessed Outcome: The DE has no major fresh waterways or tributaries within its boundary. Surface water channels are ephemeral and do not feature year-round baseflow. Additionally, the small upstream catchments, combined with the potentially high infiltration rate of sandy soils, suggest that these channels are only active for short periods of time during rainfall events (AECOM, 2022).</p> <p>There is limited baseline data available for water quality of the Hutt Lagoon, Utcha Well Nature Reserve and the lower reaches of the Hutt River. However, the Hutt Lagoon is heavily modified due to the operations of the Dunaliella Salina Farm. Farm operations significantly alter the hydrology of the lagoon through pumping of seawater into the lagoon and disposal of used water into the water body. Potential impacts that could result from the proposed clearing are unlikely to be significant in comparison to those of the Dunaliella Salina Farm operations.</p> <p>The lack of surface water features within the tenements and DE suggest there is little to no pathway for impacts to result from the proposed clearing, significantly reducing the likelihood of impacts to surface water quality. In conjunction with the existing impacts to the Hutt Lagoon water quality from the local agriculture farm, the proposed clearing is unlikely to be at variance with this Principle.</p>

Principle	Assessment
Principle (j) – Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	<p>Assessed Outcome: There is no published flood data or flood mapping for waterways in the immediate vicinity of the DE and thus conclusions on flood frequency, flood elevation and subsequent impact cannot be made with certainty for this site. The mining tenements intercept a number of small drainage pathways that carry local runoff down the steep escarpment from the east (AECOM, 2022). However, it is unlikely that these contribute to localised flooding due to the highly porous sandy, limestone soils allowing for rapid infiltration of water.</p> <p>The DE is within an extensively disturbed area, bordered by cleared areas for agriculture and mining activities with the proposed clearing only being up to 25.42 ha. Further, it is likely that the area is only subject to localised flooding during prolonged or high intensity rainfall events, which occur infrequently in the area. Therefore, the likelihood of the proposed clearing exacerbating the incidence of flooding to a further extent is highly unlikely.</p>

7 Summary of Assessment

The assessment concludes that the clearing of up to 25.94 ha of native vegetation for development of a haul road to connect the Lynton and Hose Mines for the Port Gregory Project is not at variance with the ten Clearing Principles. Field assessments of vegetation type have determined that vegetation association 371 does not occur within the DE, contradictory to what was mapped by Beard and Burns (1976), and as such the proposed clearing will not impact the remaining extent of this vegetation association within the region. Further, the vegetation type mapped as potentially being a TEC/P3 PEC was determined to not meet the classification criteria for the community, resulting in there being no TECs/PECs within the DE that will be impacted by the proposed clearing.

The lack of available baseline data for surface water quality and flood modelling for the Project area makes it difficult to assess whether the proposed clearing will impact surface water quality and exacerbate the incidence of flooding. However, there are no major surface water features within the DE, providing little to no pathway for impacts to water quality to result or for any potential impacts to be insignificant. Further, the ESA (Hutt Lagoon) has been heavily modified by the operations of the local agricultural farm, which has impacts to surface water quality through its discharge of seawater and used water into the Lagoon. The DE is not within a floodplain and is bordered by agricultural areas that have been extensively cleared, making it unlikely that the clearing of 25.42 ha will contribute significantly to any existing impacts to flooding of the area.


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APPENDIX A – Aerial imagery of habitat areas for *Caladenia elegans*


Table 8-1: Aerial imagery of habitat for *Caladenia elegans*

General Location	GPS Coordinates (MGA 94 zone 50)		Image
<p>Location of <i>C. elegans</i> record (ID 124609), eastern side of George Grey Drive. Habitat does not appear to match descriptions from GHD (2020A) and DCCEEW of suitable habitat for the species.</p>	226906	6887169	

General Location	GPS Coordinates (MGA 94 zone 50)		Image
<p>Western side of George Grey Drive. Habitat appears to match descriptions from GHD (2020A) and DCCEEW of suitable habitat for the species. Appears to match habitat described in the supporting information for the identification of the individual in the DBCA Threatened and Priority flora list</p>	226873	6887146	

General Location	GPS Coordinates (MGA 94 zone 50)		Image
<p>Western side of George Grey Drive. Habitat appears to match descriptions from GHD (2020A) and DCCEEW of suitable habitat for the species. Appears to match habitat described in the supporting information for the identification of the individual in the DBCA Threatened and Priority flora list</p>	226876	6887149	

General Location	GPS Coordinates (MGA 94 zone 50)		Image
<p>Proposed clearing area, habitat appears to reflect that of where <i>C. elegans</i> was identified, however, does not match descriptions from GHD (2020A) and DCCEEW of suitable habitat for the species.</p>	226955	6887223	

General Location	GPS Coordinates (MGA 94 zone 50)		Image
<p>Proposed clearing area, habitat appears to reflect that of where <i>C. elegans</i> was identified, however, does not match descriptions from GHD (2020A) and DCCEEW of suitable habitat for the species.</p>	226955	6887223	

APPENDIX B – Lynton Mine Expansion Biological Survey (GHD, 2020)



GMA Garnet Pty Ltd
Lynton Mine Expansion
Biological Survey

February 2020

Executive summary

GMA Garnet Pty Ltd (GMA) currently own and operate the open pit Hose and Lynton Mines, located near Port Gregory, Western Australia.

GHD Pty Ltd (GHD) was commissioned to undertake a biological assessment across three tenements M70/204, M70/1330 and M70/259. The purpose of the survey was to delineate key flora, vegetation and fauna aspects.

The outcome of the survey and information supplied in the biological survey will be used to inform the environmental assessment and approvals process. This report is subject to, and must be read in conjunction with, the limitations set out in section 1.7 and the assumptions and qualifications contained throughout the report.

Key flora findings

- Three vegetation types were identified in the survey area, not including previously cleared areas (mining areas, tracks, cleared areas with no native species)
- The condition of the vegetation ranged from Good to Completely Degraded. Areas mapped as Good had vegetation that was largely intact with native species present across each structural layer, although had high weed cover and signs of high grazing impacts from pigs and kangaroos. Much of the survey area had undergone historical clearing (exploration) and rehabilitation of some of these areas
- No vegetation communities identified in the survey area were consistent with Threatened or Priority Environmental Communities
- Sixty-four flora taxa (including subspecies and varieties) representing 26 families and 50 genera were recorded from the survey area during the field survey
- No *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or *Biodiversity Conservation Act 2016* (BC Act) listed flora were recorded within the survey area. No Priority flora, as listed by the Department of Biodiversity Conservation and Attraction, were recorded within the survey area
- The likelihood of occurrence assessment post-field survey concluded three species are considered possible to occur, five species unlikely to occur, and 40 species highly unlikely to occur in the survey area. The species considered possible to occur are; *Caladenia Bryceana* subsp. *cracens*, *Anthocercis intricata* (P3) and *Balladonia aervoides* (P3).

Key fauna findings

- Five broad habitat types (including rehabilitated and cleared areas) were recorded during the survey
- Thirty-one fauna species were recorded within the survey area, including 21 bird, 8 mammal and 2 reptile species. Of these, 24 are native and seven are introduced/feral
- No Threatened fauna listed under the EPBC Act and/or BC Act or Priority fauna species listed by the DBCA was recorded during the survey
- The Eastern Osprey (*Pandion cristatus*) which is listed as Migratory and Marine under the EPBC Act and under International Agreement under the BC Act was recorded during the survey

- Of the 35 conservation significant fauna identified in the desktop searches one species has been identified as present (Osprey), two are considered likely to occur and the remaining species are considered unlikely or highly unlikely to occur within the survey area.

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Appendix B – Relevant legislation, background information and conservation code

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1. Introduction

1.1 Project background

GMA Garnet Pty Ltd (GMA) currently own and operate the open pit Hose and Lynton Mines, located near Port Gregory, Western Australia (WA). Mining activities are currently undertaken within M70/926, M70/204 and M70/968. Mining is undertaken using an open-cut sand mining methods. Mobile earthmoving equipment, including front-end loaders, excavator and dump trucks are used for pit excavation and backfilling. Soil and overburden are moved ahead of ore excavation and replaced in their original stratigraphic order over the backfilled tailings.

GMA are currently in the process of planning for the expansion of their operations within the Lynton Mine, located to the east of Hutt Lagoon, near Port Gregory in WA. Biological surveys are required to be undertaken to inform this expansion.

1.2 Purpose of this report

GMA commissioned GHD Pty Ltd (GHD) to undertake a biological assessment across three tenements M70/204, M70/1330 and M70/259. The purpose of the survey was to delineate key flora, vegetation and fauna aspects.

The outcome of the survey and information supplied in the biological survey will be used to inform the environmental assessment and approvals process.

1.3 Study area

The study area of the project is located in Geraldton, and encapsulates an area of 10 km around the survey area.

1.4 Survey area

The survey area for this project is located at Port Gregory, approximately 96 kilometres (km) north of Geraldton in the mid-west of WA. The survey area is 413 hectare (ha) in size and occurs across three tenements (M70/204, M70/1330 and M70/259). The survey area boundary is shown in Figure 1, Appendix A.

1.5 Scope of works

The scope of works was to undertake a desktop assessment and biological survey of the survey area. The following actions were completed to fulfil the scope:

- A desktop assessment of the survey area prior to the field survey to identify biological features and constraints, which may be in, or near the survey area
- A review of relevant publicly available or supplied by GMA environmental reports
- A field survey to verify/ground truth the desktop assessment findings through a detailed (single-season) vegetation and flora survey and level 1 fauna survey
- Identification and mapping of vegetation types to a scale appropriate for the bioregion and described according to the National Vegetation Information System (NVIS) structure and floristics
- Identification and mapping of Threatened or Priority Ecological Communities (TECs or PECs) inferred through the use of quadrats and relevés

- Assessment of the survey area's flora species diversity, density, composition, structure and weed cover, recording the percentage of each in nominated quadrats
- Delineation and mapping of fauna habitat types
- A flora and fauna likelihood of occurrence assessment based on the vegetation units and fauna habitat present within the survey area and known species distribution and habitat requirements
- Mapping using Geographic Information Systems (GIS) mapping software
- A concise report (this document) on the findings of the biological survey and targeted flora assessment.

1.6 Relevant legislation, conservation codes and background information

In WA some ecological communities, flora and fauna are protected under both Federal and State Government legislation. In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation and guidelines, conservation codes and background information relevant to this biological survey is provided in Appendix B.

1.7 Report limitations and assumptions

This report has been prepared by GHD for GMA and may only be used and relied on by GMA for the purpose agreed between GHD and the GMA as set out in section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than GMA arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 1.4 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by GMA and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Site conditions may change after the date of the field survey. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This report has assessed the flora and fauna within the survey area (Figure 1, Appendix A). Should the survey area change or be refined, further assessment may be required.

2. Methodology

2.1 Desktop assessment

Prior to the commencement of the field survey, a desktop assessment was undertaken to identify relevant environmental information pertaining to the survey area and within 10 km of the survey area (referred to herein as the study area). This included a review of:

- The Department of the Environment and Energy (DotEE) Protected Matters Search Tool (PMST) to identify communities and species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially occurring within the study area (DotEE 2019) (Appendix C)
- The Department of Biodiversity, Conservation and Attractions (DBCA) TEC and PEC database to determine the potential for conservation significant communities to be present within the study area
- The DBCA *NatureMap* database for flora and fauna species previously recorded within the study area (DBCA 2019) (Appendix C)
- The DBCA Threatened (Declared Rare) and Priority Flora (TPFL) database and the WA Herbarium database (WAHERB) for Threatened flora listed under the *Biodiversity Conservation Act 2016* (BC Act) and listed as Priority by the DBCA, previously recorded within the study area
- Existing datasets including previous pre-European vegetation mapping of the survey area (Beard 1976), aerial photography, hydrology information to provide background information on the variability of the environment, likely vegetation units and fauna habitats and to identify areas that potentially contain TECs and PECs
- Existing flora, fauna and vegetation reports and/or data:
 - GMA Port Gregory Mine Tenement M70/968 Vegetation, Flora and Fauna Assessment (GHD 2013)
 - GMA Garnet Port Gregory Mine Targeted Flora Survey (GHD 2014)
 - GMA Garnet Mining Lease M70/926 Biological Survey (GHD 2016)
 - GMA Port Gregory Mine Site M70/1380 Biological Survey (GHD 2019).

The mapped biological constraints within 10 km of the survey area is provided in Figure 2, Appendix A.

2.2 Field survey

2.2.1 Flora and vegetation

Two GHD botanists/ecologists completed a detailed (single-season) flora and vegetation survey from 8 - 12 December 2019. The field survey was undertaken to verify the results of the desktop assessment, identify and describe the dominant vegetation units, assess vegetation condition, and identify and record vascular flora taxa present at the time of survey. The survey seasonal timing did not allow for targeted searches for key conservation significant flora species, however potential habitat for significant flora were identified and mapped where present.

The survey methodology employed by GHD was undertaken with reference to the Environmental Protection Authority (EPA) Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a).

Data collection

Field survey methods involved a combination of sampling quadrats and transects located in identified vegetation units and traversing the survey area by vehicle and foot. Twenty non-permanent quadrats and seven relevés were placed within the survey area, which is deemed suitable for the represented vegetation types identified. Transects were spaced at 10 m intervals when traversing a specified vegetation type. The degraded condition of vegetation in much of the survey area caused transects to become spaced further apart (<50 m) as the survey progressed.

Quadrats (measuring 10 m x 10 m – area of 100 m²) were located within each identified vegetation unit. Field data at each quadrat was recorded on a pro-forma data sheet and included the parameters detailed in Table 1.

Table 1 Data collected during the flora and vegetation field survey

Aspect	Measurement
Collection attributes	Site code, personnel/recorder, date, quadrat dimensions, photograph of the quadrat, marking method
Physical features	Landform, aspect, slope, soil attributes, ground surface cover, leaf and wood litter
Location	Coordinates recorded in GDA94 datum (Zone 50) using a hand-held Global Positioning System (GPS) tool to accuracy approximately ±5 m
Vegetation condition	Vegetation condition in accordance with the vegetation condition rating scale for the South-West Interzone Botanical Province (EPA 2016)
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora	List of dominant flora from each structural layer, list of all species within the quadrat including stratum, average height and cover (using National Vegetation Information System (NVIS)).

Quadrat data is provided in Appendix D. A flora inventory was compiled from taxa listed in described quadrats, relevés and opportunistic floristic records throughout the survey area (Appendix D).

Vegetation units

Vegetation units were identified and boundaries delineated using a combination of aerial photography, topographical features, field data/observations and statistical analyses.

Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by quadrat data and field observations. Vegetation unit descriptions follow the NVIS and are consistent with NVIS Level V (Association). At Level V, three (or more) taxa per stratum are used to describe the association (NVIS Technical Working Group 2017).

Statistical analyses

PRIMER version 6 (Clarke and Gorley 2006) was used to examine the similarity between sites using collected data. A presence/absence matrix was created of all taxa (including perennials and annuals) present in GHD quadrats. The dissimilarity between quadrats was determined using the Bray-Curtis measure and the Resemblance function in PRIMER. A Cluster analysis (using Agglomerative Hierarchical Clustering technique) based on group average was undertaken using the Bray-Curtis similarity matrix and results presented as a dendrogram. In addition, a nonmetric multi-dimensional scaling analysis (MDS) was undertaken using the Bray-Curtis similarity matrix and results presented as a two dimensional scatter plot. The analysis was repeated using removing all singleton taxa. The outputs of the PRIMER analysis were used to inform decisions on vegetation units.

Vegetation condition

The vegetation condition of the survey area was assessed and mapped in accordance with the vegetation condition rating scale for the South-West Interzone Botanical Province of WA (devised by Keighery (1994) and adapted by the EPA (2016a)). The scales recognise the intactness of vegetation and consists of six rating levels as outlined in Appendix B.

Flora identification and nomenclature

Species that were well known to the survey botanists were identified in the field; all other species were collected and assigned a unique collection number to facilitate tracking. Flora collections were made under Joel Collin's DBCA Scientific Flora License (#FB620000200). All specimens collected during the field assessment were dried and processed in accordance with the requirements of the WA Herbarium. Species were identified by a qualified taxonomist using taxonomic literature, electronic keys and online electronic databases.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 2020) and the EPBC Act Threatened species database provided by DotEE (2020). Nomenclature used in this report follows that used by the WA Herbarium as reported on *FloraBase* (WA Herbarium 2020).

2.2.2 Fauna

GHD ecologists undertook a Level 1 fauna survey (reconnaissance survey) in conjunction with the flora and vegetation survey from 8 - 12 December 2019. The survey area was traversed on foot over the course of the survey to identify and describe the dominant fauna habitat types present and their condition, assess habitat connectivity, and identify and record fauna species within the survey area. An assessment of the likelihood of conservation significant fauna occurring within the survey area was also undertaken.

The survey methodology employed by GHD was undertaken in accordance with the EPA *Technical Guidance – Sampling methods for terrestrial vertebrate fauna* (EPA 2016b) and *Technical Guidance – Terrestrial Fauna Surveys* (EPA 2016c).

Opportunistic fauna searches

Opportunistic fauna searches were conducted across the survey area. Opportunistic searches involved:

- Searching the survey area for tracks, scats, bones, diggings and feeding areas for both native and introduced/feral species
- Visual and aural surveys, which accounted for many bird species potentially utilising the survey area
- Recording GPS locations of any conservation significant fauna species observed.

Fauna species identification

Identification of fauna species was made in the field using available field guides and electronic guides (e.g. Morcombe 2011). Where identification was not possible, photographs of specimens were collected to be later identified.

Fauna nomenclature

Nomenclature used in this report follows that used by the Western Australian Museum and the DBCA NatureMap database (DBCA 2019) with the exception of birds, where Christidis & Boles (2008) was used.

2.3 Limitations

2.3.1 Desktop limitations

The EPBC Act PMST is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. The records from the DBCA searches of Threatened fauna provide more accurate information for the general area and local occurrence. However, some collection, sighting or trapping records cannot be dated and often misrepresent the current range of Threatened species

2.3.2 Field survey limitations

The EPA (2016a, b) states that flora and fauna survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 2.

Table 2 Flora and fauna survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Nil	<p>Adequate information is available for the survey area.</p> <ul style="list-style-type: none"> • Pre-European vegetation mapping (Beard 1976) • GHD (2019) GMA Garnet Port Gregory Mine Mining Tenement M70/1380 Biological Survey • GHD (2016) GMA Garnet Mining Lease M70/926 • GHD (2014) GMA Garnet Port Gregory Mine Targeted Flora Survey • GHD (2013) GMA Garnet Port Gregory Mine M70/968 Vegetation, Flora and Fauna Assessment.
Scope (what life forms were sampled etc.)	Nil	<p>Vascular flora and terrestrial vertebrate fauna were sampled during the survey. Non-vascular flora, invertebrate and aquatic fauna were not surveyed.</p> <p>Adequate time was available to complete the biological survey to the required standard.</p>
Proportion of flora collected and identified (based on sampling, timing and intensity) Proportion of fauna identified, recorded and/or collected	Moderate	<p>The flora and vegetation survey was undertaken from 8 - 12 December 2019. Spring is considered the most optimal time to undertake vegetation surveys in the Geraldton bioregion. This survey is considered an out of season survey as seasonal conditions at the time of the survey are deemed unsatisfactory for some annuals and ephemeral species, such as orchids. The survey sampling and intensity was considered adequate. The vegetation survey was a broad scale and targeted assessment, undertaken to identify and describe the dominant vegetation units and map conservation significant flora. The portion of flora collected and identified was considered appropriate for the level of experience of the Senior Botanist undertaking the survey. All taxonomic groups were considered to be represented. The portion of flora collected and identified was considered moderate; and it is likely the survey under-recorded some grass species (Poaceae), annuals and herbs due to lower than average rainfall and out of season timing. However, based on the likelihood assessment it is unlikely these species would be conservation significant.</p> <p>The reconnaissance fauna survey was undertaken from 8 - 12 December 2019. The fauna assessment sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings, etc. Many cryptic species would not have been identified during a reconnaissance survey and seasonal variation within species often requires targeted surveys at a particular time of the year. Of the fauna species recorded during the survey, all were identified to species level.</p>
Flora determination	Minor	<p>Flora determination was undertaken by GHD botanist/ecologist in the field and at the WA Herbarium by Botanist Frank Obbens.</p> <p>Four taxa could be identified to genus level only, due to lack of flowering and/or fruiting material required for identification. None of these taxa were considered to be conservation significant species.</p> <p>The taxonomy and conservation status of the WA flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time of report development, but it should be noted this may change in response to ongoing research and review of the International Union for Conservation Nature criteria.</p>

Aspect	Constraint	Comment
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Minor	The majority of the survey area was accessible and was accessed by foot and vehicle. There were some areas of large piles of dead Acacia logs and branches which restricted movement by foot, however, these areas could still be ground-truthed.
Mapping reliability	Minor	<p>The vegetation was mapped using high-resolution ESRI aerial imagery obtained from Landgate, topographical features, previous broad scale mapping (Beard 1976) and field data.</p> <p>Data was recorded in the field using hand-held GPS tools (e.g. Samsung tablet and Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are accurate to within ± 5 metres on average. Therefore the data points consisting of coordinates recorded from the GPS may contain inaccuracies.</p>
Timing/weather/season/cycle	Moderate	<p>The Detailed Flora and Level 1 fauna field survey was conducted in December 2019. In the six months prior to the flora survey (June -November), Lynton weather station (BoM 2020) recorded a total of 270 mm of rainfall. This rainfall total is slightly lower than the long-term average for the same period (June to November; 277 mm) (BoM 2020).</p> <ul style="list-style-type: none"> • The weather conditions during the field survey included: • Daily maximum temperatures ranging from 25 to 35 °C • Daily minimum temperature ranging from 14 to 22 °C • No rainfall occurred during the survey. <p>This survey is considered an out of season flora survey as seasonal conditions at the time of the survey are deemed unsatisfactory for some annuals and ephemeral species, such as orchids. For majority of the other flora species the timing of detailed flora survey was considered appropriate due to a number of flora flowering or fruiting at the time of the survey.</p>
Disturbances (e.g. fire, flood, accidental human intervention)	Minor	Much of the survey area had undergone historical clearing (exploration) and rehabilitation of some of these areas. Newly cleared or disturbed areas (roads and tracks) were also prevalent, as well as completely cleared areas, where the mine development has progressed. These disturbances did not limit the survey.
Resources	Nil	Adequate resources were employed during the field survey. Two staff over five days were spent undertaking the flora and fauna survey using a dedicated botanist and ecologist.
Access restrictions	Nil	No access problems were encountered during the survey. There were some areas of large piles of dead Acacia logs and branches which restricted movement by foot, however, these areas could still be ground-truthed.
Experience levels	Nil	The botanist/ecologists who executed the survey were practitioners suitably qualified in their respective fields. Joel Collins, is suitably qualified with over 16 years' experience in undertaking flora and fauna surveys and assessments in Western Australia. Joel has extensive experience undertaking flora and

Aspect	Constraint	Comment
		assessments on the Geraldton Sandplains. Sarah Flemington (Ecologist) has three years experience undertaking flora and fauna surveys across the South West and across the arid region and interzone.

3. Desktop assessment

3.1 Regional biogeography

The survey area is located within the Geraldton Sandplains bioregion and Geraldton Hills sub-region as described by the Interim Biogeographic Regionalisation of Australia (IBRA).

This region comprises of sandy earths of an extensive undulating and lateritic sandplain mantling Permian to Cretaceous strata. This region occurs within the southern end of the Carnarvon Basin and the northern end of the Perth Basin, with exposed areas of Permian/Silurian siltstone and Jurassic sandstones mostly overlain by sandplains, alluvial plains and coastal limestone. The vegetation consists primarily of proteaceous heath with *Banksia* - York gum woodlands on alluvial plains and *Acacia* scrub on limestone (Desmond and Chant, 2002).

3.2 Climate

The survey area experiences a Mediterranean type climate, characterised by warm to hot dry summers and mild wet winters. The Bureau of Meteorology (BoM) Kalbarri weather station (Number 8251) is the nearest active weather station to the survey area with continuous long-term temperature data (approximately 54 km from the survey area). Climatic data from this site indicates the mean maximum temperature of the area ranges from 21.8 degrees Celsius (°C) in July to 34.2 °C in February, and the mean minimum temperature ranges from 9.7 °C in July to 20.6 °C in February (Plate 1) (BoM 2020). Rainfall data has been sourced from the Lynton weather station (Number 8075), which was likely to better represent the survey area. The average annual rainfall measured at Lynton is 405.9 mm with the average monthly rainfall ranging 3.5 mm in December to 93.7 mm in June. Rainfall was significantly higher than the average for the area in June 2019, at 171.5 mm (Plate 1) (BoM 2020). Rainfall was not recorded at Lynton in 2019 for the months September to December. Results from 2018 have been supplemented for those months. The majority of rainfall occurs in the winter months and is generally associated with frontal systems from the south west. The summer rains are associated with isolated thunderstorms and tropical lows.

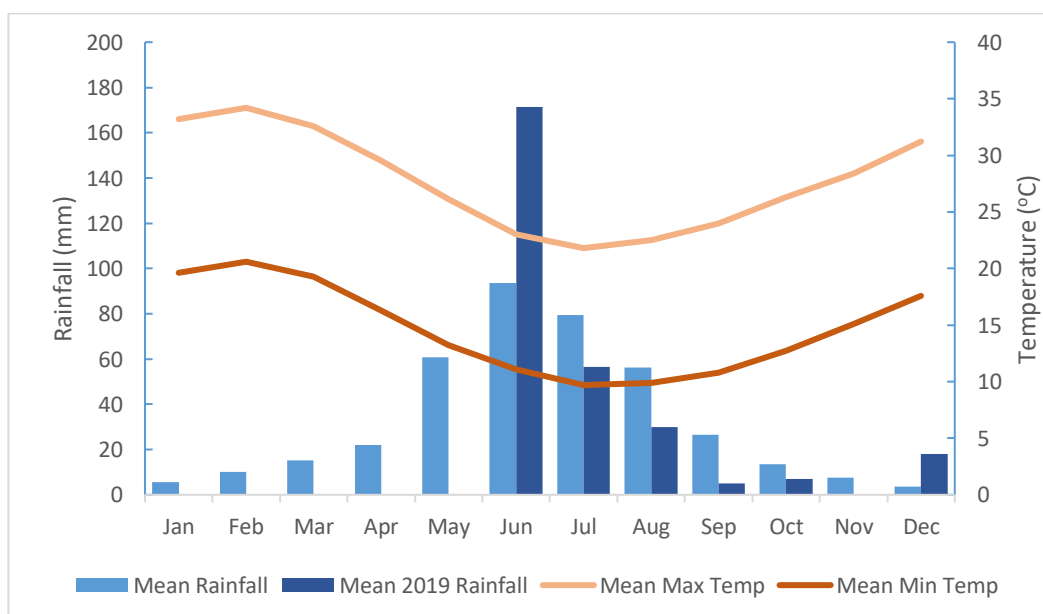


Plate 1 Mean rainfall for Lynton and temperatures for Kalbarri

3.3 Hydrology

3.3.1 Groundwater

The Department of Water and Environmental Regulation (DWER) Perth Groundwater Map indicates the survey area is located in within the Gascoyne Groundwater Area.

3.3.1 Surface water

There are no watercourses or wetlands located within the survey area. The closest watercourse is the Hutt River, which is located approximately 4 km south of the survey area and flows west into the ocean.

The Hutt Lagoon, which is located directly west of the survey area, is listed as a wetland of national importance on the Directory of Important Wetlands in Australia (DIWA) (DEC 2009). Hutt Lagoon is a macroscale elongate sumpland aligned northwest to southeast, parallel to the coast. It neighbours macroscale elongate floodplains (to the northwest and southeast) that include more than twenty microscale elongate sumplands such as Utcha Swamp (Jaensch 1992). Water supply for the Hutt Lagoon derives from direct precipitation, surface inform from several minor creeks and seepage of groundwater (DEC 2009).

3.4 Geology, landforms and soils

The survey area is located within the Tumblagooda Sandstone, which is characterised by sandstone, with minor siltstone and granulate to pebble conglomerate. The majority of the survey area is located on the Tamala North Land System, described as low hills with relict dunes and some limestone outcrop, which forms a coastal band 3 to 7 km wide. Parts of the western boundary of the survey area are located within the Grey Land System, described as river beds, terraces and alluvial flats, includes dissected margins of relic alluvial plains (Rogers et al. 1996).

3.5 Land use

3.5.1 Conservation reserves and estates

There are no conservation reserves or estates located within or immediately adjacent to the survey area. The closest conservation reserve, the Utcha Well Nature Reserve (R 640), is located approximately 3 km north of the survey area (Figure 2, Appendix A).

3.5.2 Environmentally sensitive areas

One Environmentally Sensitive Areas (ESAs) is located approximately 200 m west of the survey area. This ESA is associated with the Hutt Lagoon and does not intersect the survey area (Figure 2, Appendix A).

No PECs or TECs are located within the survey area. The nearest PEC, Kalbarri ironstone community (P1) is located approximately 8 km east of the survey area.

3.6 Vegetation and flora

3.6.1 Broad vegetation mapping and extents

Broad scale (1:250,000) pre-European vegetation mapping of the survey area has been completed by Beard (1975) at an association level. The mapping indicates that the survey area intersects two broad vegetation associations (BVA):

- Shrublands; *Acacia rostellifera* thicket: wattle, casuarina and teatree acacia-allocauarina melaleuca alliance (association 17)
- Low forest; *Acacia rostellifera*: Acacia, Rottnest pine, coastal moort or mixed tropical forest, *Acacia rostellifera*, *Callitris preissii*, *Eucalyptus lehmannii*, *E. cornuta* (association 371).

The extents of these associations within the survey area are shown in Table 3.

The pre-European mapping has been adapted and digitised by Shepherd *et al.* (2002). The extent of the vegetation associations have been determined by the state-wide vegetation remaining extent calculations maintained by the DBCA (latest update March 2019 –Government of Australia (GoWA) 2020). As shown in Table 3 the current extent of vegetation association 17 is above 30 % of its pre-European extent at the State, IBRA bioregion, IBRA subregion and Local Government Authority (LGA) levels. Vegetation association 371 is below the 30% of the pre-European extents at all levels except for the LGA.

Table 3 Extents of vegetation associations mapped within the survey area (GoWA 2020)

Vegetation association	Scale	Pre-European extent (ha)	Current extent (ha)	Remaining (%)	Remaining within DBCA Managed lands (%)	Hectares (ha) within the survey area	% of current extent within the survey area
17	State: WA	76,633.84	67,605.49	88.22	13.06	52.70	0.07
	IBRA Bioregion: Geraldton Sandplains	54,078.08	45,159.85	83.51	13.44		0.11
	Sub-region: Geraldton Hills	49,605.04	42,016.28	84.70	13.26		0.12
	LGA: Shire of Northampton	49,549.89	41,939.33	84.64	13.29		0.12
371	State: WA	32,816.04	3,499.60	10.66	6.92	360.16	10.29
	IBRA Bioregion: Geraldton Sandplains	32,807.53	3,499.10	10.67	6.92		10.29
	Sub-region: Geraldton Hills	32,807.53	3,499.10	10.67	6.92		10.29
	LGA: Shire of Northampton	5,749.92	2,142.08	36.94	10.69		16.81

3.6.2 Conservation significant ecological communities

The PMST (DotEE 2019) did not identify any TECs listed under the EPBC Act within the study area. The DBCA TEC/PEC database identified two Priority 1 PECs within the study area, however none are known to occur within the survey area (Figure 2, Appendix A). The two PECs identified are (DBCA 2019a):

- Kalbarri Ironstone Community (Priority 1 PEC) – winter wet, mallee/Melaleuca over herbs. Dense shrubland when burnt. Surrounded by sandplain. Yerina springs and north Euardy Station. Z-bend loop, Junga Dam. The taxon *Eremophila microtheca* (previously declared rare flora) occurs in this community (located approximately 8 km east of the survey area)
- Shrubland of the Northampton Area, dominated by *Melaleuca* species over exposed Kockatea Shale (Priority 1 PEC) – Heath on breakaways located in Port Gregory, west of Northampton. Community includes priority taxa; *Ptilotus chortophytum* (P1), *Leucopogon* sp. Port Gregory, *Ozothamnus* sp. Northampton, *Gastrolobium propinquum* (P1), outlier of *Ptilotus helichrysoides*. Unusual geology (Kockatea Shale) outcropping at surface (closest record is approximately 5 km south-east of the survey area).

3.6.3 Flora diversity

The *NatureMap* database (DBCA 2019) identified 455 flora taxa, representing 85 families and 235 genera previously recorded within 10 km of the survey area. This total comprised 403 native flora taxa and 52 naturalised (introduced) flora taxa. Dominant families recorded included Myrtaceae (48 taxa), Asteraceae (36 taxa), Fabaceae (36 taxa) and Poaceae (30 taxa).

The *NatureMap* database search is provided in Appendix C.

3.6.4 Conservation significant flora

The EPBC Act PMST, *NatureMap* and DBCA Threatened and Priority Flora databases identified the presence/potential presence of 48 conservation significant flora taxa within 10 km of the survey area (Appendix C). The desktop searches recorded:

- 13 Threatened flora taxa listed under the EPBC Act and/or BC Act
- One taxa listed as Threatened under the EPBC Act and Priority 4 by DBCA
- Six Priority 1 taxa
- Seven Priority 2 taxa
- 14 Priority 3 taxa
- Seven Priority 4 taxa.

The locations of conservation significant flora registered on the DBCA databases are mapped on Figure 2, Appendix A. Previously recorded conservation significant flora in report *GMA Garnet Port Gregory Mine Mining Tenement M70/1380 Biological Survey* (see section 3.8) have also been represented in Figure 2, due to the proximity of these records to the survey area.

3.7 Fauna

3.7.1 Fauna diversity

The *NatureMap* database identified 176 terrestrial vertebrate fauna species previously recorded within 10 km of the survey area. This total comprised of four amphibians, 151 birds, 14 reptiles and seven mammals. Of the 176 fauna species previously recorded, 172 are native species and

four are naturalised (introduced) species (under the *Biosecurity and Agriculture Management Act 2007* (BAM Act)).

The *NatureMap* database search is provided in Appendix C.

3.7.2 Conservation significant fauna

The EPBC Act PMST and DBCA databases identified the potential presence of 33 conservation significant fauna within 10 km of the survey area (Appendix C). This total does not include species identified as exclusively marine (e.g. marine mammals and reptiles) as no marine habitat is present within the survey area.

The species listed include:

- 25 listed as Threatened under the EPBC Act and/or BC Act
- Five bird species listed as Migratory (terrestrial or wetland) only, under the EPBC Act and/or Schedule 5 (Migratory birds protected under an international agreement) of the BC Act
- One species listed as Schedule 7 (Specially Protected) under the BC Act
- Two listed as Priority 4 by the DBCA.

3.8 Previous survey results

GMA Garnet Port Gregory Mine Mining Tenement M70/1380 Biological Survey

The vegetation, flora and fauna assessment was undertaken by GHD between July and August 2019. The survey area was located within mining tenement M70/1380, approximately 1,465 ha in size. The key findings of the survey include:

- Eight vegetation types were delineated from the survey area. None of the vegetation types were considered representative of either a conservation significant ecological community or other significant vegetation community
- Six broad fauna habitat types were recorded from the survey area. Marginal foraging habitat was recorded that included 31.4 ha of Banksia woodland
- One hundred and sixty-five flora taxa (including subspecies and varieties) representing 61 families and 121 genera were recorded from the survey area. This total included 18 introduced flora
- One flora species (*Senna planitiicola*) considered to be an extension of its known range and has not been previously recorded within the Geraldton Sandplains IBRA however the species was recorded within a farming paddock and was considered to have been planted
- One EPBC Act / BC Act listed flora and three DBCA Priority listed flora species were identified within the survey area:
 - *Caladenia bryceana* subsp. *cracens* (Vulnerable – EPBC Act, Endangered – BC Act)
 - *Melaleuca huttensis* (Priority 3)
 - *Anthocercis intricata* (Priority 3)
 - *Diuris recurva* (Priority 4)
- A total of 42 fauna species, including one amphibian, 28 birds, nine mammals and four reptiles were recorded within the survey area of which eight were introduced
- No conservation significant fauna was identified during the survey.

GMA Garnet Mining Lease M70/926 Biological Survey

A biological survey was undertaken by GHD in August 2016 to identify environmental constraints within mining tenement M70/926, located approximately 7 km north of M70/1380. The key findings include:

- A total of four vegetation types were delineated from the study location including:
 - *Acacia rostellifera* Low Forest
 - *Acacia rostellifera* Tall Open Shrubland
 - *Acacia rostellifera* Low Shrubland on Shallow Soils
 - Cleared and Degraded.
- A total of 60 flora taxa from 28 families were recorded at the study location, of which 26 were introduced
- Twenty-one fauna taxa were recorded from the study location, including 17 birds and six mammals
- No conservation significant communities, flora or fauna were recorded.

GMA Garnet Port Gregory Mine Targeted Flora Survey

A targeted flora survey was undertaken by GHD in August 2014 for the Threatened flora species *Caladenia bryceana* subsp. *cracens* at M70/968. The key findings include:

- No Threatened Flora was recorded during the survey
- Habitat for the threatened orchid was considered extremely marginal
- Evidence of disturbances such as wild pigs, which further reduced the likelihood of the species occurrence
- Two State-listed Priority species were recorded including 23 individual plants of *Melaleuca huttensis* (Priority 1) and 54 individual plants of *Anthocercis intricata* (Priority 3).

GMA Garnet Port Gregory Mine Tenement M70/968 Vegetation, Flora and Fauna Assessment

The vegetation, flora and fauna assessments were undertaken by GHD in August 2013 to identify environmental constraints within mining tenement M70/968. The key findings include:

- Six vegetation types were recorded from the study location, none of which were considered conservation significant
- A total of 75 flora taxa from 39 families were recorded from the study location, No conservation significant communities or flora were present
- The study location was considered to be very marginal habitat for the Threatened *Caladenia bryceana* subsp. *cracens*
- There was evidence of current disturbances from feral fauna (rabbits and pigs)
- A total of five birds and two mammals were recorded from the study location, none were conservation significant.

4. Field results

4.1 Flora and vegetation

4.1.1 Vegetation types

Three vegetation types were identified in the survey area, not including previously cleared areas and regrowth/rehabilitated areas, which were mapped separately from the vegetation types (Table 4). Much of the survey area had undergone historical clearing (exploration) and rehabilitation of these areas. Newly cleared or disturbed areas (roads and tracks) were also prevalent, as well as completely cleared areas, where the mine development has progressed. Rehabilitated areas contained fragmented vegetation resembling VT01 (*Acacia rostellifera* open woodland), but with an understory dominated by introduced grasses.


A significant portion of the survey area consisted of *Acacia rostellifera* open woodland to woodland (VT01) (67.9% 280.43 ha). This vegetation type occurred in low-lying and middle to upper slopes. Both BVA 371 (Low forest, *Acacia rostellifera*) and BVA 17 (Shrublands, *Acacia rostellifera*) intersected VT01. The description of BVA 17 by Beard & Burns (1976) aligns closely with VT01 (*Acacia rostellifera* dense thicket at 6 m in height, principal species comprise *Alyogyne cuneiformis*, *Pimelea floribunda* and *Melaleuca cardiophylla*). *Melaleuca cardiophylla* shrubland to open shrubland (VT02) (6.8% 28.30 ha) occurred on the upper slopes, west facing of the survey area, to the north, on limestone. Beard & Burns (1976) describes *M. cardiophylla* as dominant, more or less as a sole species on the rockiest and steepest places in BVA 17, which strongly aligns with VT02. *Myoporum insulare* shrubland (VT03) (0.1% 0.45 ha) was isolated in occurrence, and consisted of chenopod shrubland with *Frankenia pauciflora* and *Threlkeldia diffusa*, due to saline influence. All 0.45 ha of VT03 was mapped within BVA 371.


The vegetation types VT01 and VT02 generally align with BVA 17, where VT01 contains mostly wooded areas (Low forest), and VT02 contains *Melaleuca* shrublands (thicket). VT03 does not align with BVA 371, which is likely, considering the small size of the vegetation type. However, VT03 does align with association 125 (Salt lake, lagoon, clay pan) (Beard 1975) that describes the Hutt Lagoon.


Floristic analysis


The similarity between the quadrats were examined using PRIMER with all species recorded in the quadrats analysed based on presence/absence. Quadrat Lyn12 (VT03) was removed from the analysis as it was very different from the other quadrats it impacted the MDS results, which did not allow for a useful analysis. A stress value of 0.16 was produced indicating a fair representation (Plate 2). The MDS scatter plot for VT01 and VT02 quadrats loosely grouped together, particularly for VT01. The vegetation types were mapped using a combination of statistical analysis, dominant species, landforms and field observations.

Table 4 Vegetation types identified within the survey area

Vegetation Types	Vegetation type description and landform	Representative quadrat/releve and Total area (ha)	Representative photograph
VT01 - <i>Acacia rostellifera</i> open woodland to woodland	<i>Acacia rostellifera</i> open woodland to woodland over <i>Rhagodia preissii</i> subsp. <i>obovata</i> , <i>Pimelea microcephala</i> subsp. <i>microcephala</i> , <i>Olearia</i> sp. Kennedy Range (G. Byrne 66) and <i>Stylobasium spathulatum</i> open shrubland over <i>Austrostipa elegantissima</i> and <i>*Ehrharta longiflora</i> open grassland to grassland. Other common species include <i>Alyogyne hakeifolia</i> , <i>Roepera fruticulosa</i> , <i>Commicarpus australis</i> and <i>Euphorbia boophthona</i> . Occurs over lower and middle slopes on brown to orange sands. Previously disturbed through historic clearing and heavily disturbed by grazing.	Lyn04, Lyn05, Lyn06, Lyn07, Lyn08, Lyn09, Lyn13 (releve), Lyn14 (releve), Lyn17, Lyn19, Lyn20, Lyn22 (releve), Lyn 23 (releve), Lyn25, Lyn26, Lyn27 280.43 ha	

Vegetation Types	Vegetation type description and landform	Representative quadrat/releve and Total area (ha)	Representative photograph
VT02 - <i>Melaleuca cardiophylla</i> shrubland to open shrubland	<p><i>Melaleuca cardiophylla</i> shrubland to open shrubland over <i>Alyogyne hakeifolia</i>, <i>Pimelea microcephala</i> subsp. <i>microcephala</i> and <i>Rhagodia preissii</i> subsp. <i>obovata</i> open shrubland over <i>Ptilotus divaricatus</i> scattered forbland. Other common species include <i>Roepera fruticulosa</i>, <i>Pimelea gilgiana</i> and <i>*Bromus diandrus</i>. Areas that contain deeper soils <i>Acacia rostellifera</i> was also recorded. Occurs on upper mid slopes on white-brown sand with limestone outcropping. Disturbances include high grazing impacts from feral pigs and other native species (kangaroo).</p>	<p>Lyn01, Lyn02, Lyn03, Lyn10, Lyn11, Lyn15 (releve), Lyn16 (releve), Lyn18</p> <p>28.30 ha</p>	

Vegetation Types	Vegetation type description and landform	Representative quadrat/releve and Total area (ha)	Representative photograph
VT03 – <i>Myoporum insulare</i> shrubland	<i>Myoporum insulare</i> shrubland over <i>Frankenia pauciflora</i> and <i>Threlkeldia diffusa</i> open chenopod shrubland over <i>Sporobolus virginicus</i> open grassland. Occurs on light brown clay on seasonally wet brackish drainage flats.	Lyn12 0.45 ha	

Vegetation Types	Vegetation type description and landform	Representative quadrat/releve and Total area (ha)	Representative photograph
Rehabilitation areas	Rehabilitation areas consisting of <i>Acacia rostellifera</i> , <i>Alyogyne hakeifolia</i> , <i>Pimelea microcephala</i> subsp. <i>microcephala</i> , <i>Stylobasium spathulatum</i> and <i>Olearia</i> sp. Kennedy Range (G. Byrne 66) on lower and middle slopes on brown to orange sands. The undertsorey is dominated by introduced grasses including <i>Avena barbata</i> and <i>Ehrharta calycina</i> .	Lyn21, Lyn24 (releve) 34.52 ha	

Vegetation Types	Vegetation type description and landform	Representative quadrat/releve and Total area (ha)	Representative photograph
Cleared areas (including mine areas, tracks, cleared areas containing no native species)	N/A	N/A 69.16 ha	

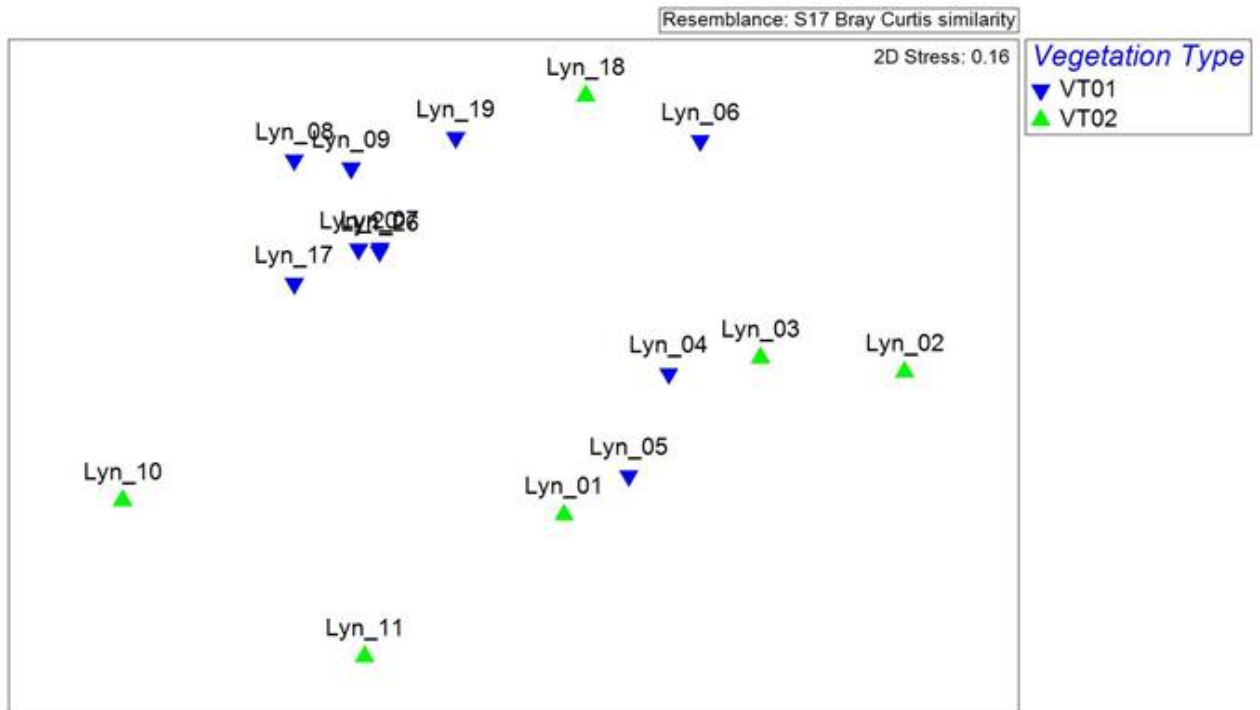


Plate 2 MDS showing broad clusters of quadrats for VT01 and VT02

4.1.2 Conservation significant ecological communities

Based on the results of the desktop searches, dominant species, landform features, field observations, and coupled with the statistical analyses no vegetation communities identified in the survey area were consistent with any TECs or PECs.

4.1.3 Other significant vegetation

No other vegetation considered significant as per EPA (2016a) was recorded from the survey area.

4.1.4 Vegetation condition

The condition of the vegetation within the survey area ranged from Good to Completely Degraded. The extents of the vegetation condition within the survey area are detailed in Table 5 and mapped in Figure 4, Appendix A.

Areas mapped as Good had vegetation that was largely intact with native species present across each structural layer, however, also had high weed cover and signs of high grazing impacts from pigs and kangaroos. Much of the survey area had undergone historical clearing (exploration) and rehabilitation of some of these areas. Newly cleared or disturbed areas (roads and tracks) were also prevalent, as well as completely cleared areas, where the mine development has progressed. Rehabilitated areas contained fragmented vegetation resembling VT01.

Table 5 Extent of vegetation condition ratings mapped in the survey area

Vegetation Condition	Extent in the survey area (ha) (%)
Cleared	69.83 (16.9)
Completely Degraded	34.34 (8.3)
Degraded	105.15 (25.4)
Good	203.54 (49.3)

4.1.5 Flora diversity

Sixty-four flora taxa (including subspecies and varieties) representing 26 families and 50 genera were recorded from the survey area during the field survey. This total comprised 49 native taxa and 15 introduced flora taxa.

Dominant families recorded from the survey area included:

- Poaceae (10 taxa)
- Chenopodiaceae (6 taxa)

Based on described quadrats, species diversity ranged from 9 to 21 (average 14) taxa per 100 m².

The full list of flora identified within the survey area compiled by quadrat and species inventory by family is provided in Appendix D.

4.1.6 Introduced flora

Fifteen introduced flora species were recorded from the survey area. No introduced flora species recorded are listed as Declared Pests under the BAM Act or WoNS. All introduced flora species recorded are considered environmental weeds and all have been previously recorded on the Geraldton Sandplains bioregion.

4.1.7 Conservation significant flora

No EPBC Act or BC Act listed flora were recorded within the survey area. No Priority flora, as listed by the DBCA, were recorded within the survey area.

Likelihood of occurrence assessment

A likelihood of occurrence assessment was conducted post-field survey for all conservation significant flora taxa identified in the desktop assessment (Appendix D). This assessment took into account previous records, habitat requirements, efficacy of the survey, intensity of the survey, flowering times and any uniquely defining characteristics or interactions of species. Due to the size of the survey area and some seasonal limitation some of the potentially occurring species may be present, but not observed during the survey.

The likelihood of occurrence assessment post-field survey concluded that three species are considered possible to occur, 40 species highly unlikely and five species unlikely to occur in the survey area. The species considered possible to occur are:

- The Threatened *Caladenia bryceana* subsp. *cracens* is considered possible to occur in VT02 *Melaleuca cardiophylla* shrubland to open shrubland
- *Anthocercis intricata* (P3)
- *Balladonia aervoides* (P3).

4.1.8 Other significant flora

No other significant flora, such as significant range extensions, were recorded from the survey area.

4.2 Fauna

4.2.1 Fauna habitat

Five broad habitat types (including rehabilitated and cleared areas) were recorded during the survey (Figure 5, Appendix A). The five habitat types described in Table 6 closely align with vegetation types described in section 4.1.1. The five broad habitat types include:


- Acacia woodlands
- Melaleuca shrublands on limestone
- Shrublands on seasonally wet brackish drainage flats
- Rehabilitation areas
- Cleared areas.



4.2.2 Habitat corridors and linkages


The survey area comprises remnant vegetation much of which has been previously disturbed, cleared land for mine exploration and activity, and cleared agricultural land. Much of the land outside of the survey area is cleared for paddocks, or developed for the GMA processing area and existing roads. There is little contiguous vegetation remaining in the survey area and wider study area.


Within the survey area, regrowth vegetation and rehabilitated patches surround largely cleared areas, or are adjacent drive tracks. There is significant evidence of foraging within the survey area by feral pigs, European rabbits and sheep. Evidence of feral cat, red fox and domestic dog were also recorded. The patchy vegetation and drive tracks and roads may increase the likelihood of use by feral species, due to the access between habitats for these fauna.

Table 6 Fauna habitat types identified within the survey area

Fauna habitat type	Extent within survey area	Representative photo
<p>Acacia woodlands</p> <p>This habitat type was recorded over the majority of the survey area and associated with lower and middle slopes on brown to orange sands. The vegetation type comprises <i>Acacia rostellifera</i> over chenopod shrubs (<i>Rhagodia preissii</i> subsp. <i>obovata</i>) and other mixed low shrubs, native and introduced grasses. The habitat contains a high level of wood and branches through previously cleared Acacia trees providing suitable habitat for reptiles and birds. There is evidence of high grazing impacts, including from feral pigs within this habitat type.</p> <p>Conservation significant fauna</p> <p>A nesting record of the Eastern Osprey (<i>Pandion cristatus</i>) was recorded within this habitat, with the species utilising the nearby coastline and saline system of the Hutt Lagoon for foraging. The habitat type is considered very rarely used by other conservation significant species, such as the Peregrine Falcon and Fork-tailed Swift.</p>	280.43 ha	

Fauna habitat type	Extent within survey area	Representative photo
<p>Melaleuca shrublands on limestone</p> <p>This habitat type was restricted to the shallow limestone upper mid slopes on white-brown sand with limestone outcropping on the eastern side of the survey area. This habitat type is dominated by <i>Melaleuca cardiophylla</i> on shallow limestone and in areas of deeper soils scattered <i>Acacia rostellifera</i> was present. The environment had areas of good ground cover, litter and debris. Some areas of outcropping with exfoliating rock and crevices was present and would provide excellent cover for a range of fauna species. There is evidence of high grazing impacts, including from feral pigs within this habitat type.</p> <p>Conservation significant fauna</p> <p>No conservation significant fauna were recorded within this habitat type. The habitat type is considered very rarely to be used by conservation significant species, such as the Peregrine Falcon and Fork-tailed Swift.</p>	28.30 ha	
<p>Shrubland on seasonally wet brackish drainage flats</p> <p>This habitat type occurred over a small area on the western boundary of the survey area. This habitat type was dominated by <i>Myoporum insulare</i>, <i>Frankenia pauciflora</i> and <i>Threlkeldia diffusa</i> shrubs with native marine couch grass. Occurs on light brown clay on seasonally wet brackish drainage flats. The dense vegetation provides ideal habitat for reptiles and birds.</p> <p>Conservation significant fauna</p> <p>No conservation significant fauna were recorded within this habitat type. The habitat type is considered to be marginal habitat for migratory bird species given the small size of the area and the major inundation occurring outside of the migratory bird species summer patterns. The habitat would also be very rarely to be used by conservation significant species, such as the Peregrine Falcon and Fork-tailed Swift.</p>	0.45 ha	

Fauna habitat type	Extent within survey area	Representative photo
<p>Rehabilitation areas</p> <p>Rehabilitation areas consisting of mixed trees and shrubs of <i>Acacia rostellifera</i>, <i>Alyogyne hakeifolia</i>, <i>Pimelea microcephala</i> subsp. <i>microcephala</i>, <i>Stylobasium spathulatum</i> and <i>Olearia</i> sp. Kennedy Range (G. Byrne 66) on lower and middle slopes on brown to orange sands. The undertsorey is dominated by introduced grasses including <i>Avena barbata</i> and <i>Ehrharta calycina</i>. The habitat contains moderate level of wood and branches with more open areas. There is evidence of high grazing impacts, including from feral pigs within this habitat type.</p> <p>Conservation significant fauna</p> <p>No conservation significant fauna were recorded within this habitat type. The habitat would also be very rarely to be used by conservation significant species, such as the Peregrine Falcon and Fork-tailed Swift.</p>	34.52 ha	

Fauna habitat type	Extent within survey area	Representative photo
<p>Cleared areas</p> <p>The cleared and degraded habitat type was associated with previously cleared areas, access tracks and firebreaks. Much of the cleared degraded areas comprised of introduced grasses .</p> <p>Conservation significant fauna</p> <p>No conservation significant fauna were recorded within this habitat type. The habitat would also be very rarely to be used by conservation significant species, such as the Peregrine Falcon and Fork-tailed Swift.</p>	69.83 ha	

4.2.3 Fauna diversity

During the field survey 31 fauna species were recorded within the survey area, including 21 bird, 8 mammal and 2 reptile species. Of these, 24 are native and seven are introduced/feral (BAM Act) including:

- *Canis lupis* (Domestic Dog)
- *Felis catus* (Feral Cat)
- *Capra hircus* (Feral Goat)
- *Ovis aries* (Sheep)
- *Oryctolagus cuniculus* (European Rabbit)
- *Sus scrofa* (Wild Boar)
- *Streptopelia senegalensis* (Laughing Turtle-dove).

A full list of fauna recorded during the survey is provided in Appendix E.

4.2.4 Conservation significant fauna

No Threatened fauna listed under the EPBC Act and/or BC Act or Priority fauna species listed by the DBCA was recorded during the survey.

The Eastern Osprey (*Pandion cristatus*), listed as Migratory and Marine under the EPBC Act was recorded during the survey. A pair was recorded feeding a chick in a nest on the south-western portion of the survey area. The location of the Osprey nest is shown on Figure 5 with the coordinates presented in Table 7. Ospreys are generally found on or near the coast but also range inland along large rivers, mainly in northern Australia.

Table 7 Conservation listed fauna Osprey location coordinates

Species	EPBC Act	BC Act/ DBCA	Coordinates	
			Eastings	Northings
Eastern Osprey (<i>Pandion cristatus</i>)	MI	IA	230871.59	6882759.92

Likelihood of occurrence assessment

A likelihood of occurrence assessment was conducted for all conservation significant fauna species identified in the desktop assessment. This assessment was based on species biology, habitat requirements, the likely quality and availability of suitable habitat (based on vegetation associations present within the survey area) and records of the species in the vicinity of the survey area. The assessment is provided in Appendix E.

Of the 35 conservation significant fauna identified in the desktop searches one species has been identified as present (Osprey), two are considered likely to occur and the remaining species are considered unlikely or highly unlikely to occur within the survey area. The fauna species identified as present and likely to occur within the survey area are listed in Table 8.

Table 8 Conservation significant fauna present or likely to occur within the survey area

Species	EPBC Act	BC Act/ DBCA	Likelihood of occurrence
Osprey (<i>Pandion cristatus</i>)	MI	IA	Known – The survey area is situated near the coastline. This species was observed nesting within the survey area.
Fork-tailed Swift (<i>Apus pacificus</i>)	MI	IA	Likely – There are a number of records along the coast at Port Gregory and near Hutt Lagoon. This is a widespread species of coastal and sub-coastal areas. Fork-tailed Swifts are almost exclusively aerial and is likely to only utilise the survey area opportunistically.
Peregrine Falcon (<i>Falco peregrinus</i>)		OS	Likely – There are records of this species occurring around the Port Gregory area. This species may occur as an infrequent visitor, foraging within the survey area, however lacks suitable breeding habitat. Therefore likely to occur at least on an occasional basis for foraging.

No species of conservation significance are likely to be solely dependent on the habitats present within the survey area.

5. Recommendations

5.1 Recommendations

The following recommendations are provided to manage and minimise impacts to native vegetation and fauna:

- Minimise native vegetation clearing as much as practical
- Undertake further targeted flora surveys, in particular for *Caladenia bryceana* subsp. *cracens* (Threatened) as it is considered possible to occur in VT02 *Melaleuca cardiophylla* shrubland to open shrubland
- Revegetation should be undertaken by using local “provenance” native seed and / or seedlings
- Implement weed management during project activities to avoid spread of weeds
- Machinery to be maintained and cleaned to reduce the spread of weeds throughout the survey areas
- Restrict movement of machines and other vehicles to the limits of the areas cleared
- If any native fauna is disturbed during clearing it should be allowed to make its own way to adjacent vegetated areas
- Avoid disturbing habitat surrounding Osprey nest site, in particular during the nesting season (autumn – spring, April to February, and later in the season in the southern portion of Australia) (DotEE 2020; Morcombe 2011). An approximate buffer of 100 m around the nest site would be suitable, due to the discreet nature of breeding Osprey. The nest site is currently providing security through vegetation cover.
- Any injured wildlife as a result of vegetation clearing should be taken to a designated veterinary clinic, a DBCA nominated wildlife carer or suitable euthanasia by an appropriately experienced person.

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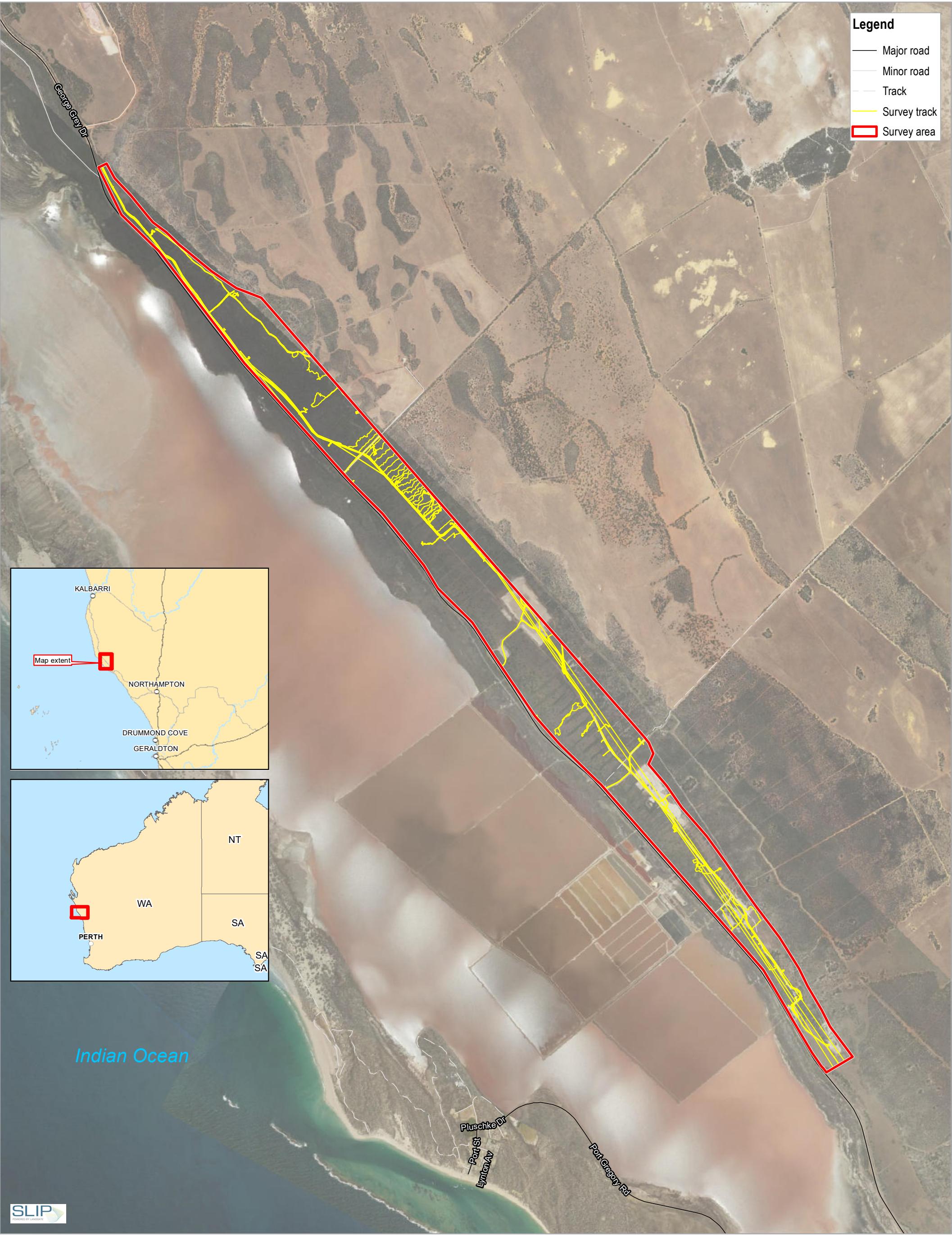
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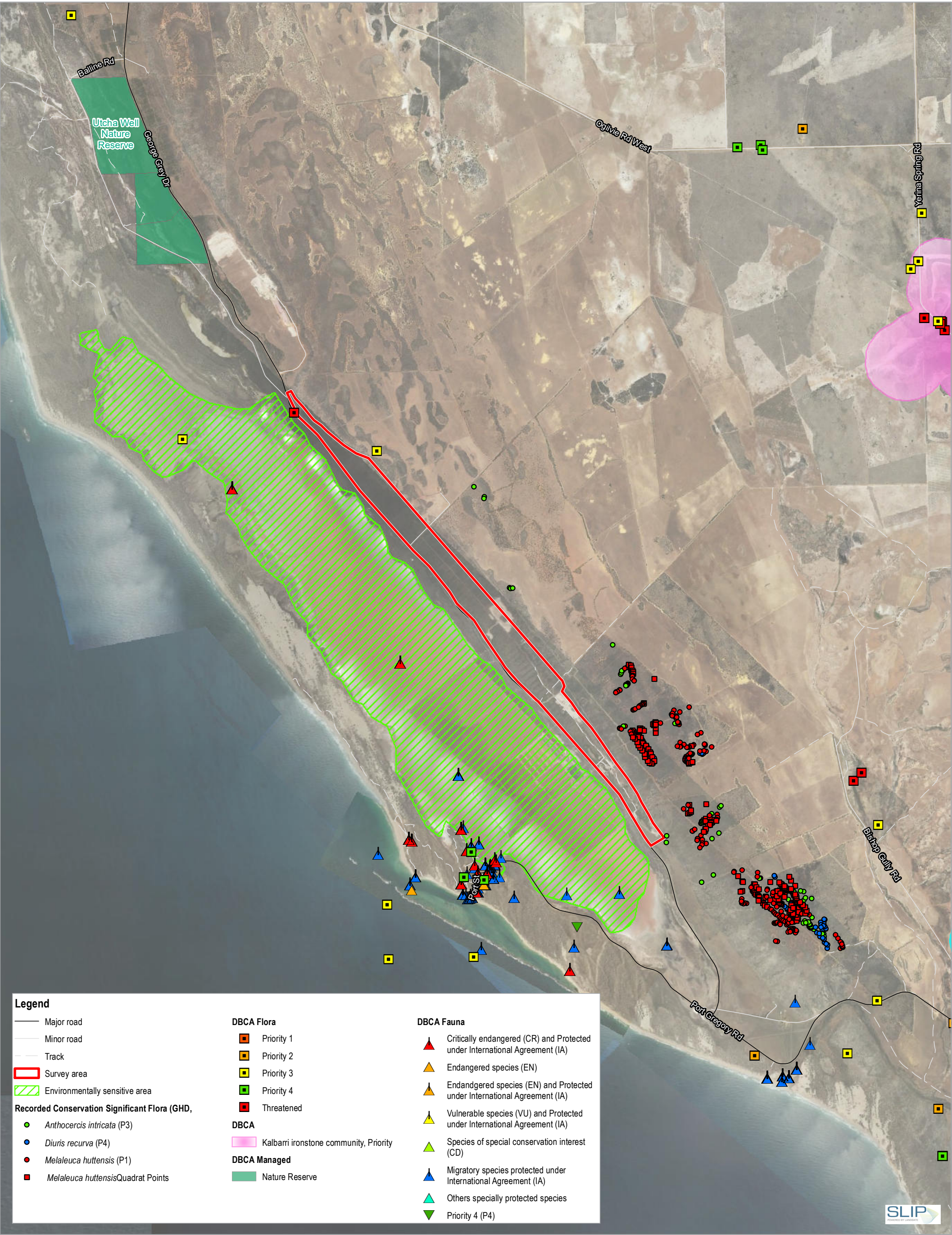
Western Australian (WA) Herbarium 2020, *FloraBase—the Western Australian Flora*, Department of Parks and Wildlife, from <http://florabase.dpaw.wa.gov.au/>.

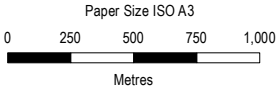
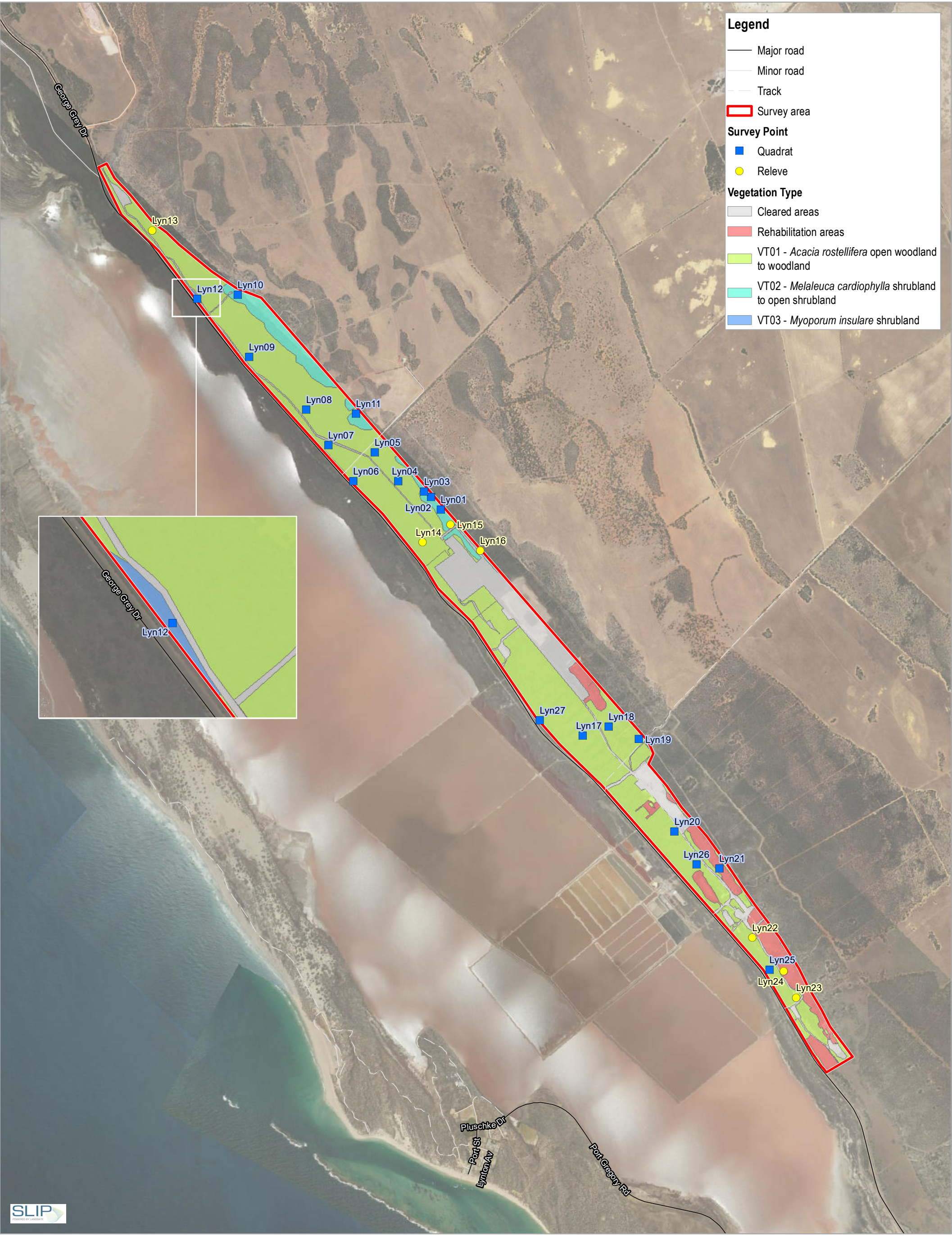
Appendices

Appendix A – Figures

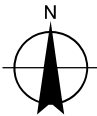
- Figure 1 Survey area**
- Figure 2 Environmental constraints**
- Figure 3 Vegetation types**
- Figure 4 Vegetation condition**
- Figure 5 Fauna habitats**







Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50



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Lynton Mine Expansion Biological Survey

Vegetation Types

Project No. 61-38125-05
Revision No. 0
Date 07 Feb 2020

FIGURE 3



Legend

Major road
Minor road
Track

Survey area

Vegetation Condition

Cleared
Good
Degraded
Completely Degraded

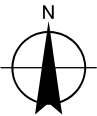


Paper Size ISO A3

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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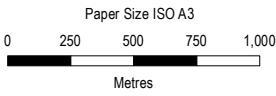


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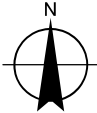
Vegetation Condition

Project No. 61-38125-05
Revision No. 0
Date 07 Feb 2020

FIGURE 4



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50



GMA Garnet Pty Ltd
Lynton Mine Expansion Biological Survey

Fauna Habitats

Project No. 61-38125-05
Revision No. 0
Date 07 Feb 2020

FIGURE 5

Appendix B – Relevant legislation, background information and conservation code

Relevant legislation

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of the Environment and Energy (DEE).

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Water and Environment Regulation (DWER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DWER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

- a) Native vegetation should not be cleared if it comprises a high level of biodiversity.
- b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.
- c) Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.
- d) Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.
- e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.
- f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.
- g) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.
- h) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

- i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.
- j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State Biodiversity and Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of biodiversity and biodiversity components, as well as the promotion of the ecologically sustainable use of biodiversity components in Western Australia. The BC Act replaces both the repealed *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act), as well as their associated regulations. To attain the objectives of the BC Act, principles of ecological sustainable development have been established:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
- The conservation of biodiversity and ecological integrity should be a fundamental consideration in decision-making
- Improved valuation, pricing and incentive mechanisms should be promoted.

The BC Act is administered by the Department of Biodiversity Conservation and Attractions (DBCA).

State Biosecurity and Agriculture Management Act 2007

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Primary Industries and Regional Development (DPIRD) and replace the repealed *Agriculture and Related Resources Protection Act 1976*. The main purposes of the BAM Act and its regulations are to:

- Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA
- Manage the impact and spread of those pests already present in the state
- Safely manage the use of agricultural and veterinary chemicals
- Increased control over the sale of agricultural products that contain violative chemical residues.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

DPIRD Categories for Declared Pests under the BAM Act

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Background information

Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the EP Act. The Table below outlines the aspects of areas declared as ESA in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005.

Aspects of ESAs

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the EPBC Act.
An area that is included on the Register of the National Estate (RNE), because of its natural values, under the <i>Australian Heritage Commission Act 1975</i> of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland. Defined wetlands include Ramsar wetlands, conservation category wetlands and nationally important wetlands.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a Threatened Ecological Community.
A Bush Forever Site listed in “Bush Forever” Volumes 1 and 2 (2000), published by the Western Australia Planning Commission, except to the extent to which the site is approved to be developed by the Western Australia Planning Commission.
The areas covered by the <i>Environmental Protection (Gnangara Mound Crown Land) Policy 1992</i> .
The areas covered by the <i>Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002</i> .
The areas covered by the lakes to which the <i>Environmental Protection (Swan Coastal Plain Lakes) Policy 1992</i> (EPP Lakes) applies.
Protected wetlands as defined in the <i>Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998</i> .

Reserves and conservation areas

Department of Biodiversity, Conservation and Attractions managed lands and waters

DBCA manages lands and waters throughout Western Australia to conserve ecosystems and species, and to provide for recreation and appreciation of the natural environment. DBCA managed lands and waters include national parks, conservation parks and reserves, marine parks and reserves, regional parks, nature reserves, State forest and timber reserves. DBCA managed conservation estate, is vested with the Conservation Commission of Western Australia. Access to, or through, some areas of DBCA managed lands may require a permit or could be restricted due to management activities. Proposed land use changes and development proposals that about DBCA managed lands will generally be referred to DBCA throughout the assessment process.

Wetlands

Wetlands include not only lakes with open water, but areas of seasonally, intermittently or permanently waterlogged soil.

Ramsar Listed Wetlands

The Convention of Wetlands of International Importance was signed in 1971 at the Iranian town of Ramsar. The Convention has since been referred to as the Ramsar Convention. Ramsar Listed wetlands are “sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity ... because of their ecological, botanical, zoological, limnological or hydrological importance” (DEE 2019b). Once a Ramsar Listed Wetland is designated, the country agrees to manage its conservation and ensure its wise use. Under the Convention, wise use is broadly defined as “maintaining the ecological character of a wetland” (DEE 2019b).

Nationally important wetlands

Wetlands of national significance are listed under the Directory of Important Wetlands in Australia. Nationally important wetlands are wetlands which meet at least one of the following criteria (DEE 2019a):

- It is a good example of a wetland type occurring within a biogeographic region in Australia
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
- The wetland supports one percent or more of the national populations of any native plant or animal taxa
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
- The wetland is of outstanding historical or cultural significance

Vegetation extent and status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia’s biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia’s Biological Diversity (ANZECC 2000).

The extent of remnant native vegetation in WA has been assessed by Shepherd et al. (2002) and the GoWA (2018), based on broadscale vegetation association mapping by Beard (various publications). The GoWA produces Statewide Vegetation Statistics Reports that are used for a number of purposes including conservation planning, land use planning and when assessing development applications. The reports are updated at least every two years.

Vegetation condition

The vegetation condition can be assessed in accordance with the vegetation condition rating scale for the South West and Interzone Botanical Provinces (EPA 2016a). The scale recognises the intactness of vegetation and consists of six rating levels as outlined below.

Vegetation condition rating scale for the South West and Interzone Botanical Provinces

Condition	South West and Interzone Botanical Provinces description
Pristine	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State BC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

Ecological communities

Conservation significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth 1997). Federally listed Threatened Ecological Communities (TECs) are protected under the EPBC Act. The BC Act provides for the Minister to list an ecological community as a TEC (section 27), or as a collapsed ecological community (section 31) statutory listing of State TECs by the Minister. The legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs.

Possible TECs that do not meet survey criteria are added to the DBCA Priority Ecological Community (PEC) List under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5. PECs are not listed under any formal Federal or State legislation, however, may be listed as TECs under the EPBC Act.

Conservation codes and definitions for TECs listed under the EPBC Act and/ or BC Act

Categories	Definition
Federal Government Conservation Categories (EPBC Act)	
Critically Endangered (CR)	An ecological community if, at that time, is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Endangered (EN)	An ecological community if, at that time: A) is not critically endangered; and B) is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Vulnerable (VU)	An ecological community if, at that time: A) is not critically endangered or endangered; and B) is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria (as outlined in Environment Protection and Biodiversity Conservation Regulations 2000)
Western Australia Conservation Categories (BC Act)	
<u>Threatened Ecological Communities</u>	

Categories	Definition
Critically Endangered (CR)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.
<u>Collapsed ecological communities</u>	
<p>An ecological community is eligible for listing as a collapsed ecological community at a particular time if, at that time –</p> <p>(a) there is no reasonable doubt that the last occurrence of the ecological community has collapsed); or</p> <p>(b) the ecological community has been so extensively modified throughout its range that no occurrence of it is likely to recover –</p> <p style="padding-left: 40px;">(i) its species composition or structure; or</p> <p style="padding-left: 40px;">(ii) its species composition and structure.</p> <p>Section 33 of the BC Act provides for a collapsed ecological community to be regarded as a threatened ecological community if it is discovered in a state that no longer makes it eligible for listing as a collapsed ecological community.</p>	

Conservation categories and definitions for PECS as listed by the DBCA

Category	Description
Priority 1	<p>Poorly known ecological communities.</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>
Priority 2	<p>Poorly known ecological communities.</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>

Category	Description
Priority 3	<p>Poorly known ecological communities.</p> <p>(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:</p> <p>(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;</p> <p>(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.</p> <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
Priority 4	<p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <p>(i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.</p> <p>(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.</p>
Priority 5	<p>Conservation Dependent ecological communities.</p> <p>Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>

Other significant vegetation

Vegetation may be significant for a range of reasons other than a statutory listing. The EPA (2016b) states that significant vegetation may include vegetation that includes the following:

- Restricted distribution
- Degree of historical impact from threatening processes
- Local endemism in restricted habitats
- Novel combinations of taxa
- A role as a refuge
- A role as a key habitat for Threatened species or large population representing a significant proportion of the local to regional total population of a species
- Being representative of a vegetation unit in 'pristine' condition in a highly cleared landscape, recently discovered range extensions, or isolated outliers of the main range)
- Being poorly reserved.

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

Flora and fauna

Conservation significant flora and fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the BC Act can warrant referral to the DEE and/or the EPA.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act. The significance levels for flora and fauna used in the EPBC Act align with the International Union for Conservation of Nature (IUCN) Red List criteria, which are internationally recognised as providing best practice for assigning the conservation status of species. The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of flora and fauna species and their significance status also follows the IUCN Red List criteria. Under the BC Act flora and fauna can be listed as Threatened, Extinct and as Specially Protected species.

Threatened species are those species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of Threatened species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria. Specially protected species meet one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as Threatened or Extinct species under the BC Act cannot also be listed as Specially Protected species.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

For the purposes of this assessment, all species listed under the EPBC Act, BC Act and DBCA Priority species are considered conservation significant.

Conservation categories and definitions for EPBC Act and BC Act listed flora and fauna species

Conservation category	Definition
Threatened species	
Critically Endangered (CR)	<p>Threatened species considered to be “facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines”.</p> <p>Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.</p>
Endangered (EN)	<p>Threatened species considered to be “facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines”.</p> <p>Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines.</p>
Vulnerable (VU)	<p>Threatened species considered to be “facing a high risk of extinction in the wild in the medium term future, as determined in accordance with criteria set out in the ministerial guidelines”.</p> <p>Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.</p>
Extinct species	
Extinct (EX)	Species where “there is no reasonable doubt that the last member of the species has died”, and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
Extinct in the Wild (EW)	Species that “is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form”, and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).
Specially protected species	
Migratory (MI)	<p>Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).</p> <p>Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.</p>

Conservation category	Definition
Species of special conservation interest (conservation dependent fauna) (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Conservation codes for DBCA listed Priority flora and fauna

Priority category	Definition
Priority 1	<p>Poorly-known taxa</p> <p>Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.</p>
Priority 2	<p>Poorly-known taxa</p> <p>Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.</p>
Priority 3	<p>Poorly-known taxa</p> <p>Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.</p>
Priority 4	<p>Rare, Near Threatened and other taxa in need of monitoring</p> <p>A. Rare: Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.</p> <p>B. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>C. Taxa that have been removed from the list of threatened taxa during the past five years for reasons other than taxonomy.</p>

Other significant flora

Flora species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than a statutory listing. The EPA (2016b) states that significant flora may include taxa that have:

- A keystone role in a particular habitat for threatened or Priority flora or fauna species, or large populations representing a considerable proportion of the local or regional total population of a species
- Relictual status, being representation of taxonomic or physiognomic groups that no longer occur widely in the broader landscape
- Anomalous features that indicate a potential new discovery
- Being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range)
- The presence of restricted subspecies, varieties, or naturally occurring hybrids
- Local endemism (a restricted distribution) or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems)
- Being poorly reserved

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

Introduced plants (weeds)

Declared Pests

Information on species considered to be Declared Pests is provided under *State Biosecurity and Agriculture Management Act 2007*.

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values

Australian state and territory governments have identified thirty-two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

References

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- Shepherd, DP, Beeston, GR & Hopkins, AJM 2002, *Native Vegetation in Western Australia – Extent, Type and Status*, Resource Management Technical Report 249, Perth, Department of Agriculture.

Appendix C – Desktop searches

EPBC Act PMST (10 km)

Naturemap Flora report (10 km)

Naturemap Fauna report (10 km)



EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 20/01/20 13:03:54

[Summary](#)

[Details](#)

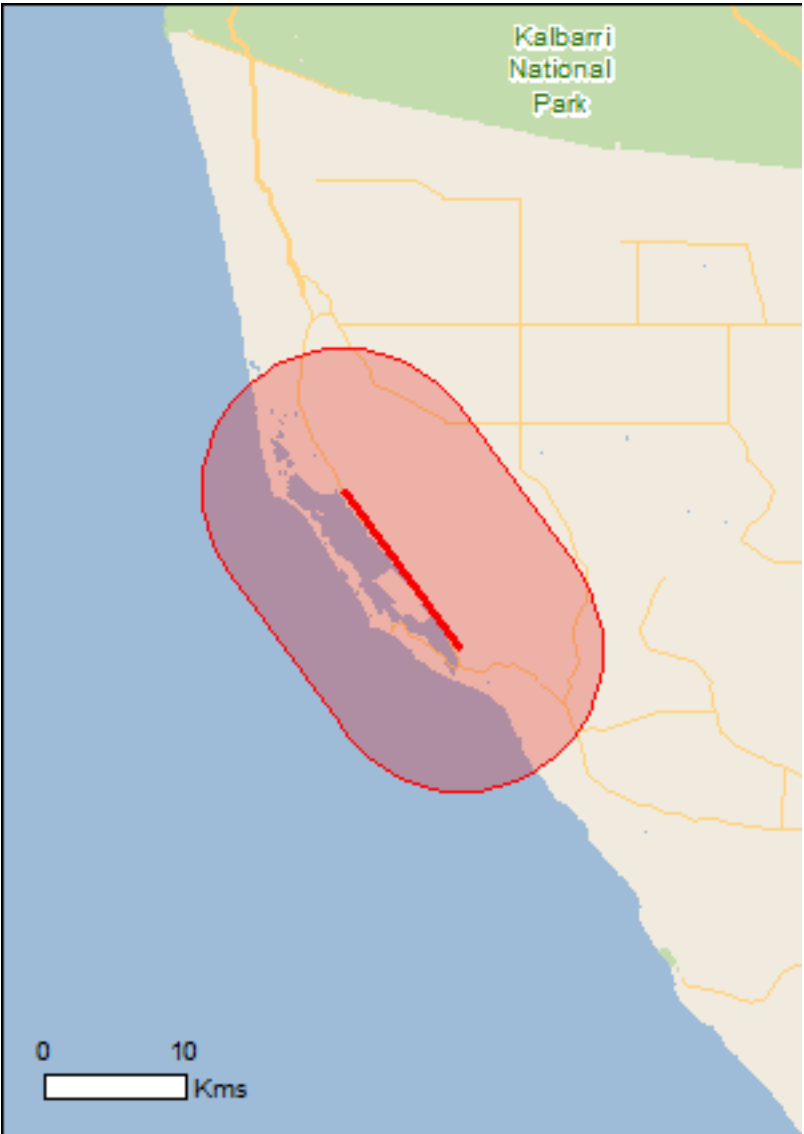
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

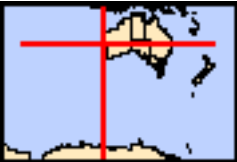
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

[Buffer: 10.0Km](#)



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	48
Listed Migratory Species:	46

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	76
Whales and Other Cetaceans:	11
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	15
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	2

Details

Matters of National Environmental Significance

Commonwealth Marine Area

[Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name

EEZ and Territorial Sea

Marine Regions

[Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name

[South-west](#)

Listed Threatened Species

[Resource Information]

Name	Status	Type of Presence
Birds		

Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat likely to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta cauta Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Species or species habitat may occur within

Name	Status	Type of Presence area
Other		
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat may occur within area
Plants		
Androcalva bivillosa Straggling Androcalva [87807]	Critically Endangered	Species or species habitat likely to occur within area
Caladenia barbarella Small Dragon Orchid, Common Dragon Orchid [68686]	Endangered	Species or species habitat may occur within area
Caladenia bryceana subsp. cracens Northern Dwarf Spider-orchid [64556]	Vulnerable	Species or species habitat may occur within area
Caladenia elegans Elegant Spider-orchid [56775]	Endangered	Species or species habitat known to occur within area
Caladenia hoffmanii Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat known to occur within area
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat known to occur within area
Drakaea concolor Kneeling Hammer-orchid [56777]	Vulnerable	Species or species habitat known to occur within area
Drummondita ericoides Morseby Range Drummondita [9193]	Endangered	Species or species habitat may occur within area
Eucalyptus cuprea Mallee Box [56773]	Endangered	Species or species habitat likely to occur within area
Hypocalymma angustifolium subsp. Hutt River (S.Patrick 2982) [85023]	Endangered	Species or species habitat known to occur within area
Pterostylis sinuata Northampton Midget Greenhood, Western Swan Grrenhood [84991]	Endangered	Species or species habitat known to occur within area
Stachystemon nematophorus Three-flowered Stachystemon [81447]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species		
[Resource Information]		
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Hydroprogne caspia Caspian Tern [808]		Foraging, feeding or related behaviour known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species

Name	Threatened	Type of Presence
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris alba Sanderling [875]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur

Name	Threatened	Type of Presence
Chrysococcyx osculans Black-eared Cuckoo [705]		within area Species or species habitat likely to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Species or species habitat known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Species or species habitat known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within

Name	Threatened	Type of Presence
Caretta caretta Loggerhead Turtle [1763]	Endangered	area Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves		[Resource Information]
Name		State
Port Gregory		WA
Utcha Well		WA

Invasive Species

[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Nationally Important Wetlands		[Resource Information]
Name		State
Hutt Lagoon System		WA

Key Ecological Features (Marine)	[Resource Information]
Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.	

Name	Region
Commonwealth marine environment within and	South-west
Western rock lobster	South-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-28.109489 114.219784,-28.199066 114.294036,-28.199947 114.294436,-28.199947 114.294436

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Office of Environment and Heritage, New South Wales](#)
- [Department of Environment and Primary Industries, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment, Water and Natural Resources, South Australia](#)
- [Department of Land and Resource Management, Northern Territory](#)
- [Department of Environmental and Heritage Protection, Queensland](#)
- [Department of Parks and Wildlife, Western Australia](#)
- [Environment and Planning Directorate, ACT](#)
- [Birdlife Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [South Australian Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.

NatureMap Species Report

Created By Guest user on 04/12/2019

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 114° 15' 04" E, 28° 07' 59" S
Buffer 10km
Group By Kingdom

Kingdom	Species	Records
Animalia	353	3102
Chromista	10	13
Fungi	18	33
Plantae	304	516
TOTAL	685	3664

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Animalia				
1.	<i>Abudefduf sexfasciatus</i>			
2.	24559 <i>Acanthagenys rufogularis</i> (Spiny-cheeked Honeyeater)			
3.	<i>Acanthistius pardalotus</i>			
4.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
5.	<i>Acariformes</i> sp.			
6.	25536 <i>Accipiter fasciatus</i> (Brown Goshawk)			
7.	<i>Acritoptila globosa</i>			
8.	41323 <i>Actitis hypoleucos</i> (Common Sandpiper)		IA	
9.	<i>Adversaeschna brevistyla</i>			
10.	<i>Aeshnidae</i> sp.			
11.	<i>Agraptocorixa eurynome</i>			
12.	<i>Agraptocorixa</i> sp.			
13.	<i>Alboa worooa</i>			
14.	<i>Allotrochosina karri</i>			
15.	<i>Alona rigidicaudis</i>			
16.	<i>Alotanypus dalyupensis</i>			
17.	24312 <i>Anas gracilis</i> (Grey Teal)			
18.	24315 <i>Anas rhynchotis</i> (Australasian Shoveler)			
19.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
20.	<i>Anax papuensis</i>			
21.	47414 <i>Anhinga novaehollandiae</i> (Australasian Darter)			
22.	<i>Anisops elstoni</i>			
23.	<i>Anisops nasutus</i>			
24.	<i>Anisops thienemanni</i>			
25.	<i>Anopheles annulipes</i> s.l.			
26.	25634 <i>Anous stolidus</i> (Common Noddy)		IA	
27.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			
28.	<i>Apocyclops dengizicus</i>			
29.	<i>Apogon doederleini</i>			
30.	<i>Apogon victoriae</i>			
31.	25554 <i>Apus pacificus</i> (Fork-tailed Swift, Pacific Swift)		IA	
32.	24285 <i>Aquila audax</i> (Wedge-tailed Eagle)			
33.	<i>Arcella</i> sp. a (SAP)			
34.	<i>Arcella</i> sp. c (SAP)			
35.	<i>Archaeosynthemis occidentalis</i>			
36.	25558 <i>Ardea ibis</i> (Cattle Egret)			
37.	41324 <i>Ardea modesta</i> (great egret, white egret)			
38.	24610 <i>Ardeotis australis</i> (Australian Bustard)			
39.	25736 <i>Arenaria interpres</i> (Ruddy Turnstone)		IA	
40.	<i>Armatalona macrocopa</i>			
41.	<i>Arrenurus (Truncaturus)</i> sp. 25 (TST)			
42.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
43.	24355 <i>Artamus minor</i> (Little Woodswallow)			

	Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
44.	24356	<i>Artamus personatus</i> (Masked Woodswallow)			
45.		<i>Artemia</i> sp.			
46.		<i>Artoria cingulipes</i>			
47.		<i>Australocypris insularis</i>			
48.		<i>Australoeucyclops darwini</i> (ex <i>Paracyclops</i> sp 1 nr <i>timmsi</i>)			
49.		<i>Austrochilontia subtenuis</i>			
50.		<i>Austrolestes aleison</i>			
51.		<i>Austrolestes annulosus</i>			
52.	24318	<i>Aythya australis</i> (Hardhead)			
53.		<i>Barnardius zonarius</i>			
54.		<i>Bdelloidea</i> sp.			
55.		<i>Berosus approximans</i>			
56.		<i>Berosus discolor</i>			
57.		<i>Berosus</i> sp.			
58.		<i>Bezzia</i> sp. 2 (SAP)			
59.	24319	<i>Biziura lobata</i> (Musk Duck)			
60.		<i>Brachionus plicatilis</i> s.l.			
61.		<i>Brentidae</i> sp.			
62.	42307	<i>Cacomantis pallidus</i> (Pallid Cuckoo)			
63.	24269	<i>Calamanthus campestris</i> (Rufous Fieldwren)			
64.		<i>Calamoecia clitellata</i>			
65.	24779	<i>Calidris acuminata</i> (Sharp-tailed Sandpiper)		IA	
66.	24780	<i>Calidris alba</i> (Sanderling)		IA	
67.	25738	<i>Calidris canutus</i> (Red Knot, knot)		IA	
68.	24784	<i>Calidris ferruginea</i> (Curlew Sandpiper)		T	
69.	24786	<i>Calidris melanotos</i> (Pectoral Sandpiper)		IA	
70.	24788	<i>Calidris ruficollis</i> (Red-necked Stint)		IA	
71.	24789	<i>Calidris subminuta</i> (Long-toed Stint)		IA	
72.	24790	<i>Calidris tenuirostris</i> (Great Knot)		T	
73.	24734	<i>Calyptrorhynchus latirostris</i> (Carnaby's Cockatoo, White-tailed Short-billed Black Cockatoo)		T	
74.		<i>Candonocypris novaezelandiae</i>			
75.		<i>Ceinidae</i> sp.			
76.		<i>Centropyxis</i> cf <i>kahlui</i>			Y
77.		<i>Cephalodella gibba</i>			
78.		<i>Ceratopogonidae</i> sp.			
79.	25575	<i>Charadrius leschenaultii</i> (Greater Sand Plover)		T	
80.	25576	<i>Charadrius mongolus</i> (Lesser Sand Plover)		T	
81.	24377	<i>Charadrius ruficapillus</i> (Red-capped Plover)			
82.	24321	<i>Chenonetta jubata</i> (Australian Wood Duck, Wood Duck)			
83.	47909	<i>Cheramoeca leucosterna</i> (White-backed Swallow)			
84.		<i>Chironominae</i> sp.			
85.		<i>Chironomus</i> aff. <i>alternans</i> (V24) (CB)			
86.		<i>Choeroichthys suillus</i>			
87.		<i>Chroicocephalus novaehollandiae</i>			
88.	24288	<i>Circus approximans</i> (Swamp Harrier)			
89.		<i>Cladopelma curtivalva</i>			
90.	24774	<i>Cladorhynchus leucocephalus</i> (Banded Stilt)			
91.		<i>Cleidopus gloriamaris</i>			
92.		<i>Cletocamptus dietersi</i>			
93.		<i>Cloeon</i> sp.			
94.	25675	<i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
95.	24399	<i>Columba livia</i> (Domestic Pigeon)	Y		
96.		<i>Colurodontis paxmani</i>			
97.	25568	<i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
98.		<i>Corduliidae</i> sp.			
99.		<i>Corixidae</i> sp.			
100.	24416	<i>Corvus bennetti</i> (Little Crow)			
101.	25592	<i>Corvus coronoides</i> (Australian Raven)			
102.		<i>Corynoneura</i> sp.			
103.		<i>Corynoneura</i> sp. (V49) (SAP)			
104.		<i>Coxiella striatula</i>			
105.	24420	<i>Cracticus nigrogularis</i> (Pied Butcherbird)			
106.	25595	<i>Cracticus tibicen</i> (Australian Magpie)			
107.	25596	<i>Cracticus torquatus</i> (Grey Butcherbird)			
108.	25401	<i>Crinia pseudinsignifera</i> (Bleating Froglet)			
109.		<i>Cristiceps australis</i>			
110.	24881	<i>Ctenophorus maculatus</i> subsp. <i>maculatus</i> (Spotted Military Dragon)			
111.	24886	<i>Ctenophorus reticulatus</i> (Western Netted Dragon)			
112.		<i>Culicidae</i> sp.			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
113.	<i>Culicoides</i> sp.			
114.	24322 <i>Cygnus atratus</i> (Black Swan)			
115.	<i>Cypretta baylyi</i>			
116.	<i>Dasyhelea</i> sp.			
117.	<i>Diacypris spinosa</i>			
118.	25607 <i>Dicaeum hirundinaceum</i> (Mistletoebird)			
119.	<i>Dicrotendipes conjunctus</i>			
120.	<i>Diffugia</i> sp.			
121.	<i>Diplacodes bipunctata</i>			
122.	<i>Dipulus caecus</i>			
123.	24470 <i>Dromaius novaehollandiae</i> (Emu)			
124.	<i>Dytiscidae</i> sp.			
125.	<i>Egretta novaehollandiae</i>			
126.	<i>Elanus axillaris</i>			
127.	47937 <i>Elseymoris melanops</i> (Black-fronted Dotterel)			
128.	<i>Enchytraeidae</i> sp.			
129.	<i>Eolophus roseicapillus</i>			
130.	24651 <i>Eopsaltria australis</i> subsp. <i>griseogularis</i> (Western Yellow Robin)			
131.	<i>Ephydriidae</i> sp. 6 (SAP)			
132.	<i>Epinephelus coioides</i>			
133.	24567 <i>Epthianura albiglans</i> (White-fronted Chat)			
134.	24568 <i>Epthianura aurifrons</i> (Orange Chat)			
135.	24570 <i>Epthianura tricolor</i> (Crimson Chat)			
136.	24379 <i>Erythronyx cinctus</i> (Red-kneed Dotterel)			
137.	<i>Euchlanis deflexa</i>			Y
138.	<i>Eucyclops australiensis</i>			
139.	<i>Eviota bimaculata</i>			
140.	25621 <i>Falco berigora</i> (Brown Falcon)			
141.	25622 <i>Falco cenchroides</i> (Australian Kestrel, Nankeen Kestrel)			
142.	25623 <i>Falco longipennis</i> (Australian Hobby)			
143.	25624 <i>Falco peregrinus</i> (Peregrine Falcon)		S	
144.	<i>Forcypomyia</i> sp.			
145.	24761 <i>Fulica atra</i> subsp. <i>australis</i> (Eurasian Coot)			
146.	24959 <i>Gehyra variegata</i>			
147.	47954 <i>Gelochelidon nilotica</i> (Gull-billed Tern)		IA	
148.	24401 <i>Geopelia cuneata</i> (Diamond Dove)			
149.	25585 <i>Geopelia striata</i> (Zebra Dove)			
150.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
151.	<i>Gymnothorax woodwardi</i>			
152.	25627 <i>Haematopus fuliginosus</i> (Sooty Oystercatcher)			
153.	24487 <i>Haematopus longirostris</i> (Pied Oystercatcher)			
154.	24293 <i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)			
155.	24295 <i>Haliastur sphenurus</i> (Whistling Kite)			
156.	<i>Halichoeres brownfieldi</i>			
157.	<i>Halicyclops ambiguus</i>			Y
158.	<i>Halplus fuscatus</i>			
159.	<i>Helcogramma decurrens</i>			
160.	<i>Helochares tenuistriatus</i>			
161.	<i>Hemicordulia tau</i>			
162.	24961 <i>Heteronotia binoei</i> (Bynoe's Gecko)			
163.	47965 <i>Hieraaetus morphnoides</i> (Little Eagle)			
164.	25734 <i>Himantopus himantopus</i> (Black-winged Stilt)			
165.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
166.	<i>Hydrachna australica</i>			
167.	<i>Hydrachna</i> nr. <i>approximata</i> (SAP)			
168.	<i>Hydroglyphus leai</i>			
169.	<i>Hydrophilidae</i> sp.			
170.	48587 <i>Hydroprogne caspia</i> (Caspian Tern)		IA	
171.	<i>Hydropsychidae</i> sp.			
172.	<i>Hyphydrus elegans</i>			
173.	<i>Hyphydrus</i> sp.			
174.	<i>Ischnura aurora aurora</i>			
175.	<i>Ischnura heterosticta heterosticta</i>			
176.	<i>Istiblennius meleagris</i>			
177.	<i>Kennethia cristata</i>			
178.	<i>Keratella procurva</i>			
179.	<i>Kiefferulus intertinctus</i>			
180.	<i>Labracinus lineatus</i>			
181.	25638 <i>Larus pacificus</i> (Pacific Gull)			
182.	<i>Lecane bulla</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
183.	<i>Lecane luna</i>			
184.	<i>Lecane thalera</i>			
185.	<i>Lepadichthys sandaracatus</i>			
186.	<i>Lepidoptera</i> sp.			
187.	<i>Leptoceridae</i> sp.			
188.	25148 <i>Lerista lineopunctulata</i>			
189.	25165 <i>Lerista praepedita</i>			
190.	<i>Lestidae</i> sp.			
191.	<i>Lethrinus genivittatus</i>			
192.	<i>Lethrinus miniatus</i>			
193.	25005 <i>Lialis burtonis</i>			
194.	<i>Libellulidae</i> sp.			
195.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
196.	<i>Limnichidae</i> sp.			
197.	<i>Limnocythere mowbrayensis</i>			
198.	25415 <i>Limnodynastes dorsalis</i> (Western Banjo Frog)			
199.	<i>Limnophyes vestitus</i> (V41)			
200.	30932 <i>Limosa lapponica</i> (Bar-tailed Godwit)		IA	
201.	25388 <i>Litoria moorei</i> (Motorbike Frog)			
202.	<i>Lophoictinia isura</i>			
203.	<i>Lourinidae</i> sp.			Y
204.	24132 <i>Macropus fuliginosus</i> (Western Grey Kangaroo)			
205.	<i>Macrothrix breviseta</i>			
206.	24326 <i>Malacorhynchus membranaceus</i> (Pink-eared Duck)			
207.	25651 <i>Malurus lamberti</i> (Variegated Fairy-wren)			
208.	24544 <i>Malurus lamberti</i> subsp. <i>assimilis</i> (Variegated Fairy-wren)			
209.	25652 <i>Malurus leucopterus</i> (White-winged Fairy-wren)			
210.	24551 <i>Malurus pulcherrimus</i> (Blue-breasted Fairy-wren)			
211.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
212.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
213.	25758 <i>Megalurus gramineus</i> (Little Grassbird)			
214.	<i>Megaporus</i> sp.			
215.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)			
216.	<i>Mesochra baylyi</i>			
217.	<i>Mesocyclops brooksi</i>			
218.	<i>Mesocyclops</i> sp.			
219.	<i>Mesostigmata</i> sp.			
220.	<i>Microcarbo melanoleucos</i>			
221.	<i>Micronecta robusta</i>			
222.	<i>Microvelia</i> (<i>Austromicrovelia</i>) <i>peramoena</i>			
223.	<i>Microvelia</i> (<i>Pacificovelia</i>) <i>oceanica</i>			
224.	<i>Microvelia</i> sp.			
225.	25191 <i>Morethia lineocellata</i>			
226.	48008 <i>Morus serrator</i> (Australasian Gannet)			
227.	<i>Muraenichthys</i> sp.			
228.	24223 <i>Mus musculus</i> (House Mouse)	Y		
229.	25420 <i>Myobatrachus gouldii</i> (Turtle Frog)			
230.	<i>Mytilocypris mytiloides</i>			
231.	<i>Naididae</i> (ex <i>Tubificidae</i>)			
232.	<i>Nannophya occidentalis</i>			
233.	<i>Necterosoma penicillatus</i>			
234.	<i>Necterosoma</i> sp.			
235.	<i>Nematoda</i> sp.			
236.	<i>Nemertini</i> sp.			
237.	<i>Neohydrocoptus subfasciatus</i>			
238.	33984 <i>Neopasiphae simplicior</i> (a short-tongued bee)		T	
239.	<i>Nitocra</i> sp. 3 (SAP)			Y
240.	<i>Nitocra</i> sp. 5 (nr <i>reducta</i>) (SAP)			
241.	<i>Notolabrus parilus</i>			
242.	<i>Notonectidae</i> sp.			
243.	24799 <i>Numenius minutus</i> (Little Curlew, Little Whimbrel)		IA	
244.	25742 <i>Numenius phaeopus</i> (Whimbrel)		IA	
245.	24194 <i>Nyctophilus geoffroyi</i> (Lesser Long-eared Bat)			
246.	24742 <i>Nymphicus hollandicus</i> (Cockatiel)			
247.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			
248.	<i>Oecetis</i> sp.			
249.	<i>Oligochaeta</i> sp.			
250.	<i>Onychocamptus bengalensis</i>			
251.	<i>Onychohydus</i> sp.			
252.	<i>Oribatida</i> sp.			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
253.	<i>Orthetrum caledonicum</i>			
254.	<i>Orthocladinae</i> sp.			
255.	<i>Orthocladinae</i> sp. 1 (SAP)			
256.	<i>Oxyethira</i> sp.			
257.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
258.	48591 <i>Pandion cristatus</i> (Osprey, Eastern Osprey)		IA	
259.	<i>Paracyclops chiltoni</i>			
260.	<i>Paracyclops</i> sp.			
261.	<i>Paradoxostoma</i> sp.			Y
262.	<i>Parakiefferiella variegatus</i>			
263.	<i>Paralimnophyes pullulus</i> (V42)			
264.	<i>Paramerina levidensis</i>			
265.	<i>Parapercis haackei</i>			
266.	<i>Parma occidentalis</i>			
267.	24648 <i>Pelecanus conspicillatus</i> (Australian Pelican)			
268.	<i>Pempheris mangula</i>			
269.	<i>Pescecyclops</i> sp. 462			
270.	48060 <i>Petrochelidon ariel</i> (Fairy Martin)			
271.	48061 <i>Petrochelidon nigricans</i> (Tree Martin)			
272.	25697 <i>Phalacrocorax carbo</i> (Great Cormorant)			
273.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
274.	25699 <i>Phalacrocorax varius</i> (Pied Cormorant)			
275.	24801 <i>Phalaropus lobatus</i> (Red-necked Phalarope)		IA	
276.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
277.	24802 <i>Philomachus pugnax</i> (Ruff, reeve)		IA	
278.	<i>Platynectes</i> sp.			
279.	<i>Plectorhinchus flavomaculatus</i>			
280.	<i>Plotiopsis</i> sp.			
281.	<i>Plotosus lineatus</i>			
282.	24382 <i>Pluvialis fulva</i> (Pacific Golden Plover)		IA	
283.	24383 <i>Pluvialis squatarola</i> (Grey Plover)		IA	
284.	25703 <i>Podargus strigoides</i> (Tawny Frogmouth)			
285.	24681 <i>Poliiocephalus poliocephalus</i> (Hoary-headed Grebe)			
286.	<i>Polypedilum nr. convexum</i> (SAP)			
287.	<i>Polypedilum nubifer</i>			
288.	<i>Pomacentrus milleri</i>			
289.	24769 <i>Porzana fluminea</i> (Australian Spotted Crake)			
290.	24771 <i>Porzana tabuensis</i> (Spotless Crake)			
291.	<i>Priolepis nuchifasciata</i>			
292.	<i>Pristina sima</i>			
293.	<i>Procladius paludicola</i>			
294.	<i>Procladius villosimanus</i>			
295.	<i>Pseudochromis wilsoni</i>			
296.	42416 <i>Pseudonaja mengdeni</i> (Western Brown Snake)			
297.	<i>Pyrallidae nr. sp. 39/40 of JHH</i> (SAP)			
298.	24245 <i>Rattus rattus</i> (Black Rat)	Y		
299.	24776 <i>Recurvirostra novaehollandiae</i> (Red-necked Avocet)			
300.	48096 <i>Rhipidura albiscapa</i> (Grey Fantail)			
301.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
302.	<i>Robertsonia</i> sp.			Y
303.	<i>Sargocentron rubrum</i>			
304.	<i>Sarscyridopsis aculeata</i>			
305.	<i>Schuettea woodwardi</i>			
306.	<i>Scirtidae</i> sp.			
307.	<i>Scorpaena sumptuosa</i>			
308.	<i>Scorpaenodes steenei</i>			
309.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
310.	<i>Sillago robusta</i>			
311.	<i>Simocephalus elizabethae</i>			
312.	<i>Simocephalus</i> sp.			
313.	<i>Simuliidae</i> sp.			
314.	<i>Simulium ornatipes</i>			
315.	<i>Solegnathus lettiensis</i>			
316.	<i>Staphylinidae</i> sp.			
317.	<i>Stegastes obreptus</i>			
318.	48594 <i>Sternula nereis</i> (Fairy Tern)			
319.	<i>Stratiomyidae</i> sp.			
320.	25590 <i>Streptopelia senegalensis</i> (Laughing Turtle-Dove)	Y		
321.	24942 <i>Strophurus spinigerus</i> subsp. <i>spinigerus</i>			
322.	33992 <i>Synemon gratiosa</i> (Graceful Sunmoth)			

P4

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
323.	<i>Tabanidae</i> sp.			
324.	25705 <i>Tachybaptus novaehollandiae</i> (Australasian Grebe, Black-throated Grebe)			
325.	24682 <i>Tachybaptus novaehollandiae</i> subsp. <i>novaehollandiae</i> (Australasian Grebe, Black-throated Grebe)			
326.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck, Mountain Duck)			
327.	30870 <i>Taeniopygia guttata</i> (Zebra Finch)			
328.	<i>Tanypodinae</i> sp.			
329.	<i>Tanytarsus barbitarsis</i>			
330.	<i>Tanytarsus fuscithorax/semibarbitarsus</i>			
331.	<i>Tanytarsus palmatus</i>			
332.	<i>Tanytarsus</i> sp. D (SAP)			
333.	<i>Tanytarsus</i> sp. G (SAP)			
334.	24167 <i>Tarsipes rostratus</i> (Honey Possum, Noolbenger)			
335.	48597 <i>Thalasseus bergii</i> (Crested Tern)		IA	
336.	<i>Thalassoma septemfasciata</i>			
337.	<i>Thienemanniella</i> sp. (V19) (SAP)			
338.	<i>Tipulidae</i> sp.			
339.	<i>Tipulidae</i> type F (SAP)			
340.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
341.	48141 <i>Tribonyx ventralis</i> (Black-tailed Native-hen)			
342.	24803 <i>Tringa brevipes</i> (Grey-tailed Tattler)		P4	
343.	24806 <i>Tringa glareola</i> (Wood Sandpiper)		IA	
344.	24808 <i>Tringa nebularia</i> (Common Greenshank, greenshank)		IA	
345.	24809 <i>Tringa stagnatilis</i> (Marsh Sandpiper, little greenshank)		IA	
346.	<i>Triplectides australis</i>			
347.	<i>Turbellaria</i> sp.			
348.	<i>Veliidae</i> sp.			
349.	<i>Venatrix pullastra</i>			
350.	<i>Venonia micarioides</i>			
351.	<i>Xanthagrion erythroneurum</i>			
352.	41351 <i>Xenus cinereus</i> (Terek Sandpiper)		IA	
353.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye, Silvereye)			

Chromista

354.	35910 <i>Canistrocarpus crispatus</i>			
355.	26586 <i>Caulocystis uvifera</i>			
356.	26766 <i>Dictyopteris muelleri</i>			
357.	26778 <i>Dictyota furcellata</i>			
358.	26810 <i>Encyothalia cliftonii</i>			
359.	26949 <i>Hydroclathrus clathratus</i>			
360.	27043 <i>Lobophora variegata</i>			
361.	27246 <i>Sargassum lacerifolium</i>			
362.	35911 <i>Scytosiphon lomentaria</i>			
363.	27373 <i>Zonaria turneriana</i>			

Fungi

364.	27574 <i>Acarospora citrina</i>			
365.	31099 <i>Caloplaca kantvilasii</i>			
366.	48963 <i>Caloplaca lithophila</i>			
367.	48176 <i>Cladia beaugleholei</i>			
368.	48177 <i>Cladia muelleri</i>			
369.	28208 <i>Cladonia cervicornis</i> subsp. <i>verticillata</i>			
370.	27753 <i>Fulgensia bracteata</i>			
371.	27754 <i>Fulgensia subbracteata</i>			
372.	<i>Lecanora</i> sp.			
373.	27815 <i>Lecanora sphaerospora</i>			
374.	<i>Lecidea</i> sp.			
375.	30457 <i>Notocladonia cochleata</i>			
376.	27935 <i>Peltula euploca</i>			
377.	49073 <i>Peziza austrogeaster</i>			
378.	27999 <i>Psora crystallifera</i>			
379.	28000 <i>Psora decipiens</i>			
380.	28060 <i>Siphula coriacea</i>			
381.	28070 <i>Thysanothecium hookeri</i>			

Plantae

382.	16111 <i>Acacia alata</i> var. <i>biglandulosa</i>			
383.	3225 <i>Acacia ashbyae</i>			
384.	3376 <i>Acacia idiomorpha</i>			
385.	11611 <i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>			
386.	14612 <i>Acacia latipes</i> subsp. <i>licina</i>		P3	
387.	14134 <i>Acacia pelophila</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
			P1	
388.	15481 <i>Acacia pulchella</i> var. <i>glaberrima</i>			
389.	3521 <i>Acacia ridleyana</i>		P3	
390.	3525 <i>Acacia rostellifera</i> (Summer-scented Wattle)			
391.	3532 <i>Acacia scirpifolia</i>			
392.	3549 <i>Acacia spathulifolia</i>			
393.	15484 <i>Acacia sphacelata</i> subsp. <i>sphacelata</i>			
394.	1208 <i>Acanthocarpus preissii</i>			
395.	20797 <i>Acanthocarpus</i> sp. <i>Ajana</i> (C.A. Gardner 8596)			
396.	1775 <i>Adenanthos cygnorum</i> (Common Woollybush)			
397.	11837 <i>Adenanthos cygnorum</i> subsp. <i>cygnorum</i> (Common Woollybush)			
398.	17422 <i>Adriana tomentosa</i> var. <i>tomentosa</i>			
399.	36277 <i>Aloe vera</i> var. <i>officinalis</i>	Y		
400.	4905 <i>Alyogyne hakeifolia</i>			
401.	4906 <i>Alyogyne huegelii</i> (Lilac Hibiscus)			
402.	42940 <i>Alyogyne</i> sp. <i>Geraldton</i> (R. Davis 3487)			
403.	13267 <i>Amyema linophylla</i> subsp. <i>linophylla</i>			
404.	13266 <i>Amyema miraculosa</i> subsp. <i>miraculosa</i>			
405.	40914 <i>Androcalva gaudichaudii</i>			
406.	11434 <i>Anigozanthos humilis</i> subsp. <i>humilis</i>			
407.	1410 <i>Anigozanthos kalbarriensis</i> (Kalbarri Catspaw)			
408.	11565 <i>Anigozanthos manglesii</i> subsp. <i>quadrans</i>			
409.	11725 <i>Anthocercis ilicifolia</i> subsp. <i>ilicifolia</i>			
410.	6949 <i>Anthocercis littorea</i> (Yellow Tailflower)			
411.	3180 <i>Aphanopetalum clematideum</i>			
412.	26486 <i>Asparagopsis taxiformis</i>			
413.	20695 <i>Astroloma</i> sp. <i>Kalbarri</i> (D. & B. Bellairs 1368)		P2	
414.	16369 <i>Atriplex canescens</i>	Y		Y
415.	2452 <i>Atriplex cinerea</i> (Grey Saltbush)			
416.	2463 <i>Atriplex isatidea</i> (Coast Saltbush)			
417.	2470 <i>Atriplex paludosa</i> (Marsh Saltbush)			
418.	11525 <i>Atriplex paludosa</i> subsp. <i>baudinii</i>			
419.	17237 <i>Austrostipa elegantissima</i>			
420.	17240 <i>Austrostipa flavescens</i>			
421.	17244 <i>Austrostipa macalpinei</i>			
422.	17246 <i>Austrostipa nitida</i>			
423.	233 <i>Avena barbata</i> (Bearded Oat)	Y		
424.	48221 <i>Balladonia aevoides</i>		P3	
425.	32524 <i>Banksia fraseri</i> var. <i>ashbyi</i>			
426.	11386 <i>Banksia leptophylla</i> var. <i>melletica</i>			
427.	32079 <i>Banksia sessilis</i> var. <i>flabellifolia</i>			
428.	1852 <i>Banksia telmatiaea</i> (Swamp Fox Banksia)			
429.	743 <i>Baumea juncea</i> (Bare Twigrush)			
430.	747 <i>Baumea rubiginosa</i>			
431.	748 <i>Baumea vaginalis</i> (Sheath Twigrush)			
432.	31606 <i>Blackallia nudiflora</i> (Wedge-leaved Cryptandra)		P3	
433.	11381 <i>Boronia ramosa</i> subsp. <i>anethifolia</i>			
434.	3719 <i>Bossiaea spinescens</i>			
435.	8661 <i>Brachypodium distachyon</i> (False Brome)	Y		
436.	249 <i>Bromus diandrus</i> (Great Brome)	Y		
437.	6213 <i>Bupleurum semicompositum</i>	Y		
438.	29439 <i>Caesia</i> sp. <i>Wongan</i> (K.F. Kenneally 8820)			
439.	13618 <i>Caladenia elegans</i>		T	
440.	15348 <i>Caladenia flava</i> subsp. <i>flava</i>			
441.	15349 <i>Caladenia flava</i> subsp. <i>maculata</i>			
442.	17760 <i>Caladenia nobilis</i>			
443.	2860 <i>Calandrinia polyandra</i> (Parakeelya)			
444.	19304 <i>Calectasia browneana</i>		P2	
445.	5401 <i>Calothamnus blepharospemus</i>			
446.	35758 <i>Calothamnus quadrifidus</i> subsp. <i>homalophyllus</i> (Murchison Clawflower)			
447.	5450 <i>Calytrix depressa</i>			
448.	5460 <i>Calytrix fraseri</i> (Pink Summer Calytrix)			
449.	7911 <i>Carthamus lanatus</i> (Saffron Thistle)	Y		
450.	2948 <i>Cassytha aurea</i>			
451.	12073 <i>Cassytha aurea</i> var. <i>aurea</i>			
452.	2952 <i>Cassytha glabella</i> (Tangled Dodder Laurel)			
453.	2957 <i>Cassytha racemosa</i> (Dodder Laurel)			
454.	11799 <i>Cassytha racemosa</i> forma <i>racemosa</i>			
455.	48455 <i>Caulerpa geminata</i>			
456.	258 <i>Cenchrus ciliaris</i> (Buffel Grass)	Y		

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457.	1124	<i>Centrolepis cephaliformis</i>			
458.	17685	<i>Chaetanthus aristatus</i>			
459.	2494	<i>Chenopodium murale</i> (Nettle-leaf Goosefoot)	Y		
460.	29619	<i>Chondrophycus brandenii</i>			
461.	4853	<i>Clematicissus angustissima</i>			
462.	26683	<i>Codium spongiosum</i>			
463.	4550	<i>Comesperma calymega</i> (Blue-spike Milkwort)			
464.	4554	<i>Comesperma flavum</i>			
465.	4564	<i>Comesperma virgatum</i> (Milkwort)			
466.	40872	<i>Commersonia borealis</i>			
467.	2776	<i>Commicarpus australis</i> (Perennial Tar Vine)			
468.	15607	<i>Conospermum acerosum</i> subsp. <i>acerosum</i>			
469.	15608	<i>Conospermum acerosum</i> subsp. <i>hirsutum</i>			
470.	15513	<i>Conospermum boreale</i> subsp. <i>boreale</i>			
471.	15611	<i>Conospermum stoechadis</i> subsp. <i>stoechadis</i> (Common Smokebush)			
472.	12028	<i>Conostylis aculeata</i> subsp. <i>septentrionora</i>			
473.	1423	<i>Conostylis aurea</i> (Golden Conostylis)			
474.	1446	<i>Conostylis prolifera</i> (Mat Cottonheads)			
475.	1456	<i>Conostylis stylidioides</i>			
476.	6614	<i>Convolvulus remotus</i>			
477.	3137	<i>Crassula colorata</i> (Dense Stonecrop)			
478.	35839	<i>Cristonia stenophylla</i>			
479.	4802	<i>Cryptandra mutila</i>			
480.	6663	<i>Cuscuta epithymum</i> (Lesser Dodder, Greater Dodder)	Y		
481.	283	<i>Cynodon dactylon</i> (Couch)	Y		
482.	794	<i>Cyperus gymnocaulos</i> (Spiny Flat-sedge)			
483.	801	<i>Cyperus laevigatus</i>	Y		
484.	7421	<i>Dampiera altissima</i> (Tall Dampiera)			
485.	11723	<i>Dampiera incana</i> var. <i>incana</i>			
486.	7459	<i>Dampiera oligophylla</i> (Sparse-leaved Dampiera)			
487.	5522	<i>Darwinia pauciflora</i>			
488.	5534	<i>Darwinia virescens</i> (Murchison Darwinia)			
489.	18561	<i>Daviesia divaricata</i> subsp. <i>lanulosa</i>			
490.	1287	<i>Dichopogon capillipes</i>			
491.	1290	<i>Dichopogon tyleri</i>			
492.	15270	<i>Diplolaena geraldtonensis</i>			
493.	4456	<i>Diplolaena grandiflora</i> (Wild Rose)			
494.	4748	<i>Diplopeltis petiolaris</i>			
495.	7961	<i>Dittrichia graveolens</i> (Stinkwort)	Y		
496.	10796	<i>Diuris drummondii</i> (Tall Donkey Orchid)		T	
497.	12936	<i>Diuris recurva</i>		P4	
498.	13633	<i>Drakaea concolor</i>		T	
499.	3113	<i>Drosera neesii</i> (Jewel Rainbow)			
500.	3116	<i>Drosera omissa</i> (Bright Sundew)			
501.	346	<i>Ehrharta brevifolia</i> (Annual Veldt Grass)	Y		
502.	347	<i>Ehrharta calycina</i> (Perennial Veldt Grass)	Y		
503.	353	<i>Eleusine indica</i> (Crowsfoot Grass)	Y		
504.	378	<i>Eragrostis dielsii</i> (Mallee Lovegrass)			
505.	5538	<i>Eremaea brevifolia</i>			
506.	5539	<i>Eremaea ebracteata</i>			
507.	14102	<i>Eremaea ebracteata</i> var. <i>ebracteata</i>			
508.	17175	<i>Eremophila glabra</i> subsp. <i>albicans</i>			
509.	14193	<i>Eremophila glabra</i> subsp. <i>carcosa</i>			
510.	7241	<i>Eremophila microtheca</i> (Heath-like Eremophila)		P4	
511.	4333	<i>Erodium cicutarium</i> (Common Storksbill)	Y		
512.	12740	<i>Erymophyllum tenellum</i>			
513.	12895	<i>Eucalyptus arachnaea</i> subsp. <i>arachnaea</i>			
514.	5730	<i>Eucalyptus oraria</i> (Ooragmandee)			
515.	4620	<i>Euphorbia boophthona</i> (Gascoyne Spurge)			
516.	4644	<i>Euphorbia sharkoensis</i>			
517.	4648	<i>Euphorbia terracina</i> (Geraldton Carnation Weed)	Y		
518.	5193	<i>Frankenia confusa</i>		P4	
519.	5209	<i>Frankenia pauciflora</i> (Seaheath)			
520.	907	<i>Gahnia trifida</i> (Coast Saw-sedge)			
521.	12780	<i>Gilberta tenuifolia</i>			
522.	3938	<i>Glycine canescens</i> (Silky Glycine)			
523.	7983	<i>Gnaphalium indutum</i> (Tiny Cudweed)			
524.	3957	<i>Gompholobium tomentosum</i> (Hairy Yellow Pea)			
525.	7495	<i>Goodenia berardiana</i>			
526.	18116	<i>Grevillea commutata</i> subsp. <i>commutata</i>			

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527.	2032 <i>Grevillea leucopteris</i> (White Plume Grevillea)			
528.	8838 <i>Grevillea pinaster</i>			
529.	2113 <i>Grevillea triloba</i>		P3	
530.	5011 <i>Guichenotia ledifolia</i>			
531.	6696 <i>Halgania sericiflora</i>			
532.	47213 <i>Halimeda versatilis</i>			
533.	5120 <i>Hibbertia desmophylla</i>			
534.	5171 <i>Hibbertia spicata</i>			
535.	450 <i>Hordeum marinum</i>	Y		
536.	6234 <i>Hydrocotyle medicaginoides</i> (Trefoil Pennywort)			
537.	35071 <i>Hypocalymma angustifolium</i> subsp. Hutt River (S. Patrick 2982)		T	
538.	5821 <i>Hypocalymma longifolium</i>		T	
539.	8086 <i>Hypochaeris glabra</i> (Smooth Catsear)	Y		
540.	1070 <i>Hypolaena exsulca</i>			
541.	7396 <i>Isotoma hypocrateriformis</i> (Woodbridge Poison)			
542.	3992 <i>Isotropis cuneifolia</i> (Granny Bonnets)			
543.	14780 <i>Jacksonia arenicola</i>			
544.	14785 <i>Jacksonia rigida</i>			
545.	1175 <i>Juncus acutus</i> (Spiny Rush)	Y		
546.	1178 <i>Juncus bufonius</i> (Toad Rush)	Y		
547.	11922 <i>Juncus kraussii</i> subsp. <i>australiensis</i>			
548.	4044 <i>Kennedia prostrata</i> (Scarlet Runner)			
549.	5043 <i>Lasiopetalum oldfieldii</i>		P3	
550.	13289 <i>Lawrencella davenportii</i>			
551.	4955 <i>Lawrencia glomerata</i>			
552.	4959 <i>Lawrencia squamata</i>			
553.	4960 <i>Lawrencia viridigrisea</i>			
554.	7572 <i>Lechenaultia expansa</i>			
555.	7580 <i>Lechenaultia linarioides</i> (Yellow Leschenaultia)			
556.	946 <i>Lepidosperma striatum</i>			
557.	6487 <i>Limonium companyonis</i>	Y		
558.	41780 <i>Limonium hyblaenum</i>	Y		
559.	9289 <i>Lobelia anceps</i> (Angled Lobelia)			
560.	7403 <i>Lobelia heterophylla</i> (Wing-seeded Lobelia)			
561.	1227 <i>Lomandra hastilis</i>			
562.	1231 <i>Lomandra maritima</i>			
563.	4060 <i>Lotus australis</i> (Austral Trefoil)			
564.	18049 <i>Lyginia imberbis</i>			
565.	36375 <i>Lysimachia arvensis</i> (Pimpernel)	Y		
566.	2839 <i>Macarthuria australis</i>			
567.	19384 <i>Melaleuca bisulcata</i>			
568.	5887 <i>Melaleuca cardiophylla</i> (Tangling Melaleuca)			
569.	18112 <i>Melaleuca leuropoma</i>			
570.	5959 <i>Melaleuca raphiophylla</i> (Swamp Paperbark)			
571.	5987 <i>Melaleuca viminea</i> (Mohan)			
572.	13280 <i>Melaleuca viminea</i> subsp. <i>viminea</i>			
573.	4085 <i>Melilotus indicus</i>	Y		
574.	2813 <i>Mesembryanthemum crystallinum</i> (Iceplant)	Y		
575.	2814 <i>Mesembryanthemum nodiflorum</i> (Slender Iceplant)	Y		
576.	4100 <i>Mirbelia spinosa</i>			
577.	19177 <i>Moraea setifolia</i>	Y		
578.	7291 <i>Myoporum insulare</i> (Blueberry Tree, boobialla)			
579.	17158 <i>Myoporum montanum</i> (Native Myrtle)			
580.	138 <i>Najas marina</i> (Prickly Water Nymph)			
581.	2401 <i>Nuytsia floribunda</i> (Christmas Tree, Mudja)			
582.	6138 <i>Oenothera drummondii</i> (Beach Evening Primrose)	Y		
583.	18256 <i>Opercularia spermacoea</i>			
584.	516 <i>Parapholis incurva</i> (Coast Barbgrass)	Y		
585.	12670 <i>Parietaria cardiostegia</i>			
586.	1762 <i>Parietaria debilis</i> (Pellitory)			
587.	2290 <i>Petrophile conifera</i>			
588.	2301 <i>Petrophile macrostachya</i>			
589.	551 <i>Phalaris minor</i> (Lesser Canary Grass)	Y		
590.	4675 <i>Phyllanthus calycinus</i> (False Boronia)			
591.	6008 <i>Phymatocarpus porphyrocephalus</i>			
592.	20220 <i>Pileanthus rubronitidus</i>			
593.	18250 <i>Pileanthus vernicosus</i>			
594.	5246 <i>Pimelea gilgiana</i>			
595.	5256 <i>Pimelea microcephala</i> (Shrubby Riceflower, Banjine)			
596.	573 <i>Poa drummondiana</i> (Knotted Poa)			

	Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
597.	8184	<i>Podotheca gnaphalioides</i> (Golden Long-heads)			
598.	8188	<i>Pogonolepis stricta</i>			
599.	582	<i>Polypogon monspeliensis</i> (Annual Beardgrass)	Y		
600.	1671	<i>Prasophyllum elatum</i> (Tall Leek Orchid)			
601.	1672	<i>Prasophyllum fimbria</i> (Fringed Leek Orchid)			
602.	37460	<i>Pterostylis sinuata</i>		T	
603.	2717	<i>Ptilotus divaricatus</i> (Climbing Mulla Mulla)			
604.	2719	<i>Ptilotus eriotrichus</i>			
605.	2766	<i>Ptilotus villosiflorus</i>			
606.	592	<i>Puccinellia stricta</i> (Marsh Grass)			
607.	41041	<i>Quoya atriplicina</i>			
608.	11728	<i>Rhagodia latifolia</i> subsp. <i>latifolia</i>			
609.	2584	<i>Rhagodia preissii</i>			
610.	13241	<i>Rhodanthe chlorocephala</i> subsp. <i>rosea</i>			
611.	48887	<i>Roepera billardiarei</i>			
612.	48891	<i>Roepera fruticulosa</i>			
613.	40426	<i>Rytidosperma occidentale</i>			
614.	2906	<i>Sagina apetala</i> (Annual Pearlwort)	Y		
615.	48433	<i>Salicornia blackiana</i>			
616.	48430	<i>Salicornia quinqueflora</i>			
617.	6484	<i>Samolus repens</i> (Creeping Brookweed)			
618.	14107	<i>Samolus repens</i> var. <i>paucifolius</i>			
619.	2356	<i>Santalum acuminatum</i> (Quandong, Warnga)			
620.	7614	<i>Scaevola globulifera</i>			
621.	17026	<i>Scaevola kallophylla</i>		P4	
622.	7634	<i>Scaevola phlebopetala</i> (Velvet Fanflower)			
623.	12588	<i>Scaevola virgata</i>			
624.	972	<i>Schoenus armeria</i>			
625.	994	<i>Schoenus humilis</i>			
626.	1011	<i>Schoenus rigens</i>			
627.	1018	<i>Schoenus subfascicularis</i>			
628.	6034	<i>Scholtzia laxiflora</i>			
629.	49129	<i>Scholtzia pentamera</i> subsp. <i>pentamera</i>			
630.	15427	<i>Scholtzia spatulata</i>			
631.	6041	<i>Scholtzia umbellifera</i>			
632.	6544	<i>Sebaea ovata</i> (Yellow Sebaea)			
633.	8207	<i>Senecio glossanthus</i> (Slender Groundsel)			
634.	3069	<i>Sisymbrium erysimoides</i> (Smooth Mustard)	Y		
635.	6988	<i>Solanum americanum</i> (Glossy Nightshade)	Y		
636.	7022	<i>Solanum nigrum</i> (Black Berry Nightshade)	Y		
637.	7025	<i>Solanum oldfieldii</i>			
638.	7037	<i>Solanum symonii</i>			
639.	9367	<i>Sonchus hydrophilus</i> (Native Sowthistle)			
640.	8231	<i>Sonchus oleraceus</i> (Common Sowthistle)	Y		
641.	2915	<i>Spergularia rubra</i> (Sand Spurry)	Y		
642.	635	<i>Sporobolus virginicus</i> (Marine Couch)			
643.	19953	<i>Stachystemon nematophorus</i>		P4	
644.	43601	<i>Stackhousia</i> sp. <i>Mid west coastal</i> (D. & B. Bellairs 6561)			
645.	2316	<i>Stirlingia latifolia</i> (Blueboy)			
646.	27318	<i>Struvea plumosa</i>			
647.	7693	<i>Stylidium brunonianum</i> (Pink Fountain Triggerplant)			
648.	17412	<i>Stylidium kalbarriense</i>			
649.	25837	<i>Stylidium purpureum</i> (Purple Fountain Triggerplant)			
650.	19247	<i>Stylidium septentrionale</i>			
651.	3182	<i>Stylobasium spathulatum</i> (Pebble Bush)			
652.	2639	<i>Suaeda australis</i> (Seablite)			
653.	4220	<i>Swainsona canescens</i> (Grey Swainsona)			
654.	25902	<i>Symphyotrichum squamatum</i> (Bushy Starwort)	Y		
655.	33236	<i>Tecticornia halocnemoides</i> (Shrubby Samphire)			
656.	33319	<i>Tecticornia indica</i> subsp. <i>bidens</i>			
657.	31618	<i>Tecticornia pruinosa</i>			
658.	31716	<i>Tecticornia syncarpa</i>			
659.	31717	<i>Tecticornia undulata</i>			
660.	2820	<i>Tetragonia decumbens</i> (Sea Spinach)	Y		
661.	2823	<i>Tetragonia implexicoma</i> (Bower Spinach)			
662.	673	<i>Themeda triandra</i>			
663.	2644	<i>Threlkeldia diffusa</i> (Coast Bonefruit)			
664.	1339	<i>Thysanotus multiflorus</i> (Many-flowered Fringe Lily)			
665.	1356	<i>Thysanotus teretifolius</i>			
666.	1361	<i>Tricoryne elatior</i> (Yellow Autumn Lily)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
667.	4312 <i>Trifolium striatum</i> (Knotted Clover)	Y		
668.	147 <i>Triglochin mucronata</i>			
669.	151 <i>Triglochin striata</i>			
670.	152 <i>Triglochin trichophora</i>			
671.	98 <i>Typha domingensis</i> (Bulrush, Djandjidi)			
672.	15725 <i>Verbesina encelioides</i>	Y		
673.	7666 <i>Verreauxia reinwardtii</i> (Common Verreauxia)			
674.	12402 <i>Verticordia chrysanthella</i>			
675.	48829 <i>Wahlenbergia capillaris</i>			
676.	13331 <i>Waitzia acuminata</i> var. <i>acuminata</i>			
677.	13330 <i>Waitzia acuminata</i> var. <i>albicans</i>			
678.	13328 <i>Waitzia nitida</i>			
679.	8281 <i>Waitzia podolepis</i>			
680.	8282 <i>Waitzia suaveolens</i> (Fragrant Waitzia)			
681.	6658 <i>Wilsonia backhousei</i> (Narrow-leaf Wilsonia)			
682.	6659 <i>Wilsonia humilis</i> (Silky Wilsonia)			
683.	12072 <i>Wurmbea dioica</i> subsp. <i>alba</i>			
684.	1398 <i>Wurmbea monantha</i>			
685.	1256 <i>Xanthorrhoea preissii</i> (Grass tree, Palga)			

Conservation Codes

T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix D – Flora data

Flora species list

Quadrat data

Flora likelihood of occurrence

Flora Species List

Family	Taxon	Status
Amaranthaceae	<i>Ptilotus divaricatus</i>	
Amaranthaceae	<i>Ptilotus stirlingii</i> sp. <i>stirlingii</i>	
Apocynaceae	<i>Alyxia buxifolia</i>	
Asparagaceae	<i>Acanthocarpus canaliculatus</i>	
Asparagaceae	<i>Acanthocarpus preissii</i>	
Asparagaceae	<i>Lomandra maritima</i>	
Asparagaceae	<i>Thysanotus ?manglesianus</i>	
Asteraceae	<i>Hypochaeris glabra</i>	*
Asteraceae	<i>Helianthus annuus</i>	*
Asteraceae	<i>Reichardia tingitana</i>	*
Asteraceae	<i>Sonchus oleraceus</i>	*
Asteraceae	<i>Asteraceae</i> sp (insufficient material)	
Asteraceae	<i>Austrostipa nitida</i>	
Asteraceae	<i>Olearia</i> sp. Kennedy Range (G Byrne 66)	
Azioaceae	<i>Mesembryanthemum crystallinum</i>	*
Azioaceae	<i>Tetragonia implexicoma</i>	
Brassicaceae	<i>Brassica tournefortii</i>	*
Brassicaceae	<i>Sisymbrium orientale</i>	*
Chenopodiaceae	<i>Atriplex cinerea</i>	
Chenopodiaceae	<i>Enchylaena tomentosa</i>	
Chenopodiaceae	<i>Rhagodia latifolia</i> ssp. <i>latifolia</i>	
Chenopodiaceae	<i>Rhagodia preissii</i> subsp. <i>obovata</i>	
Chenopodiaceae	<i>Salsola australis</i>	
Chenopodiaceae	<i>Threlkeldia diffusa</i>	
Convolvulaceae	* <i>Cuscuta epithymum</i>	*
Euphorbiaceae	<i>Euphorbia boophthona</i>	
Euphorbiaceae	<i>Euphorbia terracina</i>	*
Fabaceae	<i>Acacia rostellifera</i>	
Fabaceae	<i>Acacia saligna</i>	
Fabaceae	<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>	
Fabaceae	<i>Glycine canescens</i>	
Fabaceae	<i>Templetonia retusa</i>	
Frankeniaceae	<i>Frankenia tingitana</i>	
Goodeniaceae	<i>Scaevola tomentosa</i>	
Lauraceae	<i>Cassytha aurea</i> var. <i>aurea</i>	
Loranthaceae	<i>Amyema preissii</i>	
Malvaceae	<i>Alyogyne hakeifolia</i>	
Malvaceae	<i>Commersonia boerhavia</i>	
Myrtaceae	<i>Eucalyptus baudiniana</i>	
Myrtaceae	<i>Eucalyptus utilis</i> (planted non-local)	
Myrtaceae	<i>Melaleuca cardiophylla</i>	
Nyctaginaceae	<i>Commicarpus australis</i>	

Phyllanthaceae	<i>Phyllanthus calycinus</i>	
Pittosporaceae	<i>Pittosporum ligustrifolium</i>	
Poaceae	<i>Avena barbata</i>	*
Poaceae	<i>Cenchrus ciliatus</i>	*
Poaceae	<i>Brachypodium distachyon</i>	*
Poaceae	<i>Bromus diandrus</i>	*
Poaceae	<i>Ehrharta longiflora</i>	*
Poaceae	<i>Ehrharta brevifolia</i>	*
Poaceae	<i>Aristida</i> sp (insufficient material)	
Poaceae	<i>Austrostipa elegantissima</i>	
Poaceae	<i>Austrostipa nitida</i>	
Poaceae	<i>Poaceae</i> sp. (insufficient material)	
Poaceae	<i>Sporobolus virginicus</i>	
Proteaceae	<i>Grevillea argyrophylla</i>	
Scrophulariaceae	<i>Myoporum insulare</i>	
Solanaceae	<i>Anthocercis littorea</i>	
Surianaceae	<i>Stylobasium spathulatum</i>	
Thymelaeaceae	<i>Pimelea gilgiana</i>	
Thymelaeaceae	<i>Pimelea microcephala</i> subsp <i>microcephala</i>	
Thymelaeaceae	<i>Pimelea gilgiana</i>	
Zygophyllaceae	<i>Roepera apiculata</i>	
Zygophyllaceae	<i>Roepera fruticulosa</i>	

* Denoted an introduced species

Flora species by site matrix (Site:Lyn_X)

Taxon	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
* <i>Avena barbata</i>	1				1		1	1			1		1		1		1	1	1	1	1	1	1	1		1	
* <i>Brachypodium distachyon</i>	1														1	1			1								
* <i>Brassica tournefortii</i>	1				1		1	1	1	1				1					1	1					1	1	
* <i>Bromus diandrus</i>												1															
* <i>Bromus diandrus</i>	1		1	1	1					1	1																
* <i>Cuscuta epithymum</i>					1						1																
* <i>Ehrharta longiflora</i>							1	1	1	1		1		1			1	1	1	1	1	1	1	1	1	1	1
* <i>Hypochaeris glabra</i>																					1						
* <i>Reichardia tingitana</i>					1																						
* <i>Sisymbrium orientale</i>		1	1	1	1																						
* <i>Sonchus oleraceus</i>				1			1	1				1								1						1	
<i>Acacia rostellifera</i>	1	1	1	1	1	1	1	2	1	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Acacia saligna</i>										1																	
<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>	1	1	1		2							1															
<i>Acanthocarpus canaliculatus</i>		1																									

<i>Acanthocarpus preissii</i>		1												1	1										
<i>Alyogyne hakeifolia</i>	1	1		1		1						1	1	1	1	1	1			1	1	1	1	1	
<i>Alyxia buxifolia</i>									1																
<i>Anthocercis littorea</i>																						1			
<i>Aristida sp (insufficient material)</i>	1				1					1															1
<i>Asteraceae sp (insufficient material)</i>	1	1	1	1														1						1	
<i>Austrostipa nitida</i>						1																			
<i>Austrostipa elegantissima</i>	1		1	1	1	1	1	1	1		1		1		1	1		1	1	2	1		1	1	1
<i>Austrostipa nitida</i>		1	1																						
<i>Cassythia aurea var. aurea</i>			1			1	1												1				1		
<i>Commicarpus australis</i>	1	1		1	1		1	1	1				1	1	1	1	1		1	1	1			1	1
<i>Enchylaena tomentosa</i>		1					1			1		1													
<i>Eucalyptus baudiniana</i>															1										
<i>Euphorbia boophthona</i>	1			1	1														1						1
<i>Frankenia tingitana</i>											1														
<i>Glycine canescens</i>	1				1		1																		

<i>Grevillea argyrophylla</i>											1																	
<i>Lomandra maritima</i>		1																										
<i>Melaleuca cardiophylla</i>	1	1	1							2	1		1		1	1												
<i>Myoporum insulare</i>												1																
<i>Olearia</i> sp. Kennedy Range (G Byrne 66)	1	1	1	1	1		1							1	1	1		1	1		1			1	1	1		
<i>Phyllanthus calycinus</i>																									1			
<i>Pimelea gilgiana</i>	1	1	1							1					1			1							1			
<i>Pimelea microcephala</i> subsp <i>microcephala</i>	1	1	1	1	1	1	1	2	2	1	1		1	1	1	1	1	1	1	1	1	1	1		1	1	1	
<i>Pimelea gilgiana</i>																1												
<i>Pittosporum ligustrifolium</i>																									1			
<i>Poaceae</i> sp. (insufficient material)												1																
<i>Ptilotus divaricatus</i>										1	1					1	1	1								1		
<i>Ptilotus stirlingii</i> sp. <i>stirlingii</i>	1																											
<i>Rhagodia latifolia</i> ssp. <i>latifolia</i>																		1	1									

<i>Rhagodia preissii</i> subsp. <i>obovata</i>	1	1	2	1	1	1	1	1	1	3	2		1	1	1		1	1	2	1	1		1	1	1	1	1
<i>Roepera apiculata</i>										1			1					1									
<i>Roepera fruticulosa</i>	1	1	1	1	1	1	1		1	1	1		1	1	1	1	1	1	1	1			1			1	1
<i>Salsola australis</i>																								1	1		
<i>Scaevola tomentosa</i>													1														
<i>Sporobolus virginicus</i>												1															
<i>Stylobasium spathulatum</i>			1	1	1	1								1	1	1		1	1		1				1		
<i>Templetonia retusa</i>	1	1																									
<i>Tetragonia implexicoma</i>			1		1	1	1				1			1	1	1	1			1						1	1
<i>Threlkeldia diffusa</i>											1	1													1		
<i>Thysanotus ?manglesianus</i>		1																1	1								

Flora site raw data

Site number	Taxon	Cover (%)	Height (m)	Form/Stratum	Opportunistic
Lyn_01	<i>*Avena barbata</i>	0.5	0.25	Other grass (G)	
Lyn_01	<i>*Brachypodium distachyon</i>	2	0.1	Other grass (G)	
Lyn_01	<i>*Brassica tournefortii</i>	0.1	0.1	Forb (G)	
Lyn_01	<i>*Bromus diandrus</i>	50	0.1	Other grass (G)	
Lyn_01	<i>Acacia rostellifera</i>	2	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_01	<i>Acacia sclerosperma subsp. sclerosperma</i>	0.5	0.25	Forb (G)	
Lyn_01	<i>Alyogyne hakeifolia</i>	3	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_01	<i>Aristida sp (insufficient material)</i>	0.5	0.25	Other grass (G)	
Lyn_01	<i>Asteraceae sp (insufficient material)</i>	0.1	0.1	Forb (G)	
Lyn_01	<i>Austrostipa elegantissima</i>	0.5	0.25	Other grass (G)	
Lyn_01	<i>Commicarpus australis</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_01	<i>Euphorbia boophthona</i>	0.5	0.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_01	<i>Glycine canescens</i>	0.5	0.25	Vine (G)	
Lyn_01	<i>Melaleuca cardiophylla</i>	10	1.75	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_01	<i>Olearia sp. Kennedy Range (G Byrne 66)</i>	0.5	0.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_01	<i>Pimelea gilgiana</i>	0.5	0.25	Forb (G)	
Lyn_01	<i>Pimelea microcephala subsp microcephala</i>	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_01	<i>Ptilotus stirlingii sp. stirlingii</i>	0.1	0.25	Shrub, cycad, grass-tree, tree-fern (M)	

Lyn_01	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	2	1.25	Chenopod shrub (M)	
Lyn_01	<i>Roepera fruticulosa</i>	4	0.5	Vine (G)	
Lyn_01	<i>Templetonia retusa</i>	1	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_02	* <i>Sisymbrium orientale</i>	0.1	0.1	Forb (G)	
Lyn_02	<i>Acacia rostellifera</i>	5	4	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_02	<i>Acacia sclerosperma</i> <i>subsp. sclerosperma</i>	0.5	0.25	Forb (G)	
Lyn_02	<i>Acanthocarpus</i> <i>canaliculatus</i>	20	0.1	Other grass (G)	
Lyn_02	<i>Acanthocarpus preissii</i>	0.5	0.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_02	<i>Alyogyne hakeifolia</i>	3	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_02	<i>Asteraceae sp</i> <i>(insufficient material)</i>	0.1	0.1	Forb (G)	
Lyn_02	<i>Austrostipa nitida</i>	0.1	0.25	Other grass (G)	
Lyn_02	<i>Commicarpus australis</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_02	<i>Enchylaena tomentosa</i>	0.1	0.25	Chenopod shrub (M)	
Lyn_02	<i>Lomandra maritima</i>	0.1	0.25	Forb (G)	
Lyn_02	<i>Melaleuca cardiophylla</i>	1	3.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_02	<i>Olearia sp. Kennedy</i> <i>Range (G Byrne 66)</i>	4	0.75	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_02	<i>Pimelea gilgiana</i>	0.5	0.25	Forb (G)	
Lyn_02	<i>Pimelea microcephala</i> <i>subsp. microcephala</i>	5	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_02	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	2	1.25	Chenopod shrub (M)	
Lyn_02	<i>Roepera fruticulosa</i>	4	0.5	Vine (G)	

Lyn_02	<i>Templetonia retusa</i>	10	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_02	<i>Thysanotus ?manglesianus</i>	0.1	0.25	Forb (G)	
Lyn_03	* <i>Bromus diandrus</i>	1	0.1	Other grass (G)	
Lyn_03	* <i>Sisymbrium orientale</i>	0.1	0.1	Forb (G)	
Lyn_03	<i>Acacia rostellifera</i>	1	1.75	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_03	<i>Acacia sclerosperma subsp. sclerosperma</i>	0.5	0.5	Forb (G)	
Lyn_03	<i>Asteraceae sp (insufficient material)</i>	0.1	0.1	Forb (G)	
Lyn_03	<i>Austrostipa elegantissima</i>	0.5	0.25	Other grass (G)	
Lyn_03	<i>Austrostipa nitida</i>	0.5	0.25	Other grass (G)	
Lyn_03	<i>Cassytha aurea var. aurea</i>	0.5	0.25	Vine (G)	
Lyn_03	<i>Melaleuca cardiophylla</i>	50	3.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_03	<i>Olearia sp. Kennedy Range (G Byrne 66)</i>	4	0.75	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_03	<i>Pimelea gilgiana</i>	0.5	0.25	Forb (G)	
Lyn_03	<i>Pimelea microcephala subsp microcephala</i>	2	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_03	<i>Rhagodia preissii subsp. obovata</i>	2	0.25	Chenopod shrub (M)	
Lyn_03	<i>Rhagodia preissii subsp. obovata</i>	0.1	0.75	Chenopod shrub (M)	
Lyn_03	<i>Roepera fruticulosa</i>	1	0.5	Vine (G)	
Lyn_03	<i>Stylobasium spathulatum</i>	2	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_03	<i>Tetragonia implexicoma</i>	0.5	0.25	Forb (G)	
Lyn_04	* <i>Bromus diandrus</i>	25	0.1	Other grass (G)	

Lyn_04	<i>*Sisymbrium orientale</i>	5	0.1	Forb (G)	
Lyn_04	<i>*Sonchus oleraceus</i>	0.1	0.1	Forb (G)	
Lyn_04	<i>Acacia rostellifera</i>	1	4	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_04	<i>Alyogyne hakeifolia</i>	2	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_04	<i>Asteraceae sp (insufficient material)</i>	0.1	0.1	Forb (G)	
Lyn_04	<i>Austrostipa elegantissima</i>	0.5	0.25	Other grass (G)	
Lyn_04	<i>Commicarpus australis</i>	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_04	<i>Euphorbia boophthona</i>	0.5	0.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_04	<i>Olearia sp. Kennedy Range (G Byrne 66)</i>	4	0.75	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_04	<i>Pimelea microcephala subsp microcephala</i>	5	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_04	<i>Rhagodia preissii subsp. obovata</i>	5	1	Chenopod shrub (M)	
Lyn_04	<i>Roepera fruticulosa</i>	1	0.5	Vine (G)	
Lyn_04	<i>Stylobasium spathulatum</i>	5	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_05	<i>*Avena barbata</i>	2	0.25	Other grass (G)	
Lyn_05	<i>*Brassica tournefortii</i>	1	0.25	Forb (G)	
Lyn_05	<i>*Bromus diandrus</i>	20	0.1	Other grass (G)	
Lyn_05	<i>*Cuscuta epithymum</i>	0.1	0.1	Vine (G)	
Lyn_05	<i>*Reichardia tingitana</i>	0.1	0.1	Forb (G)	
Lyn_05	<i>*Sisymbrium orientale</i>	5	0.1	Forb (G)	
Lyn_05	<i>Acacia rostellifera</i>	8	4	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_05	<i>Acacia sclerosperma subsp. sclerosperma</i>	2	0.75	Forb (G)	

Lyn_05	<i>Acacia sclerosperma</i> <i>subsp. sclerosperma</i>		1.75	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_05	<i>Aristida</i> sp (insufficient material)	0.1	0.5	Other grass (G)	
Lyn_05	<i>Austrostipa elegantissima</i>		0.25	Other grass (G)	
Lyn_05	<i>Commicarpus australis</i>	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_05	<i>Euphorbia boophthona</i>	0.5	0.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_05	<i>Glycine canescens</i>	0.1	0.25	Vine (G)	
Lyn_05	<i>Olearia</i> sp. Kennedy Range (G Byrne 66)	1	0.75	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_05	<i>Pimelea microcephala</i> <i>subsp microcephala</i>	5	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_05	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	5	1	Chenopod shrub (M)	
Lyn_05	<i>Roepera fruticulosa</i>	10	0.5	Vine (G)	
Lyn_05	<i>Stylobasium spathulatum</i>	10	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_05	<i>Tetragonia implexicoma</i>	0.5	0.25	Chenopod shrub (M)	
Lyn_06	<i>Acacia rostellifera</i>	60	6	Tree, palm (U)	
Lyn_06	<i>Alyogyne hakeifolia</i>	5	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_06	<i>Austrostipa nitida</i>	0.5	0.75	Other grass (G)	
Lyn_06	<i>Austrostipa elegantissima</i>	0.5	0.25	Other grass (G)	
Lyn_06	<i>Cassytha aurea</i> var. <i>aurea</i>	3	0.25	Vine (G)	
Lyn_06	<i>Pimelea microcephala</i> <i>subsp microcephala</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_06	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	5	1	Chenopod shrub (M)	

Lyn_06	<i>Roepera fruticulosa</i>	40	0.5	Vine (G)	
Lyn_06	<i>Stylobasium spathulatum</i>	3	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_06	<i>Tetragonia implexicoma</i>	2	0.25	Chenopod shrub (M)	
Lyn_07	* <i>Avena barbata</i>	5	0.25	Other grass (G)	
Lyn_07	* <i>Brassica tournefortii</i>	0.5	0.25	Forb (G)	
Lyn_07	* <i>Ehrharta longiflora</i>	55	0.25	Other grass (G)	
Lyn_07	* <i>Sonchus oleraceus</i>	0.1	0.1	Forb (G)	
Lyn_07	<i>Acacia rostellifera</i>	30	8	Tree, palm (U)	
Lyn_07	<i>Austrostipa elegantissima</i>	0.5	0.25	Other grass (G)	
Lyn_07	<i>Cassutha aurea</i> var. <i>aurea</i>	3	0.25	Vine (G)	
Lyn_07	<i>Commicarpus australis</i>	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_07	<i>Enchylaena tomentosa</i>	0.5	0.25	Chenopod shrub (M)	
Lyn_07	<i>Glycine canescens</i>	0.1	0.25	Vine (G)	
Lyn_07	<i>Olearia</i> sp. <i>Kennedy Range</i> (G Byrne 66)	1	0.75	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_07	<i>Pimelea microcephala</i> subsp. <i>microcephala</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_07	<i>Rhagodia preissii</i> subsp. <i>obovata</i>	35	1	Chenopod shrub (M)	
Lyn_07	<i>Roepera fruticulosa</i>	40	0.5	Vine (G)	
Lyn_07	<i>Tetragonia implexicoma</i>	2	0.25	Chenopod shrub (M)	
Lyn_08	* <i>Avena barbata</i>	1	0.25	Other grass (G)	
Lyn_08	* <i>Brassica tournefortii</i>	2	0.25	Forb (G)	
Lyn_08	* <i>Ehrharta longiflora</i>	20	0.25	Other grass (G)	
Lyn_08	* <i>Sonchus oleraceus</i>	0.1	0.1	Forb (G)	
Lyn_08	<i>Acacia rostellifera</i>	20	8	Tree, palm (U)	

Lyn_08	<i>Acacia rostellifera</i>	5	3	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_08	<i>Austrostipa elegantissima</i>	1	0.25	Other grass (G)	
Lyn_08	<i>Commicarpus australis</i>	5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_08	<i>Pimelea microcephala subsp microcephala</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_08	<i>Pimelea microcephala subsp microcephala</i>	0.5	0.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_08	<i>Rhagodia preissii subsp. obovata</i>	60	1	Chenopod shrub (M)	
Lyn_09	* <i>Brassica tournefortii</i>	0.1	0.25	Forb (G)	
Lyn_09	* <i>Ehrharta longiflora</i>	30	0.25	Other grass (G)	
Lyn_09	<i>Acacia rostellifera</i>	30	8	Tree, palm (U)	
Lyn_09	<i>Austrostipa elegantissima</i>	1	0.25	Other grass (G)	
Lyn_09	<i>Commicarpus australis</i>	5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_09	<i>Pimelea microcephala subsp microcephala</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_09	<i>Pimelea microcephala subsp microcephala</i>	0.5	0.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_09	<i>Rhagodia preissii subsp. obovata</i>	60	1	Chenopod shrub (M)	
Lyn_09	<i>Roepera fruticulosa</i>	5	0.5	Vine (G)	
Lyn_10	* <i>Brassica tournefortii</i>	2	0.25	Forb (G)	
Lyn_10	* <i>Bromus diandrus</i>	1	0.1	Other grass (G)	
Lyn_10	* <i>Ehrharta longiflora</i>	30	0.25	Other grass (G)	
Lyn_10	<i>Acacia rostellifera</i>	1	1.75	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_10	<i>Acacia saligna</i>	0.5	0.75	Shrub, cycad, grass-tree, tree-fern (M)	

Lyn_10	<i>Alyxia buxifolia</i>	1	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_10	<i>Aristida sp (insufficient material)</i>	0.1	0.75	Other grass (G)	
Lyn_10	<i>Enchylaena tomentosa</i>	0.5	0.25	Chenopod shrub (M)	
Lyn_10	<i>Melaleuca cardiophylla</i>	10	3.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_10	<i>Melaleuca cardiophylla</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_10	<i>Pimelea gilgiana</i>	0.5	0.25	Forb (G)	
Lyn_10	<i>Pimelea microcephala subsp microcephala</i>	1	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_10	<i>Ptilotus divaricatus</i>	0.5	0.5	Forb (G)	
Lyn_10	<i>Rhagodia preissii subsp. obovata</i>	25	0.25	Chenopod shrub (M)	
Lyn_10	<i>Rhagodia preissii subsp. obovata</i>	8	0.25	Other grass (G)	
Lyn_10	<i>Rhagodia preissii subsp. obovata</i>	5	1	Chenopod shrub (M)	
Lyn_10	<i>Roepera apiculata</i>	5	0.25	Chenopod shrub (M)	
Lyn_10	<i>Roepera fruticulosa</i>	3	0.5	Vine (G)	
Lyn_11	* <i>Avena barbata</i>	60	0.25	Other grass (G)	
Lyn_11	* <i>Bromus diandrus</i>	5	0.1	Other grass (G)	
Lyn_11	* <i>Cuscuta epithymum</i>	0.1	0.1	Vine (G)	
Lyn_11	<i>Austrostipa elegantissima</i>	0.1	0.25	Other grass (G)	
Lyn_11	<i>Grevillea argyrophylla</i>	0.5	1.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_11	<i>Melaleuca cardiophylla</i>	40	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_11	<i>Pimelea microcephala subsp microcephala</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_11	<i>Ptilotus divaricatus</i>	1	0.5	Forb (G)	

Lyn_11	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	5	0.25	Chenopod shrub (M)	
Lyn_11	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	1	1	Chenopod shrub (M)	
Lyn_11	<i>Roepera fruticulosa</i>	20	0.5	Vine (G)	
Lyn_11	<i>Tetragonia</i> <i>implexica</i>	1	0.5	Chenopod shrub (M)	
Lyn_11	<i>Threlkeldia diffusa</i>	0.5	0.5	Chenopod shrub (M)	
Lyn_12	* <i>Bromus diandrus</i>	2	0.25	Other grass (G)	
Lyn_12	* <i>Ehrharta longiflora</i>	40	0.5	Other grass (G)	
Lyn_12	* <i>Sonchus oleraceus</i>	0.5	0.25	Forb (G)	
Lyn_12	<i>Acacia sclerosperma</i> <i>subsp. Sclerosperma</i>	20	2	Shrub, cycad, grass- tree, tree-fern (M)	
Lyn_12	<i>Alyogyne hakeifolia</i>	2	2	Shrub, cycad, grass- tree, tree-fern (M)	
Lyn_12	<i>Enchylaena tomentosa</i>	5	0.25	Chenopod shrub (M)	
Lyn_12	<i>Frankenia tingitana</i>	5	0.25	Chenopod shrub (M)	
Lyn_12	<i>Myoporum insulare</i>	45	2	Shrub, cycad, grass- tree, tree-fern (M)	
Lyn_12	<i>Poaceae sp.</i> (insufficient material)	5	0.25	Other grass (G)	
Lyn_12	<i>Sporobolus virginicus</i>	10	0.1	Other grass (G)	
Lyn_12	<i>Threlkeldia diffusa</i>	10	0.5	Chenopod shrub (M)	
Lyn_13	* <i>Avena barbata</i>	80	0.25	Other grass (G)	
Lyn_13	<i>Acacia rostellifera</i>	20	2	Shrub, cycad, grass- tree, tree-fern (M)	
Lyn_13	<i>Alyogyne hakeifolia</i>	15	2	Shrub, cycad, grass- tree, tree-fern (M)	
Lyn_13	<i>Austrostipa</i> <i>elegantissima</i>	0.1	0.25	Other grass (G)	
Lyn_13	<i>Commicarpus australis</i>	2	1	Shrub, cycad, grass- tree, tree-fern (M)	

Lyn_13	<i>Melaleuca cardiophylla</i>	5	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_13	<i>Pimelea microcephala</i> <i>subsp microcephala</i>	5	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_13	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	15	1	Chenopod shrub (M)	
Lyn_13	<i>Roepera apiculata</i>	1	0.25	Chenopod shrub (M)	
Lyn_13	<i>Roepera fruticulosa</i>	20	0.5	Vine (G)	
Lyn_13	<i>Scaevola tomentosa</i>	0.5	1.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_14	* <i>Brassica tournefortii</i>	0.1	0.25	Forb (G)	
Lyn_14	* <i>Ehrharta longiflora</i>	0.5	0.25	Other grass (G)	
Lyn_14	<i>Acacia rostellifera</i>	20	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_14	<i>Alyogyne hakeifolia</i>	1	1.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_14	<i>Commicarpus australis</i>	1	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_14	<i>Olearia sp. Kennedy Range</i> (G Byrne 66)	1	0.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_14	<i>Pimelea microcephala</i> <i>subsp microcephala</i>	2	0.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_14	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	40	1	Chenopod shrub (M)	
Lyn_14	<i>Roepera fruticulosa</i>	5	0.5	Vine (G)	
Lyn_14	<i>Stylobasium spathulatum</i>	1	1.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_14	<i>Tetragonia implexicoma</i>	30	0.5	Chenopod shrub (M)	
Lyn_15	* <i>Avena barbata</i>	0.5	0.25	Other grass (G)	
Lyn_15	* <i>Brachypodium distachyon</i>	20	0.1	Other grass (G)	
Lyn_15	<i>Acacia rostellifera</i>	10	3	Tree, palm (U)	

Lyn_15	<i>Acanthocarpus preissii</i>	0.5	0.25	Forb (G)	
Lyn_15	<i>Alyogyne hakeifolia</i>	3	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_15	<i>Austrostipa elegantissima</i>	0.5	0.25	Other grass (G)	
Lyn_15	<i>Commicarpus australis</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_15	<i>Melaleuca cardiophylla</i>	10	3	Tree, palm (U)	
Lyn_15	<i>Olearia</i> sp. Kennedy Range (G Byrne 66)	0.5	0.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_15	<i>Pimelea gilgiana</i>	0.5	0.25	Forb (G)	
Lyn_15	<i>Pimelea microcephala</i> subsp. <i>microcephala</i>	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_15	<i>Ptilotus divaricatus</i>	0.5	0.25	Forb (G)	
Lyn_15	<i>Rhagodia preissii</i> subsp. <i>obovata</i>	2	1.25	Chenopod shrub (M)	
Lyn_15	<i>Roepera fruticulosa</i>	4	0.5	Vine (G)	
Lyn_15	<i>Stylobasium spathulatum</i>	1	1.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_15	<i>Tetragonia implexicoma</i>	10	0.5	Chenopod shrub (M)	
Lyn_16	* <i>Brachypodium distachyon</i>	20	0.1	Other grass (G)	
Lyn_16	<i>Acacia rostellifera</i>	0.5	3	Tree, palm (U)	
Lyn_16	<i>Acanthocarpus preissii</i>	0.5	0.25	Forb (G)	
Lyn_16	<i>Alyogyne hakeifolia</i>	3	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_16	<i>Austrostipa elegantissima</i>	0.5	0.25	Other grass (G)	
Lyn_16	<i>Commicarpus australis</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_16	<i>Eucalyptus baudiniana</i>	0.5	3	Mallee shrub (M)	
Lyn_16	<i>Melaleuca cardiophylla</i>	40	3	Tree, palm (U)	

Lyn_16	<i>Olearia</i> sp. Kennedy Range (G Byrne 66)	0.5	0.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_16	<i>Pimelea microcephala</i> subsp <i>microcephala</i>	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_16	<i>Pimelea gilgiana</i>	0.5	0.25	Forb (G)	
Lyn_16	<i>Ptilotus divaricatus</i>	0.5	0.25	Forb (G)	
Lyn_16	<i>Roepera fruticulosa</i>	4	0.5	Vine (G)	
Lyn_16	<i>Stylobasium spathulatum</i>	1	1.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_16	<i>Tetragonia implexicoma</i>	10	0.5	Chenopod shrub (M)	
Lyn_17	* <i>Avena barbata</i>	0.5	0.25	Other grass (G)	
Lyn_17	* <i>Ehrharta longiflora</i>	25	0.25	Other grass (G)	
Lyn_17	<i>Acacia rostellifera</i>	50	8	Tree, palm (U)	
Lyn_17	<i>Alyogyne hakeifolia</i>	2	1.75	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_17	<i>Commicarpus australis</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_17	<i>Pimelea microcephala</i> subsp <i>microcephala</i>	0.5	1.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_17	<i>Ptilotus divaricatus</i>	0.5	0.25	Forb (G)	
Lyn_17	<i>Rhagodia preissii</i> subsp. <i>obovata</i>	45	1	Chenopod shrub (M)	
Lyn_17	<i>Roepera fruticulosa</i>	1	0.5	Vine (G)	
Lyn_17	<i>Tetragonia implexicoma</i>	30	0.5	Chenopod shrub (M)	
Lyn_18	* <i>Avena barbata</i>	25	0.25	Other grass (G)	
Lyn_18	* <i>Ehrharta longiflora</i>	65	0.25	Other grass (G)	
Lyn_18	<i>Acacia rostellifera</i>	20	8	Tree, palm (U)	
Lyn_18	<i>Alyogyne hakeifolia</i>	4	1.75	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_18	<i>Austrostipa elegantissima</i>	5	0.25	Other grass (G)	

Lyn_18	<i>Olearia</i> sp. Kennedy Range (G Byrne 66)	1	0.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_18	<i>Pimelea gilgiana</i>	1	0.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_18	<i>Pimelea microcephala</i> subsp <i>microcephala</i>	5	1.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_18	<i>Rhagodia latifolia</i> ssp. <i>latifolia</i>	5	1.25	Chenopod shrub (M)	
Lyn_18	<i>Rhagodia preissii</i> subsp. <i>obovata</i>	2	1	Chenopod shrub (M)	
Lyn_18	<i>Roepera fruticulosa</i>	1	0.5	Vine (G)	
Lyn_18	<i>Stylobasium spathulatum</i>	1	1.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_18	<i>Thysanotus ?manglesianus</i>	0.5	1	Forb (G)	
Lyn_19	* <i>Avena barbata</i>	2	0.25	Other grass (G)	
Lyn_19	* <i>Brachypodium distachyon</i>	1	0.25	Other grass (G)	
Lyn_19	* <i>Brassica tournefortii</i>	0.1	0.25	Forb (G)	
Lyn_19	* <i>Ehrharta longiflora</i>	75	0.25	Other grass (G)	
Lyn_19	<i>Acacia rostellifera</i>	30	8	Tree, palm (U)	
Lyn_19	<i>Asteraceae</i> sp (insufficient material)	0.1	0.1	Forb (G)	
Lyn_19	<i>Austrostipa elegantissima</i>	6	0.25	Other grass (G)	
Lyn_19	<i>Commicarpus australis</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_19	<i>Olearia</i> sp. Kennedy Range (G Byrne 66)	1	0.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_19	<i>Pimelea microcephala</i> subsp <i>microcephala</i>	5	1.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_19	<i>Rhagodia latifolia</i> ssp. <i>latifolia</i>	1	1.25	Chenopod shrub (M)	

Lyn_19	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	2	1	Chenopod shrub (M)	
Lyn_19	<i>Rhagodia preissii</i> <i>subsp. obovata</i>				
Lyn_19	<i>Roepera apiculata</i>	0.5	0.1	Chenopod shrub (M)	
Lyn_19	<i>Roepera fruticulosa</i>	5	0.5	Vine (G)	
Lyn_19	<i>Stylobasium</i> <i>spathulatum</i>	5	1.25	Shrub, cycad, grass- tree, tree-fern (M)	
Lyn_19	<i>Thysanotus</i> <i>?manglesianus</i>	0.1	1	Forb (G)	
Lyn_20	* <i>Avena barbata</i>	1	0.25	Other grass (G)	
Lyn_20	* <i>Brassica tournefortii</i>	1	0.25	Forb (G)	
Lyn_20	* <i>Ehrharta longiflora</i>	75	0.25	Other grass (G)	
Lyn_20	* <i>Sonchus oleraceus</i>	0.1	0.1	Forb (G)	
Lyn_20	<i>Acacia rostellifera</i>	60	6	Tree, palm (U)	
Lyn_20	<i>Austrostipa</i> <i>elegantissima</i>	6	0.25	Other grass (G)	
Lyn_20	<i>Austrostipa</i> <i>elegantissima</i>	5	0.25	Other grass (G)	
Lyn_20	<i>Cassytha aurea</i> var. <i>aurea</i>	1	1	Vine (G)	
Lyn_20	<i>Commicarpus australis</i>	0.5	1	Shrub, cycad, grass- tree, tree-fern (M)	
Lyn_20	<i>Euphorbia boophthona</i>	0.1	0.25	Forb (G)	
Lyn_20	<i>Pimelea microcephala</i> <i>subsp microcephala</i>	5	1.25	Shrub, cycad, grass- tree, tree-fern (M)	
Lyn_20	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	2	1	Chenopod shrub (M)	
Lyn_20	<i>Roepera fruticulosa</i>	5	0.5	Vine (G)	
Lyn_20	<i>Tetragonia</i> <i>implexica</i>	10	0.5	Chenopod shrub (M)	
Lyn_21	* <i>Avena barbata</i>	70	0.25	Other grass (G)	
Lyn_21	* <i>Ehrharta longiflora</i>	10	0.25	Other grass (G)	


Lyn_21	<i>*Hypochaeris glabra</i>	2	0.1	Forb (G)	
Lyn_21	<i>Acacia rostellifera</i>	30	3	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_21	<i>Alyogyne hakeifolia</i>	30	2.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_21	<i>Austrostipa elegantissima</i>	2	0.25	Other grass (G)	
Lyn_21	<i>Commicarpus australis</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_21	<i>Olearia sp. Kennedy Range (G Byrne 66)</i>	1	0.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_21	<i>Pimelea microcephala subsp microcephala</i>	1	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_21	<i>Rhagodia preissii subsp. obovata</i>	2	1	Chenopod shrub (M)	
Lyn_21	<i>Stylobasium spathulatum</i>	2	1.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_22	<i>*Avena barbata</i>	40	0.25	Other grass (G)	
Lyn_22	<i>*Ehrharta longiflora</i>	30	0.25	Other grass (G)	
Lyn_22	<i>Acacia rostellifera</i>	20	7	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_22	<i>Alyogyne hakeifolia</i>	5	2.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_22	<i>Pimelea microcephala subsp microcephala</i>	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_23	<i>*Avena barbata</i>	5	0.25	Other grass (G)	
Lyn_23	<i>*Ehrharta longiflora</i>	5	0.25	Other grass (G)	
Lyn_23	<i>Acacia rostellifera</i>	40	7	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_23	<i>Alyogyne hakeifolia</i>	2	2.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_23	<i>Austrostipa elegantissima</i>	2	0.25	Other grass (G)	


Lyn_23	<i>Pimelea microcephala</i> <i>subsp. microcephala</i>	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_23	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	10	1	Chenopod shrub (M)	
Lyn_23	<i>Roepera fruticulosa</i>	1	0.5	Vine (G)	
Lyn_24	* <i>Avena barbata</i>	85	0.25	Other grass (G)	
Lyn_24	* <i>Ehrharta longiflora</i>	5	0.25	Other grass (G)	
Lyn_24	<i>Acacia rostellifera</i>	30	4	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_24	<i>Alyogyne hakeifolia</i>	2	2.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_24	<i>Olearia sp. Kennedy Range</i> (G Byrne 66)	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_24	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	2	1	Chenopod shrub (M)	
Lyn_24	<i>Salsola australis</i>	0.5	0.5	Chenopod shrub (M)	
Lyn_25	* <i>Brassica tournefortii</i>	0.1	0.1	Forb (G)	
Lyn_25	* <i>Ehrharta longiflora</i>	1	0.25	Other grass (G)	
Lyn_25	<i>Acacia rostellifera</i>	30	4	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_25	<i>Alyogyne hakeifolia</i>	2	2.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_25	<i>Anthocercis littorea</i>	0.5	0.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_25	<i>Asteraceae sp</i> (insufficient material)	0.1	0.1	Forb (G)	
Lyn_25	<i>Austrostipa elegantissima</i>	2	0.25	Other grass (G)	
Lyn_25	<i>Cassytha aurea</i> var. <i>aurea</i>	4	1.5	Vine (G)	
Lyn_25	<i>Commicarpus australis</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_25	<i>Olearia sp. Kennedy Range</i> (G Byrne 66)	5	1	Shrub, cycad, grass-tree, tree-fern (M)	


Lyn_25	<i>Phyllanthus calycinus</i>	0.5	0.5	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_25	<i>Pimelea gilgiana</i>	0.5	0.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_25	<i>Pimelea microcephala</i> <i>subsp microcephala</i>	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_25	<i>Pittosporum ligustrifolium</i>	1	1.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_25	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	5	1.25	Chenopod shrub (M)	
Lyn_25	<i>Salsola australis</i>	0.5	0.5	Chenopod shrub (M)	
Lyn_25	<i>Stylobasium spathulatum</i>	1	2.25	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_25	<i>Threlkeldia diffusa</i>	2	0.25	Chenopod shrub (M)	
Lyn_26	* <i>Avena barbata</i>	30	0.25	Other grass (G)	
Lyn_26	* <i>Brassica tournefortii</i>	0.1	0.1	Forb (G)	
Lyn_26	* <i>Ehrharta longiflora</i>	35	0.25	Other grass (G)	
Lyn_26	* <i>Sonchus oleraceus</i>	0.1	0.1	Forb (G)	
Lyn_26	<i>Acacia rostellifera</i>	10	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_26	<i>Austrostipa elegantissima</i>	2	0.25	Other grass (G)	
Lyn_26	<i>Commicarpus australis</i>	0.5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_26	<i>Olearia sp. Kennedy Range</i> (G Byrne 66)	10	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_26	<i>Pimelea microcephala</i> <i>subsp microcephala</i>	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_26	<i>Ptilotus divaricatus</i>	0.1	0.5	Forb (G)	
Lyn_26	<i>Rhagodia preissii</i> <i>subsp. obovata</i>	20	1	Chenopod shrub (M)	
Lyn_26	<i>Roepera fruticulosa</i>	1	0.5	Vine (G)	


Lyn_26	<i>Tetragonia implexicoma</i>	20	1.25	Chenopod shrub (M)	
Lyn_27	* <i>Ehrharta longiflora</i>	75	0.25	Other grass (G)	
Lyn_27	<i>Acacia rostellifera</i>	60	2	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_27	<i>Aristida sp (insufficient material)</i>	0.1	0.25	Other grass (G)	
Lyn_27	<i>Austrostipa elegantissima</i>	8	0.25	Other grass (G)	
Lyn_27	<i>Commicarpus australis</i>	2	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_27	<i>Euphorbia boophthona</i>	0.5	0.25	Forb (G)	
Lyn_27	<i>Pimelea microcephala subsp microcephala</i>	5	1	Shrub, cycad, grass-tree, tree-fern (M)	
Lyn_27	<i>Rhagodia preissii subsp. obovata</i>	10	1.25	Chenopod shrub (M)	
Lyn_27	<i>Roepera fruticulosa</i>	1	0.5	Vine (G)	
Lyn_27	<i>Tetragonia implexicoma</i>	20	1.25	Chenopod shrub (M)	
	* <i>Helianthus annuus</i>				x
	* <i>Cenchrus ciliatus</i>				x
	* <i>Ehrharta brevifolia</i>				x
	* <i>Euphorbia terracina</i>				x
	* <i>Mesembryanthemum crystallinum</i>				x
	<i>Amyema preissii</i>				x
	<i>Atriplex cinerea</i>				x
	<i>Commersonia boerhavia</i>				x
	<i>Eucalyptus utilis (planted non-local)</i>				x

Quadrat and point data

Site		Lyn_01	
Type: Quadrat		Size: 10 x 10	
Location: E 229786.45, N 6884508.45			
Vegetation Type: VT02			
Landform: Hillslope /moderate	Drainage: Good		
Soil Colour & Type: Brown/white sand			
Vegetation Condition: n/a			
Disturbances :weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 11-30%	Litter: 11-30%		

Site		Lyn_02	
Type: Quadrat		Size: 10 x 10	
Location: E 229700.52 N 6884617.32			
Vegetation Type: VT02			
Landform: Hillslope /moderate	Drainage: Good		
Soil Colour & Type: Brown/white sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 11-30%	Litter: 31-70%		

Site		Lyn_03	
Type: Quadrat		Size: 10 x 10	
Location: E 229640.3 N 6884668.98			
Vegetation Type: VT02			
Landform: Hillslope/moderate	Drainage: Good		
Soil Colour & Type: Pale/red brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 31-70%	Litter: 11-30%		
			


Site		Lyn_04	
Type: Quadrat		Size: 10 x 10	
Location: E 229410.34 N 6884757.73			
Vegetation Type: VT01			
Landform: Hillslope /moderate	Drainage: Good		
Soil Colour & Type: Dark brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 11-30%	Litter: 31-70%		


Site		Lyn_05	
Type: Quadrat		Size: 10 x 10	
Location: E 229204.34 N 6885011.92			
Vegetation Type: VT01			
Landform: Hillslope/moderate		Drainage: Good	
Soil Colour & Type: Pale brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 31-70%		Litter: 31-70%	



Site		Lyn_06	
Type: Quadrat		Size: 10 x 10	
Location: E 229015.06 N 6884757.82			
Vegetation Type: VT01			
Landform: Sandplain /gentle		Drainage: Good	
Soil Colour & Type: Dark brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: <2%		Litter: 11—30%	



Site		Lyn_07	
Type: Quadrat		Size: 10 x 10	
Location: E 228795.5 N 6885075.98			
Vegetation Type: VT01			
Landform: Sandplain /gentle	Drainage: Good		
Soil Colour & Type: Dark brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: <2%	Litter: 11-30%		


Site		Lyn_08	
Type: Quadrat		Size: 10 x 10	
Location: E 228600.3 N 6885391.62			
Vegetation Type: VT01			
Landform: Sandplain /gentle	Drainage: Good		
Soil Colour & Type: Dark brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: <2%	Litter: 11-30%		


Site		Lyn_09	
Type: Quadrat		Size: 10 x 10	
Location: E 228096.99 N 6885852.3			
Vegetation Type: VT01			
Landform: Sandplain /negligible		Drainage: Good	
Soil Colour & Type: Dark brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: <2%		Litter: 31-70%	




Site		Lyn_10	
Type: Quadrat		Size: 10 x 10	
Location: E 227994.53 N 6886401.6			
Vegetation Type: VT02			
Landform: Foothlope /moderate		Drainage: Good	
Soil Colour & Type: Dark brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 11-30%		Litter: 2-10%	





Site		Lyn_11	
Type: Quadrat		Size: 10 x 10	
Location: E 229040.02 N 6885353.38			
Vegetation Type: VT02			
Landform: Boulders/rockpile /moderate	Drainage: Good		
Soil Colour & Type: Dark brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 11-30%	Litter: 11-30%		


Site		Lyn_12	
Type: Quadrat		Size: 10 x 10	
Location: E 227639.13 N 6886366.05			
Vegetation Type: VT03			
Landform: Drainage area/floodplain/ negligible	Drainage: Seasonally wet		
Soil Colour & Type: Light brown clay			
Vegetation Condition: n/a			
Disturbances: weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 2-10%	Litter: 2-10%		

Site		Lyn_13	
Type: Releve		Size: 10 x 10	
Location: E 227241.68 N 6886969.47			
Vegetation Type: VT01			
Landform: Hillslope /moderate	Drainage: Good		
Soil Colour & Type: Light brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 2-10%	Litter: 11-30%		


Site		Lyn_14	
Type: Releve		Size: 10 x 10	
Location: E 229622.99 N 6884218.17			
Vegetation Type: VT01			
Landform: Sandplain /gentle	Drainage: Good		
Soil Colour & Type: Dark brown sand			
Vegetation Condition: n/a			
Disturbances:weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 2-10%	Litter: 31-70%		


Site		Lyn_15	
Type: Releve		Size: 10 x 10	
Location: E 229870.34 N 6884378.17			
Vegetation Type: VT02			
Landform: Hillslope /moderate	Drainage: Good		
Soil Colour & Type: Brown/white sand			
Vegetation Condition: n/a			
Disturbances:weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 31-70%	Litter: 11-30%		


Site		Lyn_16	
Type: Releve		Size: 10 x 10	
Location: E 230131.9 N 6884144.79			
Vegetation Type: VT02			
Landform: Hillslope /moderate	Drainage: Good		
Soil Colour & Type: Brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 2-10%	Litter: 31-70%		


Site		Lyn_17	
Type: Quadrat		Size: 10 x 10	
Location: E 231034.5 N 6882513.78			
Vegetation Type: VT01			
Landform: Sandplain /negligible	Drainage: Good		
Soil Colour & Type: Brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 11-30%	Litter: 31-70%		
			


Site		Lyn_18	
Type: Quadrat		Size: 10 x 10	
Location: E 231264.75 N 6882595.25			
Vegetation Type: VT01			
Landform: Foothlope /gentle	Drainage: Good		
Soil Colour & Type: Brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 2-10%	Litter: 11-30%		
			


Site		Lyn_19	
Type: Quadrat		Size: 10 x 10	
Location: E 231529.36 N 6882483.33			
Vegetation Type: VT01			
Landform: Foothlope /gentle	Drainage: Good		
Soil Colour & Type: Brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 2-10%	Litter: 11-30%		

Site		Lyn_20	
Type: Quadrat		Size: 10 x 10	
Location: E 231844.61 N 6881671.02			
Vegetation Type: VT01			
Landform: Hillcrest/Upper Hillslope	Drainage: Good		
Soil Colour & Type: Brown sand			
Vegetation Condition: n/a			
Disturbances:weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 2-10%	Litter: 2-10%		

Site		Lyn_21	
Type: Quadrat		Size: 10 x 10	
Location: E 232238.85 N 6881343.07			
Vegetation Type: Rehabilitation area			
Landform: Hillslope/moderate	Drainage: Good		
Soil Colour & Type: Light brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 2-10%	Litter: 11-30%		
			


Site		Lyn_22	
Type: Releve		Size: 10 x 10	
Location: E 232528.44 N 6880732.71			
Vegetation Type: VT01			
Landform: Hillcrest/upper Hillslope	Drainage: Good		
Soil Colour & Type: Light brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 11-30%	Litter: 2-10%		

Site		Lyn_23	
Type: Releve		Size: 10 x 10	
Location: E 232917.63 N 6880203.95			
Vegetation Type: VT01			
Landform: Hillcrest/upper Hillslope /negligible	Drainage: Good		
Soil Colour & Type: Light brown sand			
Vegetation Condition: n/a			
Disturbances: weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 31-70%	Litter: 11-30%		
			

Site		Lyn_24	
Type: Releve		Size: 10 x 10	
Location: E 232806.62 N 6880438.81			
Vegetation Type: Rehabilitation areas			
Landform: Flat/ Negligible	Drainage: Good		
Soil Colour & Type: Light brown sand			
Vegetation Condition: n/a			
Disturbances:weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 2-10%	Litter: 2-10%		
			

Site		Lyn_25	
Type: Quadrat		Size: 10 x 10	
Location: E 232681.45 N 6880449.53			
Vegetation Type: Rehabilitation areas			
Landform: Flat /Negligible	Drainage: Good		
Soil Colour & Type: Light brown sand			
Vegetation Condition: n/a			
Disturbances:weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 11-30%	Litter: 11-30%		

Site		Lyn_26	
Type: Quadrat		Size: 10 x 10	
Location: E 232038.67 N 6881377.85			
Vegetation Type: VT01			
Landform: Flat /Negligible	Drainage: Good		
Soil Colour & Type: Light brown sand			
Vegetation Condition: n/a			
Disturbances:weeds/grazing/clearing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: 11-30%	Litter: 11-30%		

Site		Lyn_27	
Type: Quadrat		Size: 10 x 10	
Location: E 230656.58 N 6882650.17			
Vegetation Type: VT01			
Landform: Flat /Gentle		Drainage: Good	
Soil Colour & Type: Dark brown sand			
Vegetation Condition: n/a			
Disturbances:weeds/grazing			
Fire Age and Intensity: Old 6+yr			
Bare Ground: <2%		Litter: 31-70%	

Flora likelihood of occurrence assessment guidelines

Likelihood of occurrence	Guideline
Known	Species recorded within study area from field project results (none as this is a desktop search only).
Likely	Species previously recorded within 2 km and large areas of suitable habitat occur in the survey area.
Possible	Species previously recorded within 10 km and areas of suitable habitat occur/may occur in the survey area.
Unlikely	Species previously recorded within 20 km, or suitable habitat does not occur in the survey area.
Highly unlikely	Species not previously recorded within 20 km, suitable habitat does not occur in the survey area and/or the survey area is outside the natural distribution of the species.
Other considerations	Date of known records, cryptic nature of species, anecdotal evidence from previous studies/surveys

Definitions

Term	Description
Study area	A 10 km buffer around the survey area
Survey area	The potential project footprint
Cr	Critically endangered
En	Endangered
T	Threatened
Vu	Vulnerable
P1 – P4	Priority 1 – Priority 4
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
DBCA	Department of Biodiversity and Conservation Attractions 2018. WA Government, Department of Parks and Wildlife Threatened (Declared Rare) and Priority Flora List
BC Act	Biodiversity Conservation Act 2016

Flora likelihood of occurrence assessment of conservation significant flora identified in the desktop assessment as potentially occurring within 10 km of the survey area

Family	Taxa	Status		Description and closest record information (if available) (WA Herbarium 2020, DBCA 2019)	Likelihood of occurrence
		Federal	State		
Amaranthaceae	<i>Ptilotus chortophytus</i>		P1	Erect perennial herb to 0.15 m high. Flowers yellow. Hillside. Kockatea, breakaway, quartz and shale. The nearest record is approximately 7 km south of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Asteraceae	<i>Balladonia aevroides</i>		P3	Annual herb. Calcareous sand or sandy loam. Flowers August to October. The nearest record is approximately 3 km west of the survey area.	Possible – there is suitable habitat within the survey area.
Asteraceae	<i>Ozothamnus vespertinus</i>		P1	Perennial small shrub, 0.6 m high x 0.5 m wide. White flowers in globular head. Edge of breakaway. Mudstone/shale gravel. Fine white loam/clay. Closest known record is approximately 8 km south-east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Colchicaceae	<i>Wurmbea tubulosa</i>	En	T	Cormous, perennial, herb, 0.01-0.03 m high, dioecious or sometimes andromonoecious. Fl. white-pink, Jun to Aug. Clay, loam. River banks, seasonally-wet places. The nearest record is approximately 8 km south.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Dasypogonaceae	<i>Calectasia browneana</i>		P2	Spreading, caespitose perennial, herb, 0.2-0.5 m high, to 0.4 m wide. Flowers blue-purple, Jun to August. White-grey sand, laterite. Adjacent to wet areas of creekline. The nearest recorded in 9 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Ericaceae	<i>Leucopogon</i> sp. Port Gregory (C. Page 33)		P1	Erect shrub to 0.3 m and 0.5 m wide. Flowers white. Shale breakaway. Wet red brown soil on	Highly Unlikely – there is no suitable habitat for this species

Family	Taxa	Status		Description and closest record information (if available) (WA Herbarium 2020, DBCA 2019)	Likelihood of occurrence
		Federal	State		
				shale. The nearest know record approximately 8 km east and south-east of the survey area.	within the survey area.
Ericaceae	<i>Styphelia cernua</i> (previously known as <i>Astroloma</i> sp. Kalbarri (D. & B. Bellairs 1368)		P2	Shrub up to 1.7 m with white flowers, green young fruit. Yellow sandplain, undulating plain, white/grey sand, dunes. Closest record approximately 10 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Euphorbiaceae	<i>Beyeria cinerea</i> subsp. <i>cinerea</i>		P3	Shrub to 1 m high. Flowers yellow. Limestone ridge. Dry, rocky brown sand over limestone, grey sands. The nearest record is approximately 10 km south of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Euphorbiaceae	<i>Stachystemon nematophorus</i>	Vu	P4	Woody, dense shrub, to 1.2 m high. Dry sand, sandy gravel over laterite, sandstone. Exposed rocky sites, disturbed ground. The nearest recorded is approximately 8 km east and south-east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Fabaceae	<i>Acacia latipes</i> subsp. <i>licina</i>		P3	Pungent shrub, 0.4-1.2 m high. White sand, granitic soils. Limestone hills, sandplains. Flowers yellow, June to September. The nearest record is approximately 200 m east of the survey area.	Unlikely – suitable survey effort did not record this species
Fabaceae	<i>Acacia pelophila</i>		P1	Dense, spreading shrub, 0.9-2 m high. Clay. Saline creeklines. Flowers yellow, July to August. The nearest recorded is approximately 8 km south of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.

Family	Taxa	Status		Description and closest record information (if available) (WA Herbarium 2020, DBCA 2019)	Likelihood of occurrence
		Federal	State		
Fabaceae	<i>Acacia ridleyana</i>		P3	Spreading, sprawling shrub, 0.2-0.9 m high, 0.5-2 m wide. Grey or yellow/brown sand, gravelly clay, granitic loam. Flowers yellow, August to December. The closest record is approximately 10 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Fabaceae	<i>Gastrolobium propinquum</i>		P3	Low, bushy shrub, to 1(-1.8) m high. Flowers orange & yellow & red, June to September. Clay, clay-loam or sandy clay soils, granite, shale. Hills, flats, drainage lines, winter-wet areas. The nearest record is 8 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Frankeniaceae	<i>Frankenia confusa</i>		P4	Low, diffuse shrub, to 0.75 m high, to 0.75 wide. Wet pale brown sand, brown clay, grey soil. Banks of rivers & waterholes, river floodplains. Flowers pink, September. The nearest record is approximately 3 km west of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Goodeniaceae	<i>Scaevola kallophylla</i>		P4	Erect, compact shrub, to 1 m high. Sandy soils over limestone. Coastal plain. Flowers white, May or August to December. The nearest record is located approximately 3 km west of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Goodeniaceae	<i>Scaevola oldfieldii</i>		P3	Erect shrub to 1.5 m and 1.2 m wide. Flowers white. Sandplains, grey sand, brown gravelly loam. The nearest record is 8 km south of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Hydatellaceae	<i>Trithuria australis</i>		P4	Small annual aquatic herb. Seasonally wet poorly drained flat, edge of wetlands, along drying margins, grey and black clayey soils.	Highly Unlikely – there is no suitable habitat for this species

Family	Taxa	Status		Description and closest record information (if available) (WA Herbarium 2020, DBCA 2019)	Likelihood of occurrence
		Federal	State		
				The nearest record is approximately 7.5 km south of the survey area.	within the survey area.
Lamiaceae	<i>Hemigenia pimelifolia</i>		P2	Shrub, 0.2-1 m high. Flowers blue-purple/violet, July to October. Gravelly soils. The nearest record is approximately 7 km south of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Lamiaceae	<i>Prostanthera scutata</i>		P2	Erect, compact shrub, 0.2 – 0.3 m high. Flowers blue-violet, October or December to January. Gravelly sand. The nearest record is approximately 7 km south of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Lamiaceae	<i>Teucrium</i> sp. Hutt River (W.H. Butler 54)		P1	No available information. Only one known record of this species (from 1964), located approximately 7 km south of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Malvaceae	<i>Androcalva bivillosa</i>	Cr	T	Low spreading shrub. Occur on flats and slopes, reddish-brown or yellow sand with lateritic gravel. Road verge lateritic gravel and orange brown clayey sand. Recent soil disturbance. White flowers July to October. Fruit present during late October to December. The closest known record is approximately 38 km south-east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Malvaceae	<i>Androcalva microphylla</i>		P2	Spreading recumbent dwarf shrub 30 cm x 100 cm. White flowers. White grey sand over sandstone. The nearest record is 10 km north of the survey area.	Highly Unlikely – there is no suitable habitat for this species

Family	Taxa	Status		Description and closest record information (if available) (WA Herbarium 2020, DBCA 2019)	Likelihood of occurrence
		Federal	State		
					within the survey area.
Malvaceae	<i>Guichenotia quasicalva</i>		P2	Erect, compact shrub, to 0.5 m high. Flowers blue-purple, September to October. Sandy clay over laterite. Drainage line. The nearest recorded in 7 km south-east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Malvaceae	<i>Lasiopetalum oldfieldii</i>		P3	Shrub, 0.2-0.8 m high. Sandy soils. Flowers pink, August to October. The nearest record is less than 2 km west of the survey area.	Unlikely – there is suitable habitat within the survey area, however, suitable survey effort did not record this species
Menyanthaceae	<i>Liparophyllum congestiflorum</i>		P4	Small annual herb to 20 cm, yellow petals, green sepals. Occurs in winter wet low lying area, low plain, grey sand over sandstone. The nearest record is approximately 7 km south of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Myrtaceae	<i>Calytrix harvestiana</i>		P2	Shrub, 0.3-0.7 m high. White or yellow sand. Flats. Flowers purple-pink/violet, September to December. Sandplain, yellow sand. Sandstone, brown sand. The nearest record is 4 km south of the survey area.	Unlikely – there is suitable habitat within the survey area, however, suitable survey effort did not record this species
Myrtaceae	<i>Calytrix pimeleoides</i>		P3	Erect, perennial shrub 1 m high x .5 m wide. Flowers yellow. Ridge. Dry, gravelly yellow-brown	Highly Unlikely – there is no suitable habitat

Family	Taxa	Status		Description and closest record information (if available) (WA Herbarium 2020, DBCA 2019)	Likelihood of occurrence
		Federal	State		
				sand. The nearest record is approximately 8 km east of the survey area.	for this species within the survey area.
Myrtaceae	<i>Chamelaucium</i> sp. Coolcalalaya (A.H. Burbidge 4233)		P1	Dense and compact shrub to 1.5 m, red-purple/white flowers. Undulating dunes, white sandplains. Yellow sandy loam. Closest known record is approximately 9 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Myrtaceae	<i>Eucalyptus blaxellii</i>		P4	(Mallee), 1-4 m high, bark smooth. Flowers white-cream, August to November. Grey sand, clay. Rocky hillsides, creek flats. The nearest record is approximately 8 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Myrtaceae	<i>Eucalyptus cuprea</i>	En	T	(Mallee), 2.5-5 m high, bark rough to 1.5 m, box-type. Flowers white, August to November. Shallow soils over granite. The nearest record is 16 km south of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Myrtaceae	<i>Hypocalymma angustifolium</i> subsp. Hutt River (S. Patrick 2982)	Vu	T	Shrub. Moist, brown black peat clay with sand. The nearest record is approximately 9 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Myrtaceae	<i>Hypocalymma longifolium</i>	Vu	T	Open shrub, to 1 m high. Grey sand or clay, sandstone. Rocky breakaways, swampland. Flowers white/cream, August to September. The nearest record is approximately 9 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.

Family	Taxa	Status		Description and closest record information (if available) (WA Herbarium 2020, DBCA 2019)	Likelihood of occurrence
		Federal	State		
Myrtaceae	<i>Melaleuca huttensis</i>		P3	Erect shrub to 1.5 m high, flowers cream. Generally occurs on brown sand over laterite, but has been previously recorded in the survey area in orange, white and yellow sands on lower slopes of undulating plains and sandplains (GHD 2019). Flat plain. There area records located in M70/968, located less than 500 m east of the survey area (GHD 2014).	Unlikely – there is suitable habitat within the survey area, however, suitable survey effort did not record this species
Myrtaceae	<i>Verticordia densiflora</i> var. <i>roseostella</i>		P3	Open shrub, 0.4-1.3 m high. Flowers pink-white, September to December. Sandy gravelly soils. The nearest record is approximately 9 km south of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Orchidaceae	<i>Caladenia barbarella</i>	En	T	Tuberous, perennial, herb, 0.08-0.25 m high. Flowers green, August to September. Occur on shallow, grey, dark brown, sandy clayey loam. Rocky ledges, alongside seasonal creeklines, winter-wet depressions. Closest known record is approximately 43 km north-east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Orchidaceae	<i>Caladenia bryceana</i> subsp. <i>cracens</i>	Vu	T	Tuberous, perennial, herb, 0.03-0.08 m high. Flowers green-yellow, August to September. Sand over limestone, and shallow beige sands under moist areas beneath <i>M. cardiophylla</i> and <i>Grevillea argyropylla</i> , in the study area (GHD 2019). South of Kalbarri in low heath on limestone hills; north in winter-moist flats. The nearest records are approximately 23 km north and south of the survey area. GHD have recorded this species in adjacent tenements, with the closest record approximately 600 m east (GHD 2019).	Possible – suitable habitat (VT02) is present in the survey area and targeted surveys during the species flowering period may possibly record the species

Family	Taxa	Status		Description and closest record information (if available) (WA Herbarium 2020, DBCA 2019)	Likelihood of occurrence
		Federal	State		
Orchidaceae	<i>Caladenia elegans</i>	En	T	Tuberous, perennial, herb, 0.2-0.3 m high. Flowers yellow, July to August. Clayey loam. Winter-wet clay flats. The nearest record is approximately 35 metres from the northern end of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area. The record of this species was recorded in 2009, and the land has since been dramatically altered.
Orchidaceae	<i>Caladenia hoffmanii</i>	En	T	Tuberous, perennial, herb, 0.13-0.3 m high. Flowers green and yellow and red, August to October. Clay, loam, laterite, granite. Rocky outcrops and hillsides, ridges, swamps and gullies. The nearest record is 8 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Orchidaceae	<i>Diuris drummondii</i>	Vu	T	Tuberous, perennial, herb, 0.5-1.05 m high. Flowers yellow, November to December or January. Low-lying depressions, swamps. The nearest record is approximately 9 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Orchidaceae	<i>Diuris recurva</i>		P4	Tuberous, perennial, herb, 0.2-0.3 m high. Flowers yellow & brown, July to August. Loam. Winter-wet areas. In the study area, has been recorded on pale brown/yellow sand in sparsely vegetated areas with <i>M. huttensis</i> and <i>Grevillea argyrophylla</i> heath, and <i>M. huttensis</i> and <i>Acacia rostellifera</i> shrubland (GHD 2019). The nearest DBCA record is approximately 8 km east of the survey area. The species has been recorded recently approximately 600 m east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.

Family	Taxa	Status		Description and closest record information (if available) (WA Herbarium 2020, DBCA 2019)	Likelihood of occurrence
		Federal	State		
Orchidaceae	<i>Drakaea concolor</i>	Vu	T	Tuberous, perennial, herb, 0.25-0.3 m high. Flowers red and yellow, August to September. Grows in moist sandy sites in the Northampton region along the Murchison and Hutt River. The nearest record is approximately 3.5 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Orchidaceae	<i>Pterostylis sinuata</i>	En	T	Small tuberous herb 5-10 cm tall. The flower spike emerges from a basal rosette of leaves and bears between two and twenty pale green 'greenhood' flowers, each of which are approximately 5 x 5 mm (Hoffman and Brown 1998). Fl. August to early September. Prefers open <i>Melaleuca uncinata</i> and <i>Hakea recurva</i> low scrub over low heath in winter-wet clay soils over laterite. The nearest record is 9 km south-east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Polygalaceae	<i>Comesperma rhadinocarpum</i>		P3	Perennial, herb. Flowers blue, October to November. Sandy soils. The nearest record is approximately 8 km north of the survey area.	Unlikely – suitable survey effort did not record this species
Proteaceae	<i>Grevillea triloba</i>		P3	Diffuse or spreading shrub, (0.4-) 0.9-1.5 (-2.5) m high. Flowers white/pink-white, June to October. Sandy loam on sandstone or limestone, lateritic soils. The nearest record is from the Port Gregory area near the Murchison (GPS record incorrect on Naturemap).	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Rhamnaceae	<i>Blackallia nudiflora</i>		P3	Shrub, 0.3-1 m high, often with spinescent branchlets. Clay or sandy clay with granite. On hills or breakaways, plains. The nearest record is approximately 4 km east of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.

Family	Taxa	Status		Description and closest record information (if available) (WA Herbarium 2020, DBCA 2019)	Likelihood of occurrence
		Federal	State		
Rutaceae	<i>Drummondita ericoides</i>	En	T	Divaricately branched shrub, 0.3-1 m high. Flowers yellow and white and violet/purple, September to October. Occur on rocky places. Closest known record is approximately 44 km south of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Scrophulariaceae	<i>Eremophila microtheca</i>		P4	Erect shrub, 0.7-1.6 m high. Sandy clay. Winter wet flats, saline flats, sandplains. Flowers blue-purple, August to September. The nearest record is approximately 3 km west of the survey area.	Highly Unlikely – there is no suitable habitat for this species within the survey area.
Solanaceae	<i>Anthocercis intricata</i>		P3	Dense, spinescent shrub, 0.9-3 m high. Flowers white-cream, June to September. Sand or loam over limestone. In the study area, orange/yellow sand in <i>M. huttensis</i> and <i>Acacia rostellifera</i> shrubland (GHD 2019). Consolidated sand dunes. The nearest DBCA record is 5 km south however GHD has recorded this species in adjacent tenements, with records less than 500 m from the survey area (GHD 2014, GHD 2019).	Possible – suitable habitat occurs within the survey area, however, the habitat is degraded.

Appendix E – Fauna data

Fauna species list

Fauna likelihood of occurrence

Fauna species recorded during the survey

Family	Genus	Species	Common Name	Status
Birds				
Acanthizidae	<i>Acanthiza</i>	<i>chrysorrhoa</i>	Yellow-rumped Thornbill	
Accipitridae	<i>Aquila</i>	<i>audax</i>	Wedge-tailed Eagle	
Accipitridae	<i>Pandion</i>	<i>cristatus</i>	Eastern Osprey	Mi, IA
Accipitrinae	<i>Elanus</i>	<i>axillaris</i>	Black-Shouldered Kite	
Artimidae	<i>Artamus</i>	<i>minor</i>	Little Woodswallow	
Artimidae	<i>Cracticus</i>	<i>nigrogularis</i>	Pied Butcherbird	
Campephagidae	<i>Coracina</i>	<i>novaeollandiae</i>	Black-faced Cuckoo-shrike	
Corvidae	<i>Corvus</i>	<i>coronoides</i>	Australian Raven	
Columbidae	<i>Streptopelia</i>	<i>senegalensis</i>	Laughing Turtle Dove	*
Falconidae	<i>Falco</i>	<i>cenchroides</i>	Australian Kestrel	
Halcyonidae	<i>Todiramphus</i>	<i>sanctus</i>	Sacred Kingfisher	
Hirundinidae	<i>Hirundo</i>	<i>neoxena</i>	Welcome Swallow	
Hirundinidae	<i>Petrochelidon</i>	<i>nigricans</i>	Tree Martin	
Maluridae	<i>Malurus</i>	<i>lamberti</i>	Variegated Fairy-wren	
Maluridae	<i>Malurus</i>	<i>splendid</i>	Splendid Fairy-wren	
Meliphagidae	<i>Gavicalis</i>	<i>virscens</i>	Singing Honeyeater	
Meliphagidae	<i>Lichmera</i>	<i>indistincta</i>	Brown Honeyeater	
Meropidae	<i>Merops</i>	<i>ornatus</i>	Rainbow Bee-eater	
Pachycephalidae	<i>Pachycephala</i>	<i>pectoralis</i>	Golden Whistler	
Petroicidae	<i>Eopsaltria</i>	<i>georgiana</i>	White-breasted Robin	
Pomatostomidae	<i>Pomatostomus</i>	<i>superciliosus</i>	White-browed Babbler	
Timaliidae	<i>Zosterops</i>	<i>lateralis</i>	Silvereye	
Tytonidae	<i>Tyto</i>	<i>alba</i>	Barn Owl	
Mammals				
Bovidae	<i>Ovis</i>	<i>aries</i>	Sheep	*
Canidae	<i>Canis</i>	<i>lupis</i>	Domestic Dog	*
Canidae	<i>Vulpes</i>	<i>vulpes</i>	Red Fox	*
Felidae	<i>Felis</i>	<i>catus</i>	Feral Cat	*
Leporidae	<i>Oryctolagus</i>	<i>cuniculus</i>	European Rabbit	*
Macropodidae	<i>Macropus</i>	<i>fuliginosus</i>	Western Grey Kangaroo	
Macropodidae	<i>Osphranter</i>	<i>rufus</i>	Red Kangaroo	
Suidae	<i>Sus</i>	<i>scrofa</i>	Wild Boar	*
Reptiles				
Agamidae	<i>Pogona</i>	<i>minor minor</i>	Bearded Dragon	
Scincidae	<i>Tiliqua</i>	<i>rugosa</i>	Bobtail Skink	

* Introduced (BAM Act)

Parameters of fauna likelihood of occurrence assessment

Assessment outcome	Description
Present	Species recorded during the field survey or from recent, reliable records from within or close proximity to the survey area.
Likely	Species are likely to occur in the survey area where there is suitable habitat within the survey area and there are recent records of occurrence of the species in close proximity to the survey area. OR Species known distribution overlaps with the survey area and there is suitable habitat within the survey area.
Unlikely	Species assessed as unlikely include those species previously recorded within 10 km of the survey area however: <ul style="list-style-type: none"> • There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area. • The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area. OR Those species that have a known distribution overlapping with the survey area however: <ul style="list-style-type: none"> • There is limited habitat in the survey area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). • The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area.
Highly unlikely	Species that are considered highly unlikely to occur in the survey area include: <ul style="list-style-type: none"> • Those species that have no suitable habitat within the survey area. • Those species that have become locally extinct, or are not known to have ever been present in the region of the survey area.

Definitions

Term	Description
Study area	A 20 km buffer around the survey area
Survey area	The potential project footprint
Cr	Critically endangered
En	Endangered
Vu	Vulnerable
IA	International agreement
Mi, Ma	Migratory, Marine
CD	Conservation dependent
OS	Other specially protected fauna
P1 – P4	Priority 1 – Priority 4
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
DBCA	Department of Biodiversity and Conservation Attractions 2019 WA Government, Department of Parks and Wildlife Threatened and Priority fauna rankings
BC Act	<i>Biodiversity Conservation Act 2016</i>

Fauna likelihood of occurrence assessment of conservation significant fauna identified in the desktop assessment as potentially occurring within the study area

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
<i>Anous tenuirostris melanops</i> Australian Lesser Noddy	Vu	En			X	The Australian Lesser Noddy is usually found only around its breeding islands in the Houtman Abrolhos Islands in Western Australia. There are also some records north of the breeding islands, for example at the Wallabi Group of islands, in the northern Houtman Abrolhos Islands, on Barrow Island, and at Webb Island. The species usually occupies coral-limestone islands that are densely fringed with White Mangrove <i>Avicennia marina</i> . It occasionally occurs on shingle or sandy beaches (Higgins & Davies 1996). The Australian Lesser Noddy roosts mainly in mangroves, especially at night but may sometimes rest on beaches.	Highly unlikely There is no suitable habitat within the survey area. The closest known records are from the Abrolhos Islands, over 60 km off the coast.
<i>Calidris canutus</i> Red knot, Knot	En	En, IA			X	In Australasia the Red Knot mainly inhabits intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps (DEE 2017). They are found near mudflats and estuaries from Murchison to Bunbury but are then uncommon from Wilson Inlet to Esperance. In the Perth region they are mainly found in Alfred Cove and Peel Inlet (Nevill 2013).	Unlikely The species has been recorded from the nearby Hutt Lagoon, however there is no suitable habitat within the survey area.

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
<i>Calidris ferruginea</i> Curlew Sandpiper	Cr	Cr	X		X	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (Higgins & Davies 1996). Curlew Sandpipers forage on mudflats and nearby shallow water. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores. At high tide, they forage among low sparse emergent vegetation, such as saltmarsh, and sometimes forage in flooded paddocks or inundated saltflats. Curlew Sandpipers generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh (Higgins & Davies 1996).	Unlikely The species has been recorded multiple times from Hutt Lagoon and nearby coastal areas, however there is no suitable habitat within the survey area.
<i>Calidris tenuirostris</i> Great Knot	Cr	Cr	X			In Australasia, the species typically prefers sheltered coastal habitats, with large intertidal mudflats or sandflats. This includes inlets, bays, harbours, estuaries and lagoons. They are occasionally found on exposed reefs or rock platforms, shorelines with mangrove vegetation, ponds in saltworks, at swamps near the coast, saltlakes and non-tidal lagoons. The Great Knot rarely occurs on inland lakes and swamps. Typically, the Great Knot roosts in large groups in	Unlikely The species has been recorded from Hutt Lagoon, however there is no suitable habitat within the survey area.

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
						open areas, often at the waters edge or in shallow water close to feeding grounds (DotEE 2020).	
<i>Calyptrorhynchus latirostris</i> Carnaby's Cockatoo	En	En	X	X	X	Carnaby's Black-cockatoo occurs in uncleared or remnant native eucalypt woodlands, especially those that contain salmon gum, wandoo, marri, jarrah and karri, and in shrubland or kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. Breeding activity is restricted to eucalypt woodlands mainly in the semiarid and subhumid interior, from Kalbarri in the north, Three Springs District south to the Stirling Range, west to Cockleshell Gully and east to Manmanning. The species has expanded its breeding range westward and south into the jarrah-marri forests of the Darling Scarp and into the tuart forests of the Swan Coastal Plain, including the Yanchep area, Lake Clifton and near Bunbury. It nests in trees older than 120-150 years (DotEE 2020).	Unlikely The survey area is located within the non-breeding range of the modelled distribution of the Carnaby's Cockatoo (DSEWPaC 2012). However, there is no suitable habitat (foraging or roosting habitat) present within the survey area.
<i>Charadrius leschenaultii</i> Greater Sand Plover	Vu	Vu	X		X	In the non-breeding grounds in Australasia, the species is almost entirely coastal, inhabiting littoral and estuarine habitats. They mainly occur on sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks, as well as sandy estuarine lagoons and inshore reefs, rock platforms, small rocky islands or sand cays on coral reefs. They are occasionally recorded on near-coastal saltworks and saltlakes, including marginal saltmarsh, and on brackish swamps (DotEE 2020).	Unlikely The species has been recorded multiple times from Hutt Lagoon and nearby coastal areas, however there is no suitable habitat within the survey area.

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
<i>Charadrius leschenaultii</i> Lesser Sand Plover	En, Mi	En	X			In non-breeding grounds in Australia, the Lesser Sand Plover usually occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops. It also sometimes occurs in short saltmarsh or among mangroves, in saltworks and near-coastal salt pans, brackish swamps and sandy or silt islands in river beds. The species is seldom recorded away from the coast, at margins of lakes, soaks and swamps associated with artesian bores (DotE 2016). The Lesser Sand Plover mainly occurs in northern regions, and becomes more scarce in the south west (Nevill 2013).	Unlikely The species has been recorded multiple times from Hutt Lagoon and nearby coastal areas, however there is no suitable habitat within the survey area.
<i>Diomedea amsterdamensis</i> (Amsterdam Albatross)	En, Mi	Cr			X	All the Albatross species have been grouped together as they are all primarily marine, pelagic, aerial birds.	Highly Unlikely No suitable habitat is present within the survey area.
<i>Diomedea epomophora</i> (Southern Royal Albatross)	Vu, Mi	Vu					
<i>Diomedea exulans</i> (Wandering Albatross)	Vu, Mi	Vu					
<i>Thalassarche carteri</i> (Indian Yellow-nosed Albatross)	Vu, Mi	En					
<i>Thalassarche cauta cauta</i> (Shy Albatross)	Vu, Mi	Vu					
<i>Thalassarche cauta steadi</i> (White-capped Albatross)	Vu, Mi	Vu					

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
<i>Thalassarche impavida</i> Campbell Albatross	Vu, Mi	Vu					
<i>Thalassarche melanophris</i> Black-browed Albatross	Vu, Mi	En					
<i>Leipoa ocellata</i> Malleefowl	Vu	Vu		X	X	The Malleefowl generally occurs in semi-arid areas of WA, in shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine <i>Callitris</i> woodlands, <i>Acacia</i> shrublands, paperbark, skheoak, Broombush <i>Melaleuca uncinata</i> vegetation, eucalypt woodlands, or coastal heathlands. Mostly they are found where there are sandy or gravel soils. The nest is a large mound of sand or soil and organic matter (Jones & Goth 2008; Morcombe 2011; Nevill 2013). In WA they are found from the southwest Nullarbor to Albany, north, and then west from Moore River up to Shark Bay, past Cue, across to Wiluna and east to the northern Victoria Desert south of the Blackstone Ranges (Nevill 2013; Pizzey & Knight 2012).	Unlikely The distribution of this species within this region is restricted to the Kalbarri National Park, which is located approximately 40 km north of the survey area. No evidence of this species was observed during the survey.
<i>Limosa lapponica</i> Bar-tailed Godwit / Northern Siberian Bar-tailed Godwit	Vu or Cr, Mi	Vu or Cr, IA			X	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh (Morcombe 2011). They usually forage near the edge of water or in shallow water, mainly in tidal estuaries and harbours and roost on sandy beaches, sandbars, spits and also in near-coastal saltmarshes (Marchant & Higgins 1993).	Unlikely The species has been recorded from Hutt Lagoon, however there is no suitable habitat within the survey area.

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
<i>Macronectes giganteus</i> Southern Giant-Petrel	En, Mi	IA			X	The Southern Giant-Petrel is marine bird that occurs in Antarctic to subtropical waters. In summer, it mainly occurs over Antarctic waters, and it is widespread south as far as the pack-ice and onto the Antarctic continent (Marchant & Higgins 1990). The species is not known to breed in Australia.	Highly unlikely There is no suitable habitat within the survey area.
<i>Macronectes halli</i> Northern Giant Petrel	Vu, Mi	Mi				The Northern Giant Petrel breeds in the sub-Antarctic and visits areas off the Australian mainland during the winter months (May-Oct). They are usually seen in waters off the south of Australia (DotEE 2020). The species is primarily Marine.	Highly unlikely There is no suitable habitat within the survey area.
<i>Numenius madagascariensis</i> Eastern Curlew	Cr, Mi	Cr			X	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass (Marchant & Higgins 1993).	Highly unlikely There is no suitable habitat within the survey area.
<i>Pterodroma mollis</i> Soft-plumaged Petrel	Vu				X	The Soft-plumaged Petrel is a marine, oceanic species. Soft-plumaged Petrels are mainly subantarctic, but occur over a wide range of sea surface-temperatures. Soft-plumaged Petrels breed on Maatsuyker Island off southern Tasmania. Beachcast birds have been found from Maryborough, Queensland, south to NSW, Tasmania, Victoria, South Australia and south-west Western Australia (DotEE 2020).	Highly unlikely There is no suitable habitat within the survey area.
<i>Rostratula australis</i> Australian Painted Snipe	En	En			X	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both	Highly unlikely There is no suitable habitat within the survey area.

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
						upper and canopy cover nearby. The species rarely occurs in south-western Australia, where it was once more common (Marchant & Higgins 1993; Garnett and Crowley 2000).	
<i>Sternula nereis nereis</i> Australian Fairy Tern	Vu	Vu			X	The Fairy Tern occurs along the coast of WA as far north as the Dampier Archipelago near Karratha, but mostly in the southern part of Australia including most of the coastline in the south west. It nests on sheltered sandy beaches, coastal inlets, spits and banks above the high tide line and below vegetation. It has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands, and mainland coastline (DotEE 2020; Nevill 2013). They can also be seen in saltfields, saline or brackish lakes, and sewage ponds near the coast (Pizzey and Knight 2012).	Highly unlikely There is no suitable habitat within the survey area.
<i>Pandion cristatus</i> Osprey	Mi	IA	X	X	X	Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes. They exhibit a preference for coastal cliffs and elevated islands in some parts of their range but may also occur on low sandy, muddy or rocky shores and over coral cays. The distribution of the species around the northern coast (south-western WA to	Present An individual was observed nesting in a dead <i>Acacia</i> tree within the survey area.

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
						south-eastern NSW) appears continuous except for a possible gap at Eighty Mile Beach (DotEE 2020).	
<i>Apus pacificus</i> Fork-tailed Swift	Mi	IA	X	X	X	The Fork-tailed Swift are widespread in coastal and sub-coastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands. This species is almost exclusively aerial, flying less than 1 m to at least 300 m above ground. Occupies low to very high airspace over varied habitat, rainforest to semi-desert; most active just ahead of summer storm fronts. They do not breed in Australia (DotEE 2020)	Likely There are a number of records along the coast at Port Gregory and near Hutt Lagoon.
<i>Pluvialis fulva</i> Pacific Golden Plover	Mi	IA	X	X	X	In Australia the Pacific Golden Plover usually inhabits coastal habitats, on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as <i>Sarcocornia</i> , or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in saltworks. It is sometimes recorded on islands, sand and coral cays and exposed reefs and rocks. They are less often recorded in terrestrial habitats, but can be seen in habitats with short grass in paddocks, crops or airstrips, or ploughed or	Unlikely This species is largely restricted to coastal areas. There are records of this species around Port Gregory and Hutt Lagoon however it is considered unlikely to utilise habitat within the survey area.

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
						recently burnt areas. This species does not breed in Australia (DotEE 2020).	
<i>Falco peregrinus</i> Peregrine Falcon		OS	X			The Peregrine Falcon is found on and near cliffs, gorges, timbered watercourses, riverine environments, wetlands, plains, open woodlands, and pylons and spires of buildings, though less frequently in desert regions (Morcombe 2011; Pizzey & Knight 2012). They are not common but can be found almost anywhere throughout WA and in the southwest, including particularly at Fitzgerald River, Stirling Range, Porongurup National Parks, Kondinin, and Peak Charles, with many more locations north of Perth (Nevill 2013).	Likely There are records of this species occurring around the Port Gregory area. This species may occur as an infrequent visitor, foraging within the survey area.

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
<i>Calidris acuminata</i> Sharp-Tailed Sandpiper	Mi	IA	X	X	X	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. Sometimes they occur on rocky shores. They are widespread from Cape Arid to Carnarvon, around coastal and subcoastal plains of Pilbara Region to south-west and east Kimberley Division (DotEE 2020).	Unlikely There are multiple records of this species occurring within Hutt Lagoon and Port Gregory, however there is no suitable habitat within the survey area.

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
<i>Calidris melanotos</i> Pectoral Sandpiper	Mi	IA	X	X	X	In Australia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum. In Western Australia the species is rarely recorded (DotEE 2020).	Unlikely There are records of this species occurring from Port Gregory, however this species is unlikely to utilise the habitat within the survey area.
<i>Tringa brevipes</i> Grey-tailed Tattler		P4	X			Habitat coastal; forages in inter-tidal pools, shallows, soft surfaces of mudflats and sand beaches as well as rock ledges, reefs. Often perches on branches, posts or jetties. Common summer migrant to northern Australia and uncommon in the south (Morcombe 2011).	Unlikely There is one record from the Gregory/Hutt Lagoon area. The survey area does not contain suitable habitat for this species.

Mammals

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
<i>Dasyurus geoffroii</i> Chuditch, Western Quoll	Vu	Vu		X	X	The Chuditch inhabits eucalypt forest (especially Jarrah, <i>E. marginata</i>), dry woodland, mallee shrublands, heaths, and desert, particularly in the south coast of WA. They also occur at lower densities in drier woodland and mallee shrubland in the goldfields and wheatbelt, as well as in Kalbarri National Park (translocated). Chuditch require adequate numbers of suitable den and refuge sites (horizontal hollow logs or earth burrows) to survive (DEC 2012a). In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest (Van Dyck and Strahan 2008). The species can travel large distances, and for this reason requires habitats that are of a suitable size and not excessively fragmented (DEC 2012a).	Highly unlikely The closest known record is approximately 20 km north-east of the survey area (dated 2008). Chuditch have been successfully translocated to Kalbarri National Park, however they are considered a geographically isolated population. The area surrounding the survey area has been largely cleared/fragmented due to agriculture. Given the lack of key habitat for this species, it is considered unlikely to occur.
<i>Notamacropus eugenii</i> subsp. <i>derbianus</i> Tammar Wallaby		P4	X	X		The Tammar Wallaby inhabits dense, low vegetation for daytime shelter and open grassy areas for feeding. It inhabits coastal scrub, heath, dry sclerophyll (leafy) forest and thickets in mallee and woodland. The tammar wallaby is currently known to inhabit three islands in the Houtman Abrolhos group, Garden Island near Perth, Middle and North Twin Peak Islands in the Archipelago of the Recherche, and at least nine sites on the mainland including Dryandra, Boyagin, Tutanning Batalling (reintroduced) Perup, private property near Pingelly, Jaloran Road timber reserve near Wagin, Hopetown, Stirling Range National Park, and Fitzgerald River National Park (DEC 2012; Van Dyck and Strahan 2008).	Unlikely There are two historic records approximately 7 and 18 km south east of the survey area. The species was considered locally extinct however they have been successfully re-introduced into the Kalbarri National Park.

Reptiles

Species	Status		Desktop Search			Ecology and habitat	Likelihood of occurrence
	Federal	State	NM	DBCA Data	PMST		
<i>Egernia stokesii badia</i> Western Spiny-tailed Skink	En	Vu			X	<i>Egernia stokesii badia</i> occurs in open eucalypt woodlands and Acacia-dominated shrublands in semi-arid to arid areas of south-western WA (Geraldton Sandplains and Yalgoo IBRA) and, depending on taxonomic clarification, around Shark Bay including Peron Peninsula, Edel Land and Dirk Hartog Island (Geraldton Sandplain and Carnarvon IBRA). It tends to shelter in logs, in cavities in the trunks and branches of shrubs, as well as in houses and ruins, especially in accumulations of old corrugated iron (DEC 2012b).	Highly Unlikely The closest known record is more than 90 km south east of the survey area.

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	S Flemington	D. Farrar		D. Farrar		5/02/2020

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APPENDIX C - Targeted *Caladenia bryceana* subsp. *cracens* survey

Memorandum (GHD, 2020)



Memorandum

09 September 2020

To GMA Garnet Pty Ltd

Copy to

From	Sarah Flemington	Tel	+61 8 62228638
Subject	Targeted <i>Caladenia bryceana</i> subsp. <i>cracens</i> survey and conservation listed flora survey of proposed haul road	Job no.	12528268

1 Introduction

1.1 Background

GMA Garnet Pty Ltd (GMA) are in the planning phase for expanding their operations within the Lynton Mine, located east of Hutt Lagoon, in Port Gregory, WA (the project). The expansion includes excavation for expansion of an open-cut mine and associated haul road. GMA has identified it will be necessary to clear vegetation to facilitate the expansion works.

GHD (2020) undertook a survey in December 2019 for the Project, with the purpose of assessing the vegetation and potential environmental values. Based on the results of this survey, GMA and GHD have determined that a targeted Threatened orchid survey is required to support the environmental approval, anticipated to be a Native Vegetation Clearing Permit (NVCP) under Part V of the *Environmental Protection Act 1986* (EP Act).

Caladenia bryceana subsp. *cracens* is known from 15 populations between Northampton and Kalbarri. The habitat and distribution is distinctly different to that of the subspecies *bryceana*, where it is geographically isolated from subsp. *cracens*. *C. bryceana* subsp. *cracens* is known to grow scattered in low heath in shallow soil on coastal limestone. The northern section of its distribution forms populations on winter-wet flats or in swales beneath thickets of *Melaleuca uncinata* in pale red-brown sandy loam or brown sandy clay (Commonwealth of Australia, 2013).

1.2 Purpose

GMA commissioned GHD to undertake a targeted survey for the Threatened orchid, *Caladenia bryceana* subsp. *cracens* (Northern Dwarf Spider-orchid), listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Endangered under the *Biodiversity Conservation Act 2016* (BC Act 2016). The purpose of the survey was to support a NVCP application. The outcomes of the survey will be provided to the Department of Mines Industry Regulation and Safety (DMIRS) to inform their environmental assessment. This memorandum should be read in conjunction with GHD (2020) *GMA Garnet Pty Ltd Lynton Mine Expansion Biological*

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Memorandum

Survey report which contains an assessment of the flora and vegetation values of the entire Project area.

1.3 Scope of works

The scope of works involved a targeted orchid survey of potential habitat for *Caladenia bryceana* subsp. *cracens* within the survey area (Figure 1). The survey area in total is approximately 28.3 hectares (ha). GHD implemented the following scope of works to achieve the purpose of the commission:

- Assessment of the desktop results as summarised in GHD (2020) prior to undertaking the field survey
- Undertake a targeted survey for *Caladenia bryceana* subsp. *cracens* (Threatened) in relevant habitat
- Undertake a targeted survey for conservation listed flora for the proposed haul road
- Draft a memorandum (this report) that documents the methods and results of the field survey
- Provide spatial data suitable to support the submission of a NVCP application to DMIRS.





Memorandum

1.4 Limitations and assumptions

This memorandum has been prepared by GHD for GMA Garnet Pty Ltd and may only be used and relied on by GMA Garnet Pty Ltd for the purpose agreed between GHD and the GMA Garnet Pty Ltd as set out in section 1.2 of this memorandum.

GHD otherwise disclaims responsibility to any person other than GMA Garnet Pty Ltd arising in connection with this memorandum. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this memorandum were limited to those specifically detailed in the memorandum and are subject to the scope limitations set out in the memorandum.

The opinions, conclusions and any recommendations in this memorandum are based on conditions encountered and information reviewed at the date of preparation of the memorandum. GHD has no responsibility or obligation to update this memorandum to account for events or changes occurring subsequent to the date that the memorandum was prepared.

The opinions, conclusions and any recommendations in this memorandum are based on information obtained from specific sample points. Site conditions at other areas of the site may be different from the site conditions found at the specific sample points. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this memorandum on the basis of information provided by GMA Garnet Pty Ltd and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the memorandum which were caused by errors or omissions in that information.

2 Methodology

The targeted orchid survey was carried out by GHD Senior Botanist Joel Collins and Ecologist Sarah Flemington over four days from 11 – 14 August 2020. The targeted survey methodology has been conducted with reference to the Environmental Protection Authority (EPA) 2016 *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* and the Commonwealth of Australia 2013 *Survey Guidelines for Australia's Threatened Orchids*.

Prior to the survey a known population of *Caladenia bryceana* subsp. *cracens* west of the survey area, recorded during a previous survey (GHD 2019), was visited to confirm the species was in flower and assess habitat type. The population outside of the survey area was confirmed as being in full flower (Plate 1).

Areas of potentially suitable habitat occurring within the survey site (VT02 *Melaleuca cardiophylla* shrubland to open shrubland) that was previously mapped (GHD 2020) were surveyed by undertaking systematic transects spaced 10 meters apart (Figure 2) across all mapped VT02 areas within the survey area.



Memorandum

A targeted survey for conservation listed flora was also undertaken across and adjacent the proposed haul road in the north-eastern section of the survey area (Figure 2). The haul road and nearby areas were traversed using the same methodology described above.

2.1 Field survey limitations

The EPA (2016) states flora survey reports for environmental impact assessment in WA should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 1.

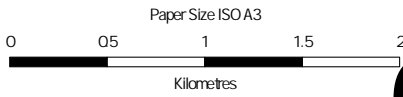
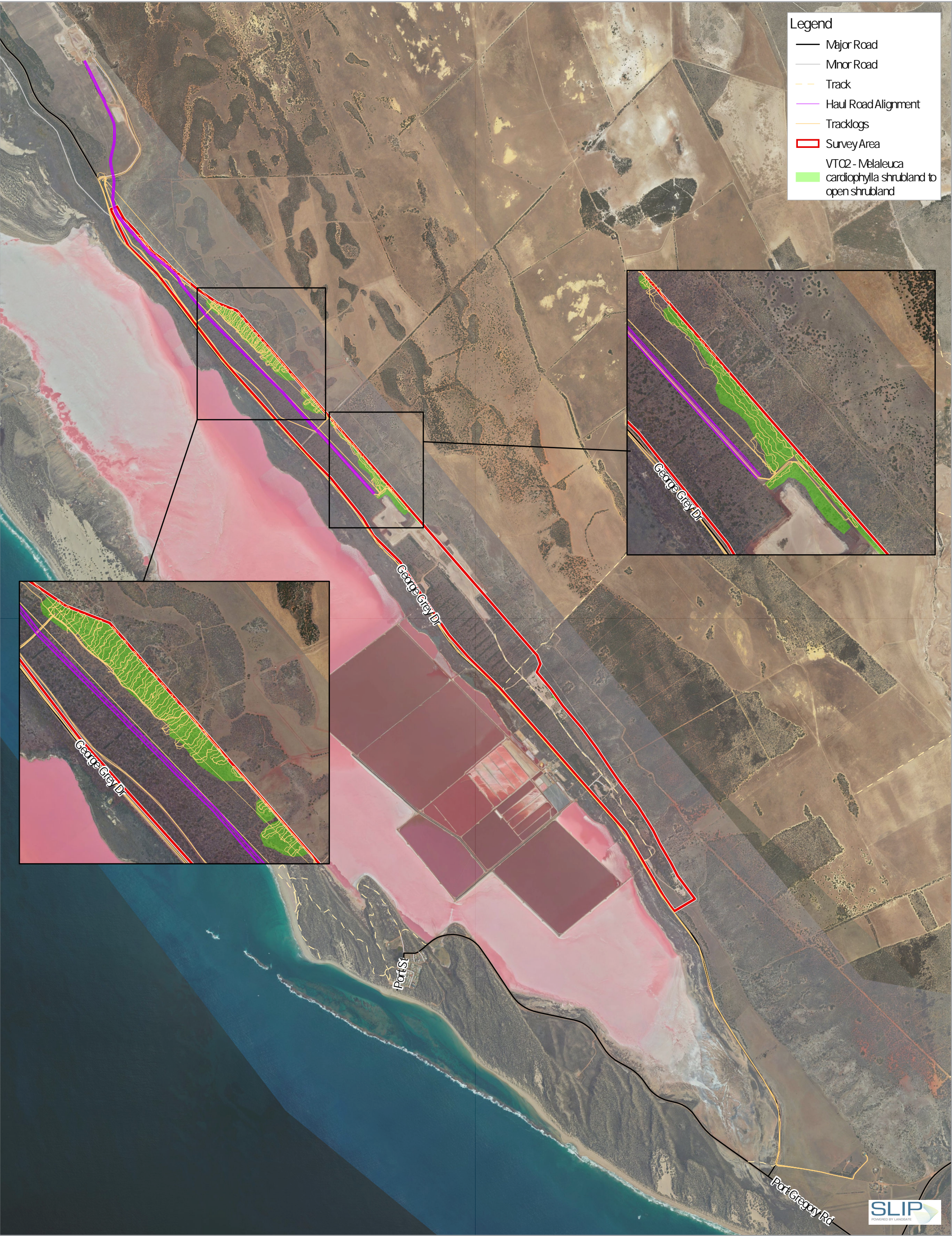
Table 1 Field survey limitations

Aspect	Constraint	Comment
Sources of information and availability of contextual information.	Nil	Adequate information is available for the survey area.
Scope (what life forms were sampled etc.)	Nil	Vascular flora were sampled during the survey. Non-vascular flora were not surveyed. The survey focused on <i>Caladenia bryceana</i> subsp. <i>cracens</i> (Threatened) and other conservation listed flora species for the proposed haul road.
Proportion of flora collected and identified (based on sampling, timing and intensity)	Nil	The survey focused on <i>Caladenia bryceana</i> subsp. <i>cracens</i> (Threatened) and other conservation listed flora species for the proposed haul road.
Flora determination	Nil	Flora determination was undertaken by GHD Botanist/Ecologist's in the field. All taxa could be identified to species level. The taxonomy and conservation status of the WA flora is dynamic. This report was prepared with reliance on taxonomy and conservation status current at the time report development, but it should be noted this may change in response to ongoing research and review of International Union for Conservation Nature criteria.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed)	Nil	The complete survey area was traversed on foot (Figure 2). All areas of the survey area were adequately surveyed for the purpose of the assessment.



Memorandum

Aspect	Constraint	Comment
Mapping reliability	Nil	Data was recorded in the field using hand-held GPS tools (e.g. Samsung tablet and Garmin GPS). Certain atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The GPS units used for this survey are accurate to within ± 4 metres on average. Therefore the data points consisting of coordinates recorded from the GPS may contain inaccuracies.
Timing/weather/season/cycle	Nil	<p>The field survey was conducted on 11-14 August 2020. The timing of the survey is not considered to be a limitation as all flora present was actively growing with flowering on many species observed. In addition <i>Caladenia bryceana</i> subsp. <i>cracens</i> at the time of the survey was flowering. The rainfall in the three months prior to timing of the survey (August), were drier than average for the area (Lynton -station 8075) (BoM, 2020), however, significantly higher than average rainfall was experienced in August (103mm compared to 56.6mm). This is sufficient for active growth and flowering of flora species.</p> <p>The survey timing was considered appropriate for the field survey.</p> <p>The weather conditions recorded during the survey were considered unlikely to have impacted upon the vegetation and flora survey.</p>
Disturbances (e.g. fire, flood, accidental human intervention)	Nil	Much of the survey area has been subjected to historical disturbance events (e.g. clearing, tracks, feral grazing, weeds); however, these disturbances did not impact the survey.
Intensity (in retrospect, was the intensity adequate)	Nil	The survey area was sufficiently covered by the GHD Botanist/Ecologist's during the survey.
Resources	Nil	Adequate resources were employed during the field surveys. Four person day was spent surveying the survey area.
Access restrictions	Nil	All areas of the survey area was accessed on foot during the survey with no restrictions.
Experience levels	Nil	The GHD Botanist/Ecologist's who executed the field survey is suitably qualified and experienced in his field. Joel Collins (Senior Botanist) has over 17 years' experience in undertaking flora and vegetation surveys and assessments in Western Australia. Joel has extensive experience undertaking targeted flora assessments on the Geraldton Sandplains and within the local area. Sarah Flemington (Ecologist) has previously undertaken flora surveys on the Geraldton Sandplains.



Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

0



GMA Gamet
GMA Gamet targeted orchid survey

Targeted Orchid Survey

Project No. 12528268
Revision No. 0
Date 9/09/2020

FIGURE 2



Memorandum

3 Results

The field survey did not record any individuals of *Caladenia bryceana* subsp. *cracens* within VT02. This was attributed to the habitat type, which did not align with the habitats containing known records of the species (GHD 2019). In addition there was the presence of invasive weeds throughout the majority of the survey area and significant wild pig grazing (Plate 3).

No conservation listed flora species were recorded within the proposed haul road. The haul road followed an existing track, and contained adjacent areas of previously cleared vegetation, mostly inundated by weeds. For these reasons, the habitats traversed within and adjacent the proposed haul road were not suitable for *C. bryceana* subsp. *cracens*.

4 Conclusion

The location of the orchids visited northeast of the survey area, were noted to be occurring on shallow beige sand on moist rocky limestone areas, higher in the landscape, (Plate 4). The vegetation type at this population is a dense shrubland of *Allocasuarina campestris*, *Melaleuca cardiophylla* and *Grevillea argyrophylla* over *Ecdeiocolea monostachya* sedgeland. These species were identified as the dominant and/or indicator species for the orchid habitat. Other individuals were growing on yellow sandy-loam soils also under *Allocasuarina campestris* (Plate 4).

This vegetation type did not occur in the survey area. *C. bryceana* subsp. *cracens* does not occur in the survey area. No conservation listed flora species occur within or adjacent the proposed haul road.



Memorandum



Plate 1 *Caladenia bryceana* subsp. *cracens*



Plate 2 Limestone habitat at known population of *Caladenia bryceana* subsp. *cracens*



Memorandum



Plate 3 Condition of vegetation within traversed habitat



Plate 4 *Caladenia bryceana* subsp. *cracens* occurring on sandy-loam soil



Memorandum

5 References

Bureau of Meteorology 2020, Climate Data Online. Commonwealth of Australia.

Commonwealth of Australia 2013, Survey Guidelines for Australia's Threatened Orchids Guidelines for detecting orchids listed as 'Threatened' under the Environment Protection and Biodiversity Conservation Act 1999.

Department of Agriculture, Water and the Environment 2020, Approved Conservation Advice for *Caladenia bryceana* subsp. *cracens* (Northern Dwarf Spider-orchid).

GHD 2019, GMA Garnet Pty Ltd, Port Gregory Mine Mining Tenement M70/1380. November 2019.

GHD 2020, GMA Garnet Pty Ltd Lynton Mine Expansion Biological Survey. February 2020.

APPENDIX D – Lynton and Hose Mine Surface Water Assessment (AECOM, 2022)

Lynton and Hose Mine Surface Water Assessment

Desktop Study

25-Jul-2022
Lynton and Hose Mine Surface Water Assessment
Doc No. 1

Lynton and Hose Mine Surface Water Assessment

Desktop Study

Client: GMA Garnet Pty Ltd

ABN: 72 009 344 227

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Quality Information

Document Lynton and Hose Mine Surface Water Assessment

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Date 25-Jul-2022

Prepared by Tony Barrett

Reviewed by Nicky Lee

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Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
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1.0 Background

This report provides a summary of the existing environment for surface water in the local and regional catchments to support the GMA Garnet Pty Ltd (GMA) proposal for garnet mining at the Lynton and Hose sites. Together, the Lynton and Hose garnet mines are known as the Port Gregory mine.

1.1 Study Objective

The purpose of this report is to define the existing conditions for surface water at the Lynton and Hose sites, at both the site and regional catchment scale. The scope included a desktop review of publicly available data and information provided by GMA to provide a description of the following aspects (where relevant and where data/information is available):

- Catchment area(s), including a map identifying the project area concerning the catchment(s).
- Surface hydrology of the project area and potentially affected downstream environment.
- Environmental values and beneficial uses of surface water.
- Surface water management areas that the project intersects or may impact.
- Water quality characteristics of the surface hydrology of the area including salinity and pH.
- Flooding characteristics of the area.
- Potential recommendations for further studies to enable better characterisation of the surface water environment

The GMA sites of interest are Lynton (M70/204, M70/259, M70/968, M70/1330, M70/1331, M70/1380 and P70/1669) and Hose (M70/926, M70/927, M70/856 and G70/171).

1.2 Port Gregory Mining Operations

1.2.1 History

The Lynton mine has been in operation since 1981 and initially commenced on tenement M70/204 and expanded to include tenements M70/259, M70/968, and M70/1331. The Hose mine opened 16 years later with operations commencing in 1997 and consists of tenements G70/171, M70/856, M70/926, and M70/927.

1.2.2 Mining process

The mine uses an open cut mining process to extract garnet. Garnet is a silicate mineral that can be used as an industrial abrasive for a broad range of industries including energy, pipelines, steel fabrication, construction, and defence. When used in abrasive blasting or waterjet cutting, garnet provides many advantages over traditional abrasives and can also be recycled several times, thereby minimising waste.

To access the garnet, around 150mm to 500mm of topsoil is removed by a bulldozer and either stockpiled adjacent to the site or used to rehabilitate recontoured tailings areas. The ore extracted from the mines are loaded and hauled to the Hose mine processing plant where they are blended together and wet screened to create a garnet concentrate.

Water from the screening process is treated and reused in the processing plant. Waste materials from the process operation are dried in a solar pond before being used to refill mine voids and graded to match the surrounding topography and landscape.

The garnet concentrate produced by the Hose mine processing plant is sent to GMA Garnet's Narngulu facility in Geraldton for further treatment and upgrading. The finished product has a garnet content that is greater than 97%. Garnet from Narngulu is transported in packaged form or sent to the bulk storage facilities at Geraldton wharf where it is shipped to national and international markets.

1.3 Disturbance Area

The total area of disturbance for the Port Gregory mine is 237.3 hectares. This includes around 124 ha of land that has already been rehabilitated with earthworks (stage 1) and the reestablishment of vegetation (stage 2). Table 1 provides a summary of the footprints inside the disturbance area, including areas currently disturbed, areas of additional proposed disturbance, total area currently rehabilitated and the intended post mining land use.

Table 1: Breakdown of disturbed areas

Domain	Current Disturbance Footprint (ha)	Proposed Additional Disturbance Footprint (ha)	Current Rehabilitation (ha)	Post mining land use
Domain 1				
Hose Pit	0.0	0.0	74.0	Agriculture
Utcha Pit	29.9	0.0	20.2	Native Vegetation
Brealey Pit	60.0	5.0	0.0	Agriculture
Lynton Pit	65.0	N/A	20.0	Native Vegetation
Domain 2				
Hose Wet Plant	1.6	0.06	0.0	Agriculture
Tailings Ponds and Water Dams	1.6	6.9	0.0	Agriculture
Old Lynton Plant	0.9	0.9	0.0	Native Vegetation
Run-of-Mine-Pads/Low Grade Ore Stockpiles (M70/204)	1.6	N/A	0.0	Native Vegetation
Run-of-Mine-Pads/Low Grade Ore Stockpiles (M70/856 and G70/171)	6.6	0.0	0.0	Agriculture
Domain 3				
Admin Buildings	0.1	0.1	0.0	Agriculture
Powerline corridor (M70/856, G70/171, M70/926)	2.8	0.0	0.0	Agriculture
Lynton Borefield (M70/204)	0.1	0.0	0.0	Native Vegetation
Workshop and washdown bay	0.9	0.0	0.9	Agriculture
Laydown areas	1.2	0.0	1.2	Agriculture
Bioremediation Facility	0.0	0.8	0.0	Agriculture
Domain 4				
Firebreaks	1.1	0.0	0.0	Agriculture
Hose Haul/Access Roads	29.9	0.0	0.0	Agriculture
Utcha Access Roads	1.1	0.0	0.0	Native Vegetation
Lynton Haul Road (M70/204)	18.4	0.0	0.0	Native Vegetation
Lynton Haul Road (M70/259)	0.5	0.0	0.0	Native Vegetation
Lynton Haul Road (M70/968)	0.4	0.0	0.0	Native Vegetation

2.0 Physical Setting

The Lynton and Hose garnet mines are located approximately 85 km north of Geraldton and 46 km south of Kalbarri in the Shire of Northampton in Western Australia (WA). The nearest settlement is Gregory, approximately 3 km south of the site. The Lynton and Hose garnet mines are also 3 km inland from the foreshore, and lie adjacent to the Hutt Lagoon. The sites can be accessed from George Grey Drive, State Highway 139. Refer to Figure 1 in Appendix A for the locality plan and geographical location of the site.

2.1 Climate

The Lynton and Hose mines are located in a subtropical climate region (as per the Köppen climate classification system, major classes). Typically, warm air that rises from the tropics, falls as dry, cooler air in the subtropical zone. This leads to the occurrence of high-pressure systems that dominate local weather patterns resulting in hot summers, mild winters, and low rainfall.

The nearest active weather station that provides a comparable daily air temperature record for the region is located in Kalbarri, approximately 45km to the north of the site (Station 008251). Mean daily maximum temperatures at the Kalbarri weather station for each month range from 34°C to 21.9°C, with the hottest months occurring in January and February, and the cooler months in July and August. Annual average evaporation totals for the region are approximately 2,600mm year, based on the Bureau of Meteorology's (BOM) Average Evaporation Map. Table 2 provides a summary of mean monthly temperature recordings and key weather statistics at the Kalbarri weather station.

Table 2 Mean monthly weather statistics recorded at the Kalbarri Weather Station (Station 008251)

Month	Mean Maximum Temperature (°C)	Mean Minimum Temperature (°C)	Mean 3pm Relative Humidity (%)	Mean 3pm Wind Speed (km/h)	Mean Number of Days Without Cloud Cover
Jan	33.3	19.7	47	24.2	19.5
Feb	34.0	20.7	46	23.2	15.3
Mar	32.6	19.3	48	20.5	16.7
Apr	29.5	16.4	50	16.3	14.0
May	26.1	13.3	51	13.1	13.4
Jun	23.0	11.1	54	12.2	12.0
Jul	21.9	9.8	55	12.5	13.1
Aug	22.5	10.0	53	13.8	14.0
Sept	24.1	10.9	53	17.0	15.8
Oct	26.3	12.7	49	21.1	16.3
Nov	28.4	15.1	50	22.4	16.2
Dec	31.2	17.6	48	23.5	19.2
Years of record	48	48	33	36	38

BOM publishes data from two active rainfall gauges in the vicinity of the site. These are located at Lynton, approximately 15 km to the southwest (Station 008075) and Balline, approximately 9 km to the north (Station 008004).

Long term monthly rainfall data for these two stations indicates that the highest rainfall typically occurs around June and July, with the lowest rainfall totals occurring in December and January (Table 3).

In 2021, rainfall totals for January, November, and December were drier than average with no recorded rainfall events occurring during these months. The wettest month in 2021, for both stations, was July where 110 mm was recorded at Lynton and 119mm at Balline. Both of these recordings were above the long-term average.

Table 3 2020 Monthly Rainfall Data for Lynton and Balline Stations (BoM, 2022)

Month	Lynton Station (008075)			Balline Station (008004)		
	Monthly Total 2021 (mm)	Highest Daily Total (mm)	Mean (1914 to 2022) (mm)	Monthly Total 2021 (mm)	Highest Daily Total (mm)	Mean (1930 to 2022) (mm)
January	0.0	0.0	5.4	0.0	0.0	5.1
February	16.0	16.0	10.4	29.8	18.6	9.5
March	0.0	0.0	14.9	0.0	0.0	15.5
April	25.0	25.0	21.8	35.0	35.0	25.5
May	98.0	35.0	61.0	92.8	42.2	66.7
June	70.0	32.0	92.9	43.0	15.2	96.3
July	110.0	30.0	79.2	119.8	24.0	84.8
August	0.0	0.0	56.0	25.8	9.2	56.5
September	23.0	13.0	26.3	17.8	9.0	28.6
October	29.0	29.0	13.6	63.9	36.6	16.6
November	0.0	0.0	7.6	0.0	0.0	9.0
December	0.0	0.0	3.4	0.0	0.0	3.7
Annual Total	371.0		403.6	427.9		419.0

Historic rainfall data shows a mean annual rainfall total of 403.6 mm for Lynton and 419.0 mm for Balline (Table 4). In 2021, annual rainfall total for Lynton was 371.0 mm which is approximately 8% lower than the historical mean annual total. Conversely the 2021 annual rainfall total for Balline was 427.9mm and relatively close to the mean annual total of 419.0 mm for this station.

This regional difference may be the result of no recorded rainfall during in August at Lynton, however, these datasets have not been verified by BOM and any assumptions based on these values should be viewed with caution.

Table 4 Lynton and Balline Annual rainfall summary statistics for all years

	Statistic (mm)							
Site	Mean	Lowest	5 th Percentile	10 th Percentile	Median	90 th Percentile	95 th Percentile	Highest
Lynton	403.6	193.1	220.4	271.3	392.5	523.1	587.6	739.5
Balline	419.0	175.4	261.7	273.6	417.4	562.0	621.0	720.0

2.2 Topography and Geology

The Port Gregory mine site lies to the north and east of Hutt Lagoon, a large, shallow lake that was once part of the Hutt River estuary. This lagoon is isolated from the ocean by a barrier beach and dune system that has formed over buried reefs. Much of the land surrounding the lagoon is at 0m AHD with the lakebed being around -1m AHD.

On the north eastern side of Hutt Lagoon there is a linear landform that runs parallel to the lake shoreline and George Grey Drive. This landform, approximately 800m wide, rises to an elevation of 48m AHD and marks the extent of the former shorelines and beach deposits.

These former shorelines border a steep escarpment that rises in a north easterly direction to an elevation of around 80m AHD before transitioning to the gently rising Kalbarri Sandplain beyond. This escarpment marks the former inland extent of the shoreline and exhibits historic wave cut features in the Tamala Limestone. Figure 2 in Appendix A illustrates the terrain around the site.

The toe of the escarpment also denotes the change in geology where silicified quartz sandstone and conglomerate units, that are part of the Silurian Tumblagooda Sandstone, transition to the overlying superficial Quaternary sediments that include the Tamala Limestone.

2.3 Regional Hydrological Setting

The site lies in the north western region of the Greenough River Basin. This vast river basin covers an area of approximately 13,200 square kilometres and is bordered by the Murchison River Basin to the North, the Yarra Yarra River Basin to the east and the Moore-Hill Rivers Basin to the south.

The Greenough River Basin is made up of many catchments and include the Greenough River, Bowes River and Hutt River catchments. At this regional catchment classification scale, the Port Gregory Mine site is largely assigned to the coastal catchment of the Hutt River system, with just a small area of tenement M70/1380 encroaching into the lower catchment of the Hutt River catchment. Figure 3 in Appendix A shows the regional catchment plan and Figure 4 in Appendix A shows the extent of the coastal catchment.

Unlike neighbouring catchments, this coastal catchment does not feature a major river or tributary. Similarly, there are no sub catchments identified inside this coastal catchment. This lack of significant drainage pathways is most likely the result of high infiltration rates associated with the Kalbarri Sandplain that covers most of the catchment.

The nearest major river is Hutt River that originates approximately 40 km inland of the Lynton and Hose mines between the towns of Northampton and Binu. The Hutt River flows in a general westerly direction until it meets the Indian Ocean, less than 2 km from the southern edge of the Lynton mine. The main tributaries are Kennedy Creek, Yarder Gully, and Swamp Gully.

The closest waterways to the site are Bishop Gully and Urina Creek, approximately 4km and 5.5km east of the site respectively. Both waterways are categorised as minor tributaries of the Hutt River and are outside of the coastal catchment.

Surface water drainage in the vicinity of the site is dominated by the Hutt Lagoon to the south west and the adjacent Utcha Well Nature Reserve to the north west. Both of these regional scale water features receive runoff from the adjacent escarpment and landform that formed the paleo shorelines.

The Hutt Lagoon is one of Australia's naturally occurring pink lakes. The lake is approximately 15km long and extends from the junction of Port Gregory Road and George Gray Drive in the south, to the edge of the Utcha Well Nature Reserve near the Hose mine site. The lagoon is approximately 2.5km wide at its widest point near the algal farm.

Utcha Well Nature Reserve covers an area of approximately 400ha and features a network of small, connected perennial and ephemeral wetlands that lie behind a protective ridge of coastal dunes. These wetlands are hydraulically connected to Hutt Lagoon with the predicted flow direction occurring from north west to south east. However, the frequency and volume of this discharge is not documented.

3.0 Environmental Values and Beneficial Uses

The unique setting of the Lynton and Hose mine sites give rise to a broad range of environmental values and beneficial uses. In particular, the waterways and water features of the region provide ecosystem services that provide beneficial uses or outcomes to society and the environment.

The following section considers these environmental values and beneficial uses across three distinct categories that are described by the Western Australian Department of Water and Environmental Regulation. These are economic benefits, social value, and ecological value.

3.1 Economic Benefits

Australia is home to a handful of pink lakes. However, Hutt Lagoon is considered the most accessible of these naturally occurring phenomena. The lagoon is located around 6 hours' drive from Perth and is a recognised regional tourist hotspot.

Tourism generated by the lake has direct economic benefits for the settlement of Port Gregory and surrounding region. These economic benefits support businesses associated with holiday accommodation, retail, scenic flights and tour guides. Other industries, such as the service sector or trades, also benefit indirectly from tourism generated by the Hutt Lagoon.

Hutt Lagoon is also reported to contain the world's largest microalgae production plant with 250 ha of artificial ponds that are used to farm the pink microalgae *dunaliella salina*. This species of microalgae is used to create beta-carotene, a natural food colouring agent and source of vitamin A.

In addition to microalgae production, the lagoon is also used for commercial farming of Artemia Brine Shrimp. These small shrimps are used as a food source for commercial fisheries, as well as aquariums.

No surface water features in the vicinity of the site are used to supply potable water for consumption and the nearest public drinking water source is the Kalbarri Water Reserve, located to the south and east of Kalbarri. Similarly, the site does not lie in a Proclaimed Surface Water Area or Surface Water Irrigation District as defined under the Rights in Water Irrigation Act 1914.

3.2 Social Value

The Hutt River and Utcha Well Nature Reserve are of high social value to both permanent and transient communities. These social values predominantly relate to recreational and spiritual values.

Fishing is a popular activity in the region and the Hutt River is known for its recreational crayfish fisheries. Smooth Marron (*Cherax cainii*) and Hairy Marron (*Cherax tenuimanus*) are native to Western Australia and are both key target species in the Hutt River. These freshwater crayfish can grow up to 2.2kg and are the third largest freshwater crayfish in the world. Wild-stock fishing for Marron is tightly regulated and recreational fishing is only permitted during a four week season every year between January and February.

Rod and line fishing is also popular throughout the Hutt River catchment with species such as Mulloway (*argyrosomus japonicus*) and Tailor (*pomatomus saltatrix*) being key targets in the riverine and estuarine reaches.

The permanent and semi-permanent wetlands of the Utcha Well Nature Reserve provide a unique habitat for migratory shorebird species, as well as some species of raptor. Subsequently, the reserve is recognised as a destination for birdwatching. The access tracks through the reserve also make it easier to visit different habitat areas, thereby increasing bird counts during visits.

Waterways provide an important social, cultural and spiritual role for traditional owners. The traditional owners for the region around Hutt Lagoon, Hutt River and the Utcha Well Nature Reserve are the Yamatji people. For thousands of years, the Yamatji people have sustainably managed the land and catchments for food by using techniques that include burning, seed sowing, trapping and fishing.

In 2019, over 700 people attended a meeting in Geraldton to hear representations of five Yamatji Nation native title claims, one of which was the Hutt River land title. On 7 February 2020, the State Government of Western Australia signed the Yamitji Nation Indigenous Land Use Agreement following a landmark hearing in the on-Country Federal Court.

This agreement has led to a number of environmental and conservation initiatives between the State Government and Yamitja people such as investment in the Utcha Well Nature Reserve and the creation of 14 Yamitj Rangers to work with land operators, including works associated with the rehabilitation of mine sites.

3.3 Ecological Value

None of the waterways or wetlands located in the coastal catchment are currently listed as being of international importance (e.g. Ramsar Listed Wetland) or containing areas of critically endangered habitat. However, the Utcha Well Nature Reserve has an International Union for Conservation of Nature (IUCN) category rating of *Ia*. This category is for strict protection and set aside as areas of outstanding natural ecosystems and is managed by the WA Department of Parks and Wildlife and the Yamitji Conservation Estate.

Similarly, the Hutt Lagoon System is categorised as a Nationally Important Wetland because it met two of the six criteria that were originally agreed to by the ANZECC Wetlands Network in 1994. These criteria were;

- a good example of a wetland type occurring within a biogeographic region in Australia, and;
- a wetland of outstanding historical or cultural significance.

The waterways and wetlands of the Hutt River and coastal catchments provide important habitat for a wide range of fauna. The Hutt River estuary, Hutt Lagoon and Utcha Well Nature Reserve in particular are recognised for sightings of rare, migratory shorebirds. Surveys carried out Birdlife Western Australia in the region recorded sightings of 21 migratory shorebird species and 9 Australian-breeding shorebird species over 64 visits between 2006 and 2010, and 87 visits between 2017 and 2018. The most frequently sighted species were Banded Stilt *Cladorhynchus leucocephalus*, Red-capped Plover (*Charadrius ruficapillus*) and Red-necked Stint (*Calidris ruficollis*), most of which were recorded at the accessible reaches of Hutt Lagoon.

The Utcha Well Nature Reserve ecosystem is largely unimpacted by human activity and offers a protected habitat for threatened flora species and priority taxa. This includes the coastal shrub, *Comesperma rhadinocarpum* which has been recorded in the reserve. *Comesperma rhadinocarpum* occurs on a wide range of habitats that range from sandy clay, sandy loams and sand.

Approximately 20 km north of the Lynton and Hose mines is Kalbarri National Park. This National Park receives around 300,000 visitors per year and Lands adjacent to the national park have been identified as having conservation significance. The southernmost portions of the park lay within the same hydrographic catchment as the Port Gregory Mine.

4.0 Characterisation of Surface Water Environment

4.1 Site Surface Water Features

Many of the tenements occupy the gently sloping land that lies beneath a steep escarpment. These include M70/204, M70/259 and M70/1331 at the Lynton site and M70/856, M70/926 and M70/927 at the Hose site. The natural flow pathway for rainfall runoff from these areas is toward Hutt Lagoon and Utcha Well Nature reserve on the south western side of the mines. These western tenements do not feature any prominent or permanent surface water features such as eroded lines, drainage channels or ponds. For these sites, runoff most likely occurs as sheet flow between the toe of the escarpment in the east, and George Grey Drive in the west.

The tenements of G70/171, M70/968, M70/1330 and M70/1380 incorporate the steep escarpment that sits above the western tenements. Tenement M70/1380 occupies the largest area extends approximately 1.5 km in a north-westerly direction across the elevated sandplain. Rainfall runoff on the sandplain is likely to largely infiltrate into the ground and there are no identified waterways or prominent drainage channels that lead to the top of the escarpment.

The most prominent water features in the mine site are found on the steepest slopes of the escarpment. These features largely consist of vegetated ephemeral channels or gullies that convey rainfall runoff that has fallen directly onto the slope or the immediate area at the top of the ridge.

The highest concentration of these channels occurs at the south eastern limits of the Lynton Mine site in tenements M70/1380 and M70/1331. The channels at this location can be found approximately every 200m to 300m along the alignment of the escarpment with typical channel lengths ranging from 400m to 600m. Figure 5 in Appendix A highlights the location of these channels in the south eastern area of the site.

4.2 Surface Water Quality

Limited surface water quality data exists for the water features and drainage lines that interface with the site. The nearest known surface water quality monitoring sites, with publicly available data, are located in the Hutt River estuary, south east of the site boundary. These sites were used as part of the Mid West Estuaries Assessment Project and were largely active between September 2004 and January 2009 where the waterway was sampled on 12 occasions. Water quality determinands assessed by the project included inorganic metals, organic metals, nutrients, organics, plant pigments, pesticides and herbicides.

Samples were taken during varied conditions including times of static flow, high flow and during periods when the estuary bar was open to the ocean. Subsequently, the monitoring data showed equally varied water quality results with several mean values exceeding the trigger levels for the estuaries of south western Australia that were published at that time in the ANZECC water quality guidelines. These included mean values for total nitrogen and total phosphorous. These guidelines have since been revised and are now referred to as the Australian and New Zealand guidelines for Fresh and Marine Water Quality (ANZG Water Quality Guidelines). Table 5 provides a summary of the historical water quality data taken from the Hutt River estuary.

Table 5 Hutt River estuary historical key monitoring results (Mid West Estuaries Assessment Project – Site Ref 7011190).

	Lowest	5 th PCTL	Mean	95 th PCTL	Highest
pH (pH Units)	7.71	7.87	8.10	8.98	9.02
Total suspended solids (mg/L)	12	23	45	153	227
Turbidity (NTU)	0	36.0	223.0	831.2	1000
Total nitrogen (ug/L)	760	1000	1244	2140	2500
Total soluble nitrogen (ug/L)	17	45	148	548	660
Total phosphorus (ug/L)	12	30	38	83	96
Salinity (ppt)	2.95	6.40	11.21	33.53	33.53
Soluble copper (ug/L)	3	3	4	6	7
Soluble zinc (ug/L)	5	8	10	11	20

Source: Western Australian Government Department of Water and Environmental Regulation

The pre-development receptor of the Lynton and Hose mine site is the Hutt Lagoon and adjacent Utcha Well Nature Reserve. In 2009, the Western Australian Government published a report on the condition of Hutt Lagoon. The report provided a comparative summary of water quality data that was collected as part of the Salinity Action Plan (SAP) Wetland Biological Survey, Hutt Catchment Survey and RCM Survey. A summary of this historical water quality data is presented in Table 6.

The water quality data showed elevated values for sodium chloride, indicating high, naturally occurring salinity levels in the lake. The report also stated that nitrogen concentrations were considered to be above trigger levels of concern for wetlands of this region and concluded that the sources of nitrogen were most likely attributed to the leaching of fertilizers from local farms and not from the algae farm inside the lake.

Table 6 Hutt Lagoon historical water quality data

	SAP Survey (1999)	Hutt Survey (2007)	RCM Survey (2008)
pH (pH Units)	8.02	8.05	7.26
Alkalinity (mg/L)	145	250	180
TDS (g/L)	180	190	320
Turbidity (NTU)	3.9	29	31
Colour (TCU)	2.5	17	210
Total nitrogen (ug/L)	No data	No data	4800
Total phosphorus (ug/L)	No data	No data	140
Total soluble nitrogen (ug/L)	2200	2300	3300
Total soluble phosphorus (ug/L)	10	40	20
Chlorophyll (ug/L)	3.5	4.5	3.5
Na (mg/L)	69600	51800	123000
Mg (mg/L)	3000	4450	6750
Ca (mg/L)	965	372	764
K (mg/L)	1230	1640	2450
Cl (mg/L)	110000	84800	208000
SO ₄ (mg/L)	6470	7520	12000
HCO ₃ (mg/L)	177	305	220
CO ₃ (mg/L)	1	0.5	0.5

Although dated, these monitoring results provide a historical snapshot of water quality in the Hutt River estuary and Hutt Lagoon at that time.

In addition to publicly available data, GMA Garnet carry out regular monitoring of water quality in the Utcha Swamp and adjacent groundwater observation bores. This monitoring program includes annual sampling for major ion analysis and weekly salinity monitoring.

Surface water samples taken at Utcha Swamp are analysed for a broad range of miscellaneous inorganics and dissolved metals, which is carried out by a NATA accredited environmental laboratory. The certificate of analysis for samples taken in July 2021 is presented in Appendix B of this report.

Observation bore is HM15 is located at the southwestern boundary of tenement M70/926 and has been used to represent salinity in Utcha Swamp since 2010. Weekly salinity monitoring at HM15 is carried out via electrical conductivity field measurements.

Figure 1-1 presents a plot of salinity values that were recorded at bore HM15. This figure also shows a hydrograph plot (groundwater water elevation mAHD) over the same monitoring period. This data was sourced from the Hose Mine and Lynton Borefields Half Yearly Groundwater Monitoring Report - January to July 2021 (AECOM 2021). This Groundwater Monitoring Report concluded salinity values recorded at the Utcha Swamp borehole in 2021 were consistent with 2020 values and remained steady.

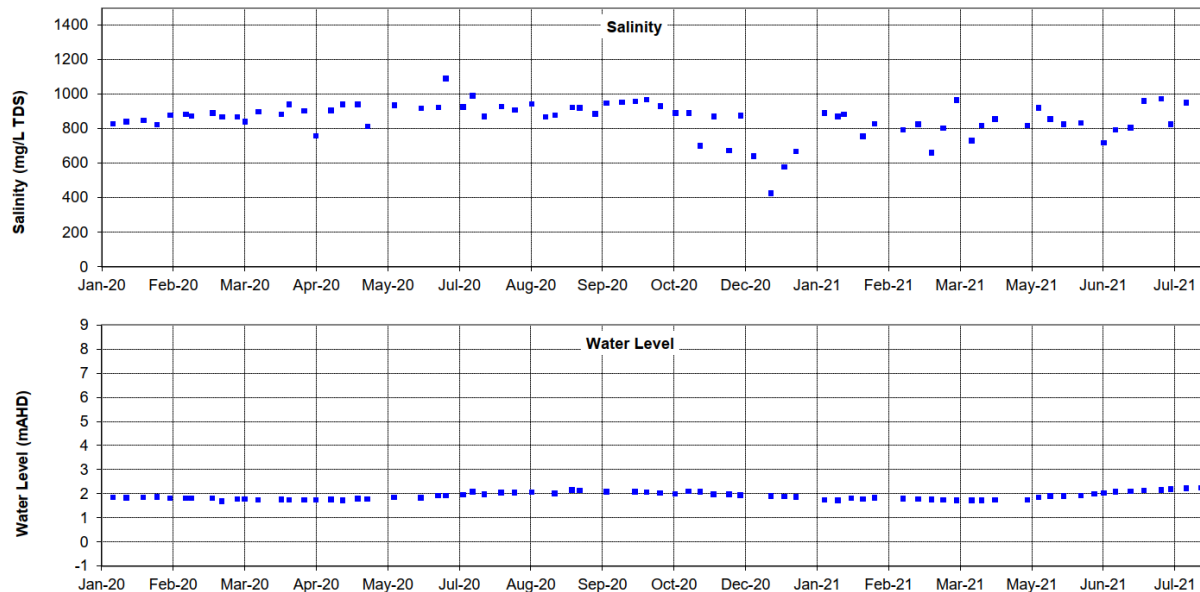


Figure 1-1 Salinity plot and hydrograph for Utcha Swamp (Source: AECOM Hose Mine and Lynton Borefield Groundwater Monitoring Report January to July 2021)

4.3 Hydrology

4.3.1 Surface Water Flow

As described in section 4.1, there are very few surface water features located inside the tenements. The most prominent surface water features inside the site consist of surface water channels that convey runoff from the top of the steep escarpment to the more gently sloping landform below.

These surface water channels are ephemeral and do not feature year-round baseflow. Additionally, the small upstream catchments, combined with the potentially high infiltration rate of sandy soils, suggest that these channels are only active for short periods of time during rainfall events.

The channels become less prominent at the base of the escarpment and it is likely that channelised flow transitions to wider, sheet flow conditions across the lower landform during intense or prolonged storm events.

The nearest permanent, or semi-permanent water features are located in the wetlands of the Utcha Well Nature Reserve and Hutt Lagoon. The western boundary of the Hose Mine site encroaches on the Utcha Well Nature Reserve, however, these water features are located outside of the site boundary and all areas of the Utcha Well Nature Reserve are outside of the disturbance area.

4.3.2 Flooding

There is no published flood data or flood mapping for waterways in the immediate vicinity of the site or for the Hutt Lagoon. The Shire of Northampton's Local Planning strategy (2021) acknowledges this data gap and refers to the likelihood of flooding occurring in most of the Shire's major waterways, particularly those with wide alluvial floodplains. This includes the Hutt River system, south east of the site.

Existing 2m contour data indicates a wide, relatively flat area occupied by Lynton Station and the adjacent airfield. The elevation of this area ranges from approximately 6m AHD at Port Gregory Road in the east, to 0m AHD at George Grey Drive near the Hutt Lagoon. This wide expansive area may form part of the Hutt River floodplain that conveys flows in a north westerly direction toward the Hutt Lagoon. However, connectivity between this potential floodplain and the Hutt River is not documented and conclusions on flood frequency, flood elevation, and subsequent impact cannot be made for this site.

In addition to the Hutt River system, the mining tenements intercept a number of small drainage pathways that carry local runoff down the steep escarpment from the east. These drainage lines may be a cause of localised flooding during prolonged or high intensity rainfall events.

The mining site is not currently considered to be affected by astronomical tides under typical weather conditions in the current climate. However, the low-lying elevation of land adjacent to Hutt Lagoon indicate that storm tides may inundate George Grey Drive and the south western boundaries of some of the tenements including M70/1330, M70/204, M70/259 and M70/1331.

Storm tides occur when storm surges (a phenomenon caused by low atmospheric pressure, onshore winds, and coastally trapped waves) coincide with high astronomical tides.

In 2017, the University of Western Australia used historical sea level data to model present day extreme sea levels, including the effects of astronomical tides, storm surges, and seasonal and interannual mean sea level variability. The model results for the nearest site, Geraldton, indicated a mean extreme sea level rise of 1.15 m above mean sea level during the predicted 1% annual exceedance probability (AEP) event for the present day.

The Intergovernmental Panel on Climate Change (IPCC) Synthesis Report of the Fifth Assessment Report (AR5, 2014) published likely global mean sea level rise predictions of 0.53 to 0.97 m by 2100, under a high emissions scenario (Representative Concentration Pathway (RCP) 8.5).

Review of the future sea level rise allowances (Coast Adapt SLR Model), under a high emissions scenario (AR5, RCP 8.5), provided a sea level rise of 0.27 m by 2050 and 0.81 m by 2100 for the Shire of Northampton.

Based on this allowance, the 1% AEP extreme sea level rise for Hutt Lagoon and the adjacent coastline could be 1.4 m above mean sea level by 2050 and nearly 2 m above mean sea level by 2100.

Increases in sea levels caused by climate change and extreme storm tides could exacerbate flood risk and cause inundation of the south western boundary of the site.

5.0 Conclusion and Recommendations

The Port Gregory Mine site is located in a coastal sub-catchment that has no major fresh waterways or tributaries. Only one small area of the proposed Lynton mine site, M70/1380 encroaches into the central Hutt River catchment.

Regional drainage is dominated by the Hutt River, Hutt Lagoon and adjacent Utcha Well Nature Reserve that function as the natural surface water receptors for the Port Gregory mine site. These surface water features are recognised at both regional and national scale for their environmental values and beneficial uses.

The low-lying elevation of land adjacent to Hutt Lagoon, including George Grey Drive and the western boundary of the mine site, may be at risk of flooding from extreme storm tides when combined with future sea level rise. It is therefore recommended that further investigations into the potential risks of extreme storm tides and flooding from the Hutt River estuary are carried out.

Similar data gaps exist on the existing surface water quality of Hutt Lagoon, Utcha Well Nature Reserve and the lower reaches of the Hutt River. Determining current baseline water quality data of the immediate and downstream receptors will provide a reference for future comparison and benchmarking. Subsequently, it is recommended that surface water monitoring of these downstream receptors and potential conveyance pathways is also carried out.

6.0 References

- Bureau of Meteorology (BoM). 2022. Climate Data for Kalbarri (008251), Lynton (008075) and Balline (008004) Weather Stations. <http://www.bom.gov.au/climate/data/index.shtml>
- Hutt Lagoon Condition Report (2009): https://www.dpaw.wa.gov.au/images/documents/conservation-management/wetlands/rcm028_hutt_lagoon_condition_report.pdf
- Government of Western Australia, Conservation Estate, Yamatji Nation Indigenous Landuse Agreement: https://www.wa.gov.au/system/files/2020-07/03.%20Conservation%20Estate_final_210720.pdf
- Australian Government Department of Agriculture, Water and the Environment – Protected Matters Search Tool: <https://pmst.awe.gov.au/#/map/>
- Hose Mine and Lynton Borefields Half Yearly Groundwater Monitoring Report - January to July 2021 (AECOM 2021)
- Yamatji Marpa Aboriginal Corporation: <https://www.ymac.org.au/?s=Hutt>
- Natural Resource Management Strategy for the Northern Agricultural Region <https://narvis.com.au/the-region/aboriginal-custodianship-background-information/>
- Birdwatching Western Australia. Birdwatching Around Geraldton Factsheet: <https://www.birdlife.org.au/>
- <https://www.samso.com.au/post/the-marron-industry-western-australia-s-native-freshwater-crayfish-insights>
- <https://www.australia.com/en/things-to-do/nature-and-national-parks/australias-pink-lakes.html>
- https://www.dpaw.wa.gov.au/images/documents/conservation-management/wetlands/rcm028_hutt_lagoon_condition_report.pdf
- Australian Government Department of Agriculture, Water and the Environment – Data Searches: <https://www.environment.gov.au/>
- Directory of Important Wetlands: <https://www.awe.gov.au/sites/default/files/documents/directory.pdf>
- <https://www.iucn.org/theme/protected-areas/about/protected-areas-categories/category-ia-strict-nature-reserve>
- <https://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat.pl>
- https://www.epa.wa.gov.au/sites/default/files/Referral_Documentation


Appendix A - Figures.




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
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LEGEND

 GMA Tenements

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus D.S, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Locality Plan

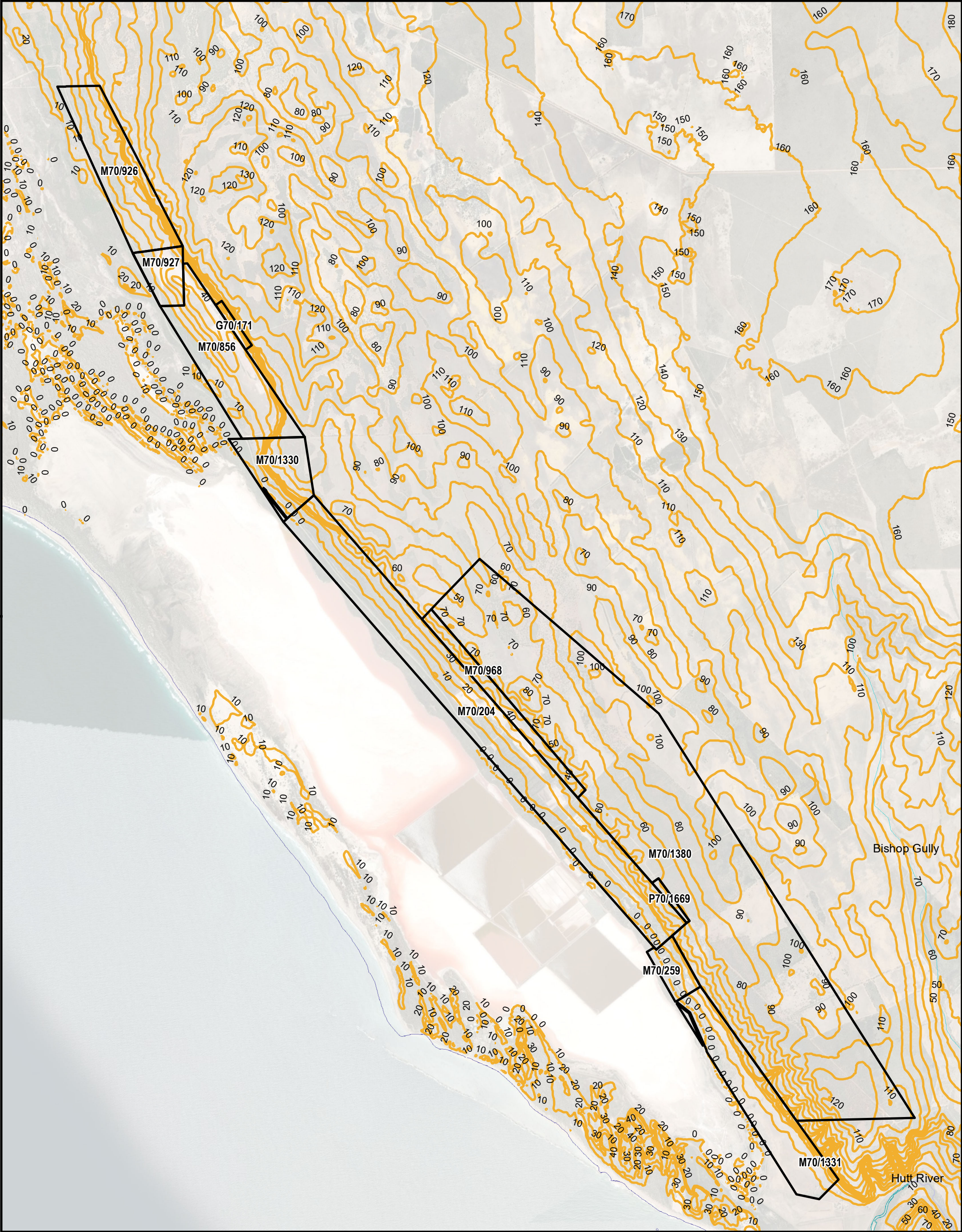
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Lynton and Hose Mine Surface Water Assessment

Figure

1

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GMA Tenements

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Terrain

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Lynton and Hose Mine Surface Water
Assessment

Figure

3

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GMA Tenements

Hydrographic Catchments - Catchments

Significant Stream

Major Trib

Minor Trib

Minor Trib

Insignificant Trib

Coastal Waterline

Estuarine

Mainstream

Major River

Minor River

Inundation Area

Paleo-Drainage Line

Infrastructure

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River Catchments

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Lynton and Hose Mine Surface Water Assessment

Figure

2

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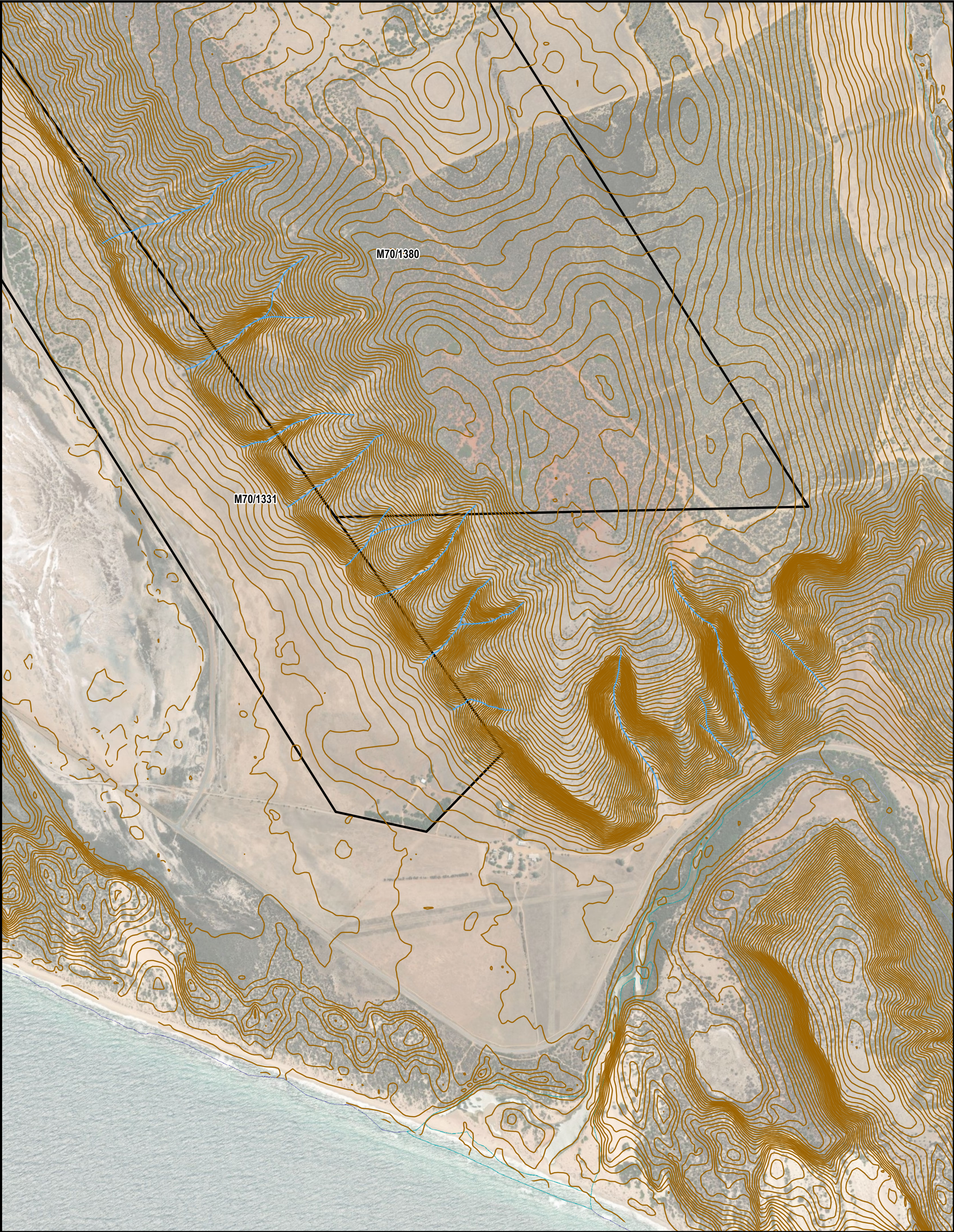
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Coastal Catchment	
GMA Garnet Pty Ltd	Figure 3
Lynton and Hose Mine Surface Water Assessment	



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2m Contours

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Coordinate System: GDA 1994 MGA Zone 50

1:12,500 (when printed at A3)

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Surface Water Drainage Channels (South East)

GMA Garnet Pty Ltd

Lynton and Hose Mine Surface Water Assessment
Western Australia

Figure

F1

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Appendix B – Laboratory Certificate of Analysis.

CERTIFICATE OF ANALYSIS 265371**Client Details**

Client	GMA Garnet Pty Ltd
Attention	Steven Petts
Address	122 Goulds Rd, Narngulu, WA, 6531

Sample Details

Your Reference	<u>July GME 2021</u>
Number of Samples	25 Water
Date samples received	15/07/2021
Date completed instructions received	15/07/2021
Location	Port Gregory

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	21/07/2021
Date of Issue	21/07/2021
NATA Accreditation Number 2901. This document shall not be reproduced except in full.	
Accredited for compliance with ISO/IEC 17025 - Testing. Tests not covered by NATA are denoted with *	

Results Approved By

Heram Halim, Operations Manager

Authorised By

Michael Kubiak, Laboratory Manager

Client Reference: July GME 2021

Miscellaneous Inorganics							
Our Reference			265371-1	265371-2	265371-3	265371-4	265371-5
Your Reference	UNITS	PQL	PW	FW	L1_Runoff_PG	L1_Slimes_PG	N2
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Date analysed	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
pH	pH Units		6.8	6.6	8.0	8.0	6.9
Electrical Conductivity (EC)	µS/cm	1	1,900	1,400	3,000	3,200	1,200
Total Dissolved Solids (grav)	mg/L	5	1,100	730	1,600	1,800	710
Ammonia as N	mg/L	0.005	<0.005	0.006	0.15	0.11	<0.005
Bromide	mg/L	0.5	1.2	0.9	1.9	2.0	0.8
Nitrate as N	mg/L	0.005	5.7	4.6	10	11	3.1
Nitrite as N	mg/L	0.005	<0.005	<0.005	0.070	0.12	<0.005
Phosphate as P	mg/L	0.005	<0.005	<0.005	<0.005	0.005	<0.005
Sulphide in water*	mg/L	0.5	<0.5	<0.5	<0.5	<0.5	[NA]

Miscellaneous Inorganics							
Our Reference			265371-6	265371-7	265371-8	265371-9	265371-10
Your Reference	UNITS	PQL	N4	N6	N7	N9	N10
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Date analysed	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
pH	pH Units		6.8	6.6	6.6	7.6	7.2
Electrical Conductivity (EC)	µS/cm	1	1,700	1,100	1,400	2,000	2,800
Total Dissolved Solids (grav)	mg/L	5	960	610	760	1,200	1,800
Ammonia as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromide	mg/L	0.5	1.2	0.8	1	1.3	2.1
Nitrate as N	mg/L	0.005	4.9	5.1	3.7	3.7	2.9
Nitrite as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Phosphate as P	mg/L	0.005	<0.005	<0.005	<0.005	0.017	0.009

Miscellaneous Inorganics

Our Reference			265371-11	265371-12	265371-13	265371-14	265371-15
Your Reference	UNITS	PQL	N11	N12	S0	S1	S2
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Date analysed	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
pH	pH Units		7.1	7.1	6.9	7.2	7.3
Electrical Conductivity (EC)	µS/cm	1	2,200	2,200	1,600	2,300	1,900
Total Dissolved Solids (grav)	mg/L	5	1,400	1,300	940	1,400	1,100
Ammonia as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromide	mg/L	0.5	1.6	1.6	1.0	1.4	1.3
Nitrate as N	mg/L	0.005	3.6	4.4	4.2	9.4	6.8
Nitrite as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Phosphate as P	mg/L	0.005	0.006	0.005	<0.005	<0.005	<0.005

Miscellaneous Inorganics

Our Reference			265371-16	265371-17	265371-18	265371-19	265371-20
Your Reference	UNITS	PQL	S3	S4	L7	L11	L12
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Date analysed	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
pH	pH Units		7.2	7.3	7.1	7.0	7.2
Electrical Conductivity (EC)	µS/cm	1	1,800	1,700	2,300	2,500	2,200
Total Dissolved Solids (grav)	mg/L	5	1,000	1,000	1,300	1,400	1,300
Ammonia as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Bromide	mg/L	0.5	1.1	1.2	1.4	1.5	1.3
Nitrate as N	mg/L	0.005	8.6	14	11	9.2	14
Nitrite as N	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Phosphate as P	mg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Miscellaneous Inorganics							
Our Reference			265371-21	265371-22	265371-23	265371-24	265371-25
Your Reference	UNITS	PQL	HM15	Utcha Swamp	RW	SE Pond	Thickener 1
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Date analysed	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
pH	pH Units		6.4	7.8	8.1	8.1	8.1
Electrical Conductivity (EC)	µS/cm	1	1,500	2,400	2,500	1,200	2,900
Total Dissolved Solids (grav)	mg/L	5	870	1,500	1,500	710	1,700
Ammonia as N	mg/L	0.005	<0.005	0.032	0.069	<0.005	0.11
Bromide	mg/L	0.5	1.2	1.3	1.7	0.7	1.7
Nitrate as N	mg/L	0.005	3.2	<0.005	8.0	0.006	10
Nitrite as N	mg/L	0.005	<0.005	<0.005	0.040	<0.005	0.050
Phosphate as P	mg/L	0.005	<0.005	0.19	<0.005	<0.005	0.006
Sulphide in water*	mg/L	0.5	[NA]	[NA]	<0.5	<0.5	<0.5

Client Reference: July GME 2021

Ionic Balance							
Our Reference	UNITS	PQL	265371-1	265371-2	265371-3	265371-4	265371-5
Your Reference			PW	FW	L1_Runoff_PG	L1_Slimes_PG	N2
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Date analysed	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Calcium - Dissolved	mg/L	0.5	37	15	70	83	16
Potassium - Dissolved	mg/L	0.5	6.9	6.0	24	32	5.3
Magnesium - Dissolved	mg/L	0.5	34	26	44	52	23
Sodium - Dissolved	mg/L	0.5	250	180	340	410	150
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	88	38	110	100	60
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH ⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	5	88	38	110	100	60
Chloride	mg/L	1	500	380	780	860	340
Sulphate	mg/L	1	71	54	220	280	44
Ionic Balance	%		-4.3	-6.4	-12	-8.6	-10
Hardness as CaCO ₃	mg/L	3	230	140	350	420	140

Ionic Balance							
Our Reference	UNITS	PQL	265371-6	265371-7	265371-8	265371-9	265371-10
Your Reference			N4	N6	N7	N9	N10
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Date analysed	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Calcium - Dissolved	mg/L	0.5	25	10	12	51	52
Potassium - Dissolved	mg/L	0.5	7.1	4.7	6.2	6.7	8.5
Magnesium - Dissolved	mg/L	0.5	31	21	24	32	55
Sodium - Dissolved	mg/L	0.5	200	150	190	260	370
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	50	36	31	140	96
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH ⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	5	50	36	31	140	96
Chloride	mg/L	1	470	310	380	540	850
Sulphate	mg/L	1	55	43	69	76	91
Ionic Balance	%		-9.5	-7.2	-7.7	-6.9	-8.9
Hardness as CaCO ₃	mg/L	3	190	110	130	260	350

Ionic Balance							
Our Reference			265371-11	265371-12	265371-13	265371-14	265371-15
Your Reference	UNITS	PQL	N11	N12	S0	S1	S2
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Date analysed	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Calcium - Dissolved	mg/L	0.5	41	45	33	52	40
Potassium - Dissolved	mg/L	0.5	7.8	8.1	6.3	7.4	7.6
Magnesium - Dissolved	mg/L	0.5	43	41	27	40	27
Sodium - Dissolved	mg/L	0.5	290	290	200	320	280
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	78	83	82	110	110
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH ⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	5	78	83	82	110	110
Chloride	mg/L	1	640	630	440	590	520
Sulphate	mg/L	1	73	91	57	100	72
Ionic Balance	%		-6.9	-6.7	-8.8	-2.6	-5.3
Hardness as CaCO ₃	mg/L	3	280	280	190	300	210

Ionic Balance							
Our Reference			265371-16	265371-17	265371-18	265371-19	265371-20
Your Reference	UNITS	PQL	S3	S4	L7	L11	L12
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Date analysed	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Calcium - Dissolved	mg/L	0.5	31	24	23	26	25
Potassium - Dissolved	mg/L	0.5	5.7	8.0	11	11	10
Magnesium - Dissolved	mg/L	0.5	28	29	48	55	54
Sodium - Dissolved	mg/L	0.5	240	250	330	340	300
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	96	87	170	180	190
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH ⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	5	96	87	170	180	190
Chloride	mg/L	1	450	430	550	600	530
Sulphate	mg/L	1	67	69	84	83	89
Ionic Balance	%		-5.1	-1.6	-2.5	-3.0	-4.8
Hardness as CaCO ₃	mg/L	3	190	180	260	290	280

Ionic Balance							
Our Reference			265371-21	265371-22	265371-23	265371-24	265371-25
Your Reference	UNITS	PQL	HM15	Utcha Swamp	RW	SE Pond	Thickener 1
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Date analysed	-		16/07/2021	16/07/2021	16/07/2021	16/07/2021	16/07/2021
Calcium - Dissolved	mg/L	0.5	18	91	63	37	75
Potassium - Dissolved	mg/L	0.5	7.4	16	23	16	30
Magnesium - Dissolved	mg/L	0.5	29	46	40	22	44
Sodium - Dissolved	mg/L	0.5	200	300	330	140	370
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	37	380	160	190	150
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Hydroxide OH ⁻ as CaCO ₃	mg/L	5	<5	<5	<5	<5	<5
Total Alkalinity as CaCO ₃	mg/L	5	37	380	160	190	150
Chloride	mg/L	1	430	570	700	270	730
Sulphate	mg/L	1	59	71	170	120	190
Ionic Balance	%		-7.2	-7.0	-10	-17	-5.6
Hardness as CaCO ₃	mg/L	3	160	420	320	180	370

Dissolved Metals in Water

Our Reference			265371-1	265371-2	265371-3	265371-5	265371-6
Your Reference	UNITS	PQL	PW	FW	L1_Runoff_PG	N2	N4
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
Date analysed	-		20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
Aluminium - Dissolved	mg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic - Dissolved	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Iron - Dissolved	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese - Dissolved	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel - Dissolved	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Silicon - Dissolved	mg/L	0.1	14	11	13	11	9.9
Thorium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	<0.0005	[NA]	[NA]
Uranium-Dissolved	mg/L	0.0005	<0.0005	<0.0005	0.0012	[NA]	[NA]

Dissolved Metals in Water

Our Reference			265371-7	265371-8	265371-9	265371-10	265371-11
Your Reference	UNITS	PQL	N6	N7	N9	N10	N11
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
Date analysed	-		20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
Aluminium - Dissolved	mg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic - Dissolved	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Iron - Dissolved	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese - Dissolved	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel - Dissolved	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Silicon - Dissolved	mg/L	0.1	10	11	15	18	18

Dissolved Metals in Water

Our Reference			265371-12	265371-13	265371-14	265371-15	265371-16
Your Reference	UNITS	PQL	N12	S0	S1	S2	S3
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
Date analysed	-		20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
Aluminium - Dissolved	mg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic - Dissolved	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Iron - Dissolved	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese - Dissolved	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel - Dissolved	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Silicon - Dissolved	mg/L	0.1	14	12	14	16	14

Dissolved Metals in Water

Our Reference			265371-17	265371-18	265371-19	265371-20	265371-21
Your Reference	UNITS	PQL	S4	L7	L11	L12	HM15
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water	Water
Date prepared	-		20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
Date analysed	-		20/07/2021	20/07/2021	20/07/2021	20/07/2021	20/07/2021
Aluminium - Dissolved	mg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic - Dissolved	mg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Iron - Dissolved	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese - Dissolved	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel - Dissolved	mg/L	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Silicon - Dissolved	mg/L	0.1	15	14	11	11	11

Dissolved Metals in Water

Our Reference			265371-22	265371-23	265371-24	265371-25
Your Reference	UNITS	PQL	Utcha Swamp	RW	SE Pond	Thickener 1
Date Sampled			14/07/2021	14/07/2021	14/07/2021	14/07/2021
Type of sample			Water	Water	Water	Water
Date prepared	-		20/07/2021	20/07/2021	20/07/2021	20/07/2021
Date analysed	-		20/07/2021	20/07/2021	20/07/2021	20/07/2021
Aluminium - Dissolved	mg/L	0.1	<0.1	<0.1	<0.1	<0.1
Arsenic - Dissolved	mg/L	0.05	<0.05	<0.05	<0.05	<0.05
Iron - Dissolved	mg/L	0.02	<0.02	<0.02	<0.02	<0.02
Manganese - Dissolved	mg/L	0.01	0.02	<0.01	<0.01	<0.01
Nickel - Dissolved	mg/L	0.02	<0.02	<0.02	<0.02	<0.02
Silicon - Dissolved	mg/L	0.1	21	12	0.9	12
Thorium-Dissolved	mg/L	0.0005	[NA]	<0.0005	<0.0005	<0.0005
Uranium-Dissolved	mg/L	0.0005	[NA]	0.0015	0.0008	0.0017

Method ID	Methodology Summary
INORG-001	pH - Measured using pH meter and electrode base on APHA latest edition, Method 4500-H+. Please note that the results for water analyses may be indicative only, as analysis can be completed outside of the APHA recommended holding times. Soils are reported from a 1:5 water extract unless otherwise specified.
INORG-002	Conductivity and Salinity - measured using a conductivity cell at 25°C based on APHA latest edition Method 2510. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-006	Alkalinity - determined titrimetrically based on APHA latest edition, Method 2320-B. Soils reported from a 1:5 water extract unless otherwise specified.
INORG-018	Total Dissolved Solids - determined gravimetrically. The solids are dried at 180±10°C
INORG-040	Ion Balance Calculation: Cations in water by ICP-OES; Anions in water by IC; Alkalinity in water by Titration using APHA methods.
INORG-051	Determination of sulphide by titration and/or colourimetric determination. Note, the Sulphide is termed as Total Sulphide given any Sulphide contained in any sediment present may also included in the determination.
INORG-055	Nitrite - determined colourimetrically. Soils are analysed from a water extract.
INORG-055	Nitrate - determined colourimetrically. Soils are analysed from a water extract.
INORG-057	Ammonia by colourimetric analysis based on APHA latest edition 4500-NH3 F.
INORG-060	Phosphate- determined colourimetrically. Soils are analysed from a water extract.
INORG-081	Anions - a range of anions are determined by Ion Chromatography based on APHA latest edition Method 4110-B. Soils and other sample types reported from a water extract unless otherwise specified (standard soil extract ratio 1:5).
METALS-008	Hardness calculated from Calcium and Magnesium as per APHA latest edition 2340B.
METALS-020	Determination of various metals by ICP-AES.
METALS-022	Determination of various metals by ICP-MS.

Client Reference: July GME 2021

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	265371-2
Date prepared	-			16/07/2021	1	16/07/2021	16/07/2021		16/07/2021	16/07/2021
Date analysed	-			16/07/2021	1	16/07/2021	16/07/2021		16/07/2021	16/07/2021
pH	pH Units		INORG-001	[NT]	1	6.8	6.8	0	103	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	<1	1	1900	1900	0	102	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	<5	1	1100	1100	0	103	[NT]
Ammonia as N	mg/L	0.005	INORG-057	<0.005	1	<0.005	<0.005	0	98	104
Bromide	mg/L	0.5	INORG-081	<0.5	1	1.2	1.3	8	102	104
Nitrate as N	mg/L	0.005	INORG-055	<0.005	1	5.7	5.5	4	102	103
Nitrite as N	mg/L	0.005	INORG-055	<0.005	1	<0.005	<0.005	0	111	113
Phosphate as P	mg/L	0.005	INORG-060	<0.005	1	<0.005	<0.005	0	115	119
Sulphide in water*	mg/L	0.5	INORG-051	<0.5	1	<0.5	[NT]		86.92	[NT]

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	265371-22
Date prepared	-			[NT]	6	16/07/2021	16/07/2021		16/07/2021	16/07/2021
Date analysed	-			[NT]	6	16/07/2021	16/07/2021		16/07/2021	16/07/2021
pH	pH Units		INORG-001	[NT]	6	6.8	[NT]		103	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	[NT]	6	1700	[NT]		104	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	[NT]	6	960	1100	14	109	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	6	<0.005	[NT]		100	92
Bromide	mg/L	0.5	INORG-081	[NT]	6	1.2	[NT]		98	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	6	4.9	[NT]		104	95
Nitrite as N	mg/L	0.005	INORG-055	[NT]	6	<0.005	[NT]		111	118
Phosphate as P	mg/L	0.005	INORG-060	[NT]	6	<0.005	[NT]		115	116

QUALITY CONTROL: Miscellaneous Inorganics					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	265371-24
Date prepared	-			[NT]	11	16/07/2021	16/07/2021		[NT]	16/07/2021
Date analysed	-			[NT]	11	16/07/2021	16/07/2021		[NT]	16/07/2021
pH	pH Units		INORG-001	[NT]	11	7.1	7.1	0	[NT]	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	[NT]	11	2200	2200	0	[NT]	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	[NT]	11	1400	[NT]		[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
Bromide	mg/L	0.5	INORG-081	[NT]	11	1.6	1.6	0	[NT]	105
Nitrate as N	mg/L	0.005	INORG-055	[NT]	11	3.6	3.6	0	[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	11	<0.005	<0.005	0	[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	11	0.006	0.006	0	[NT]	[NT]

Client Reference: July GME 2021

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate		Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	15	16/07/2021	16/07/2021		[NT]	[NT]
Date analysed	-			[NT]	15	16/07/2021	16/07/2021		[NT]	[NT]
pH	pH Units		INORG-001	[NT]	15	7.3	[NT]		[NT]	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	[NT]	15	1900	[NT]		[NT]	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	[NT]	15	1100	1100	0	[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	15	<0.005	[NT]		[NT]	[NT]
Bromide	mg/L	0.5	INORG-081	[NT]	15	1.3	[NT]		[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	15	6.8	[NT]		[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	15	<0.005	[NT]		[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	15	<0.005	[NT]		[NT]	[NT]

QUALITY CONTROL: Miscellaneous Inorganics						Duplicate		Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	16/07/2021	16/07/2021		[NT]	[NT]
Date analysed	-			[NT]	21	16/07/2021	16/07/2021		[NT]	[NT]
pH	pH Units		INORG-001	[NT]	21	6.4	6.4	0	[NT]	[NT]
Electrical Conductivity (EC)	µS/cm	1	INORG-002	[NT]	21	1500	1500	0	[NT]	[NT]
Total Dissolved Solids (grav)	mg/L	5	INORG-018	[NT]	21	870	[NT]		[NT]	[NT]
Ammonia as N	mg/L	0.005	INORG-057	[NT]	21	<0.005	<0.005	0	[NT]	[NT]
Bromide	mg/L	0.5	INORG-081	[NT]	21	1.2	1.2	0	[NT]	[NT]
Nitrate as N	mg/L	0.005	INORG-055	[NT]	21	3.2	3.4	6	[NT]	[NT]
Nitrite as N	mg/L	0.005	INORG-055	[NT]	21	<0.005	<0.005	0	[NT]	[NT]
Phosphate as P	mg/L	0.005	INORG-060	[NT]	21	<0.005	<0.005	0	[NT]	[NT]

Client Reference: July GME 2021

QUALITY CONTROL: Ionic Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	265371-2
Date prepared	-			16/07/2021	1	16/07/2021	16/07/2021		16/07/2021	16/07/2021
Date analysed	-			16/07/2021	1	16/07/2021	16/07/2021		16/07/2021	16/07/2021
Calcium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	37	37	0	99	103
Potassium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	6.9	7.0	1	101	101
Magnesium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	34	35	3	99	91
Sodium - Dissolved	mg/L	0.5	METALS-020	<0.5	1	250	260	4	103	#
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	INORG-006	<5	1	88	88	0	103	[NT]
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	INORG-006	<5	1	<5	<5	0	103	[NT]
Total Alkalinity as CaCO ₃	mg/L	5	INORG-006	<5	1	88	88	0	103	[NT]
Chloride	mg/L	1	INORG-081	<1	1	500	520	4	104	109
Sulphate	mg/L	1	INORG-081	<1	1	71	74	4	99	113
Hardness as CaCO ₃	mg/L	3	METALS-008	<3	1	230	240	4	[NT]	[NT]

QUALITY CONTROL: Ionic Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	265371-24
Date prepared	-			[NT]	11	16/07/2021	16/07/2021		16/07/2021	16/07/2021
Date analysed	-			[NT]	11	16/07/2021	16/07/2021		16/07/2021	16/07/2021
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	41	41	0	99	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	7.8	8.0	3	101	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	43	44	2	99	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	11	290	290	0	103	[NT]
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	INORG-006	[NT]	11	78	79	1	107	[NT]
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	INORG-006	[NT]	11	<5	<5	0	107	[NT]
Total Alkalinity as CaCO ₃	mg/L	5	INORG-006	[NT]	11	78	79	1	107	[NT]
Chloride	mg/L	1	INORG-081	[NT]	11	640	640	0	101	103
Sulphate	mg/L	1	INORG-081	[NT]	11	73	74	1	96	108
Hardness as CaCO ₃	mg/L	3	METALS-008	[NT]	11	280	280	0	[NT]	[NT]

Client Reference: July GME 2021

QUALITY CONTROL: Ionic Balance						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	21	16/07/2021	16/07/2021		[NT]	[NT]
Date analysed	-			[NT]	21	16/07/2021	16/07/2021		[NT]	[NT]
Calcium - Dissolved	mg/L	0.5	METALS-020	[NT]	21	18	[NT]		[NT]	[NT]
Potassium - Dissolved	mg/L	0.5	METALS-020	[NT]	21	7.4	[NT]		[NT]	[NT]
Magnesium - Dissolved	mg/L	0.5	METALS-020	[NT]	21	29	[NT]		[NT]	[NT]
Sodium - Dissolved	mg/L	0.5	METALS-020	[NT]	21	200	[NT]		[NT]	[NT]
Bicarbonate HCO ₃ as CaCO ₃	mg/L	5	INORG-006	[NT]	21	37	38	3	[NT]	[NT]
Carbonate CO ₃ ²⁻ as CaCO ₃	mg/L	5	INORG-006	[NT]	21	<5	<5	0	[NT]	[NT]
Total Alkalinity as CaCO ₃	mg/L	5	INORG-006	[NT]	21	37	38	3	[NT]	[NT]
Chloride	mg/L	1	INORG-081	[NT]	21	430	450	5	[NT]	[NT]
Sulphate	mg/L	1	INORG-081	[NT]	21	59	63	7	[NT]	[NT]
Hardness as CaCO ₃	mg/L	3	METALS-008	[NT]	21	160	[NT]		[NT]	[NT]

Client Reference: July GME 2021

QUALITY CONTROL: Dissolved Metals in Water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	265371-23
Date prepared	-			20/07/2021	1	20/07/2021	20/07/2021		20/07/2021	20/07/2021
Date analysed	-			20/07/2021	1	20/07/2021	20/07/2021		20/07/2021	20/07/2021
Aluminium - Dissolved	mg/L	0.1	METALS-020	<0.1	1	<0.1	<0.1	0	98	[NT]
Arsenic - Dissolved	mg/L	0.05	METALS-020	<0.05	1	<0.05	<0.05	0	100	[NT]
Iron - Dissolved	mg/L	0.02	METALS-020	<0.02	1	<0.02	<0.02	0	91	[NT]
Manganese - Dissolved	mg/L	0.01	METALS-020	<0.01	1	<0.01	<0.01	0	98	[NT]
Nickel - Dissolved	mg/L	0.02	METALS-020	<0.02	1	<0.02	<0.02	0	99	[NT]
Silicon - Dissolved	mg/L	0.1	METALS-020	<0.1	1	14	14	0	106	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	[NT]		101	98
Uranium-Dissolved	mg/L	0.0005	METALS-022	<0.0005	1	<0.0005	[NT]		100	100

QUALITY CONTROL: Dissolved Metals in Water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	3	20/07/2021	20/07/2021		[NT]	[NT]
Date analysed	-			[NT]	3	20/07/2021	20/07/2021		[NT]	[NT]
Aluminium - Dissolved	mg/L	0.1	METALS-020	[NT]	3	<0.1	[NT]		[NT]	[NT]
Arsenic - Dissolved	mg/L	0.05	METALS-020	[NT]	3	<0.05	[NT]		[NT]	[NT]
Iron - Dissolved	mg/L	0.02	METALS-020	[NT]	3	<0.02	[NT]		[NT]	[NT]
Manganese - Dissolved	mg/L	0.01	METALS-020	[NT]	3	<0.01	[NT]		[NT]	[NT]
Nickel - Dissolved	mg/L	0.02	METALS-020	[NT]	3	<0.02	[NT]		[NT]	[NT]
Silicon - Dissolved	mg/L	0.1	METALS-020	[NT]	3	13	[NT]		[NT]	[NT]
Thorium-Dissolved	mg/L	0.0005	METALS-022	[NT]	3	<0.0005	<0.0005	0	[NT]	[NT]
Uranium-Dissolved	mg/L	0.0005	METALS-022	[NT]	3	0.0012	0.0012	0	[NT]	[NT]

QUALITY CONTROL: Dissolved Metals in Water					Duplicate			Spike Recovery %		
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	11	20/07/2021	20/07/2021		[NT]	[NT]
Date analysed	-			[NT]	11	20/07/2021	20/07/2021		[NT]	[NT]
Aluminium - Dissolved	mg/L	0.1	METALS-020	[NT]	11	<0.1	<0.1	0	[NT]	[NT]
Arsenic - Dissolved	mg/L	0.05	METALS-020	[NT]	11	<0.05	<0.05	0	[NT]	[NT]
Iron - Dissolved	mg/L	0.02	METALS-020	[NT]	11	<0.02	<0.02	0	[NT]	[NT]
Manganese - Dissolved	mg/L	0.01	METALS-020	[NT]	11	<0.01	<0.01	0	[NT]	[NT]
Nickel - Dissolved	mg/L	0.02	METALS-020	[NT]	11	<0.02	<0.02	0	[NT]	[NT]
Silicon - Dissolved	mg/L	0.1	METALS-020	[NT]	11	18	18	0	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.
Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.	
The recommended maximums for analytes in urine are taken from "2018 TLVs and BEIs", as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.	
Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2	

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

Low (or high) spike recovery was obtained for this sample. Sample matrix interference is suspected. However, an acceptable recovery was achieved for the LCS.

APPENDIX E – GMA Letter regarding Sub Temperate Salt Marsh TEC/PEC



10 December 2020

Ms Cassie Reynolds
Environmental Officer
Resource and Environmental Compliance Division
Department of Mines, Industry Regulation and Safety
100 Plain St
East Perth WA 6004

Dear Ms Reynolds

Re: Sub Temperate Salt Marsh Lynton Mine Site

1 Introduction

1.1 Background

GMA Garnet Pty Ltd (GMA) was proposing to undertake mining expansion of the Lynton Resource Area within mining tenement M70/204. As part of the development works GMA commissioned GHD Pty Ltd (GHD) to complete a flora, vegetation, and fauna survey of M70/204, M70/259 and M70/1330. The survey results supported a clearing application (CPS 8934/1) for M70/204.

The flora, vegetation and fauna survey identified three vegetation types within the CPS 8934/1 application area including *Acacia rostellifera* open woodland to woodland, *Melaleuca cardiophylla* shrubland and *Myoporum insulare* shrubland (Figure 1). A preliminary assessment of CPS 8934/1 was undertaken in August 2020 by the Department of Mines, Industry Regulation and Safety (DMIRS). Advice sought from the Department of Biodiversity Conservation and Attractions (DBCA) indicates the *Myoporum insulare* shrubland (Vegetation Type 3) may align with the EPBC-listed Threatened Ecological Community (TEC) and the WA Priority 3 (P3) Subtropical and Temperate Coastal Saltmarsh.

1.2 Purpose

The purpose of this document is to provide information supporting the consideration that the mapped Vegetation Type 3 may not align with the TEC/P3 listed Subtropical and Temperate Coastal Saltmarsh (hereafter referred to as Saltmarsh). This consideration is based on GMA's monitoring and understanding of the local groundwater conditions.

2 Saltmarsh

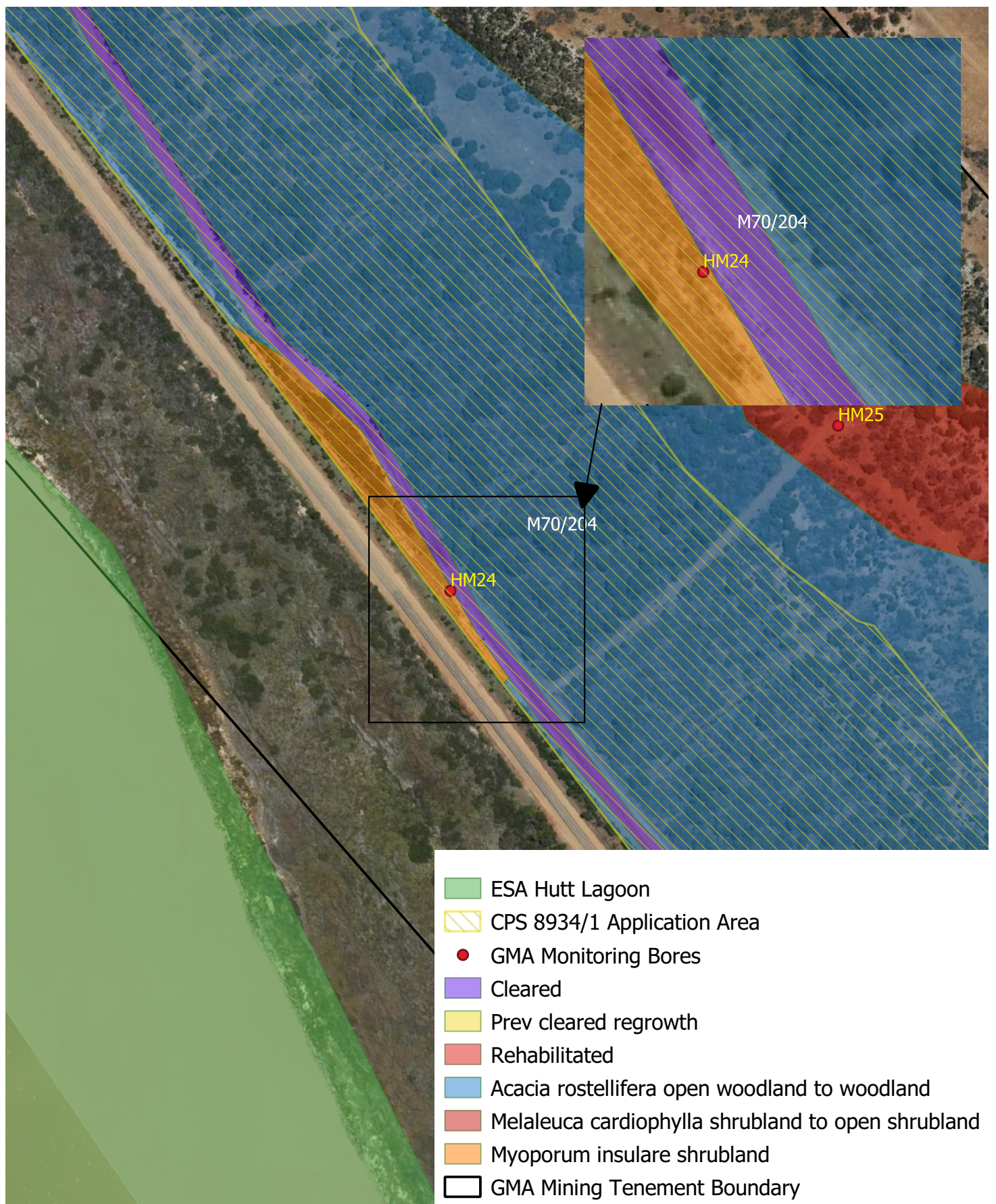
The Saltmarsh occurs along a narrow margin of the Australian coastline, extending from the subtropical and temperate climatic zones south of 23° latitude. A physical characteristic for the Saltmarsh as defined in the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) Conservation Advice for Subtropical and Temperate Coastal Saltmarsh (EPBC Conservation advice) is the physical environment is subject to tidal influence.

In WA's arid environment there is apparently less distinction between the flora of Coastal Saltmarsh and that of the inland salt lakes (Bridgewater and Creswell 2003). Western Australian coastal areas support an entire series of saline coastal wetlands that abut typical coastal saltmarshes, which includes coastal lagoons such as Hutt Lagoon (Keighery, 2013).

The Hutt Lagoon occurs adjacent to the western margin of GMA's Port Gregory mining tenements (Figure 1).

3 Hutt Lagoon

The Hutt Lagoon is a former estuary of the Hutt River and has been isolated from the sea by a barrier beach and sand dunes built on a buried reef system. The lagoon is 15 km long, up to 2.5 km wide and about 1 m



0 50 100 m



Map Project: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50
Imagery: Google Maps, 2017



Figure 1
GMA Garnet Pty Ltd
M70/204 Lynton
Resource

below sea level (URS, 2013). The Hutt Lagoon water supplied by direct precipitation, as well as surface inflow of minor creeks and groundwater seepage (DEC, 2009; Department of Agriculture, Water and the Environment, 2019). However, Keighery (2013) reported that the Hutt Lagoon is connected to the sea in various ways; however, it is unclear where the connections exist given that a sand dune and beach barrier exist between the Hutt Lagoon and the ocean.

The Hutt Lagoon at Port Gregory has substantial areas of Samphire shrubland dominated by *Tecticornia*, *Wilsonia humilis*/*W. backhousei* with *Frankenia* spp and *Juncus kraussii* sedgeland (Keighery unpub. obs.).

Water quality parameters measured at the Hutt Lagoon by the Salinity Action Plan Wetland Biological Survey, Hutt Catchment survey and IAI RCM survey indicates total dissolved solid (measurement of conductivity) range from 180,000 mg/L to 320,000 mg/L (DEC, 2009).

4 GMA Port Gregory Project

4.1 Local Groundwater Understanding

The Port Gregory project area is located east of the Hutt Lagoon. The processing and mine site water is sourced locally from a superficial aquifer occurring within palaeo beach and dune sand deposits of the Tamala Limestone and more recent interglacial beach deposits. Rockwater (1997) demonstrated that these formations were up to 15 m thick and extended to 15 – 20 m below sea level at the eastern edge of the Hutt Lagoon. These deposits thinned out towards the east and contained unconfined groundwater with a water table sloping downward to the southwest (Figure 2).

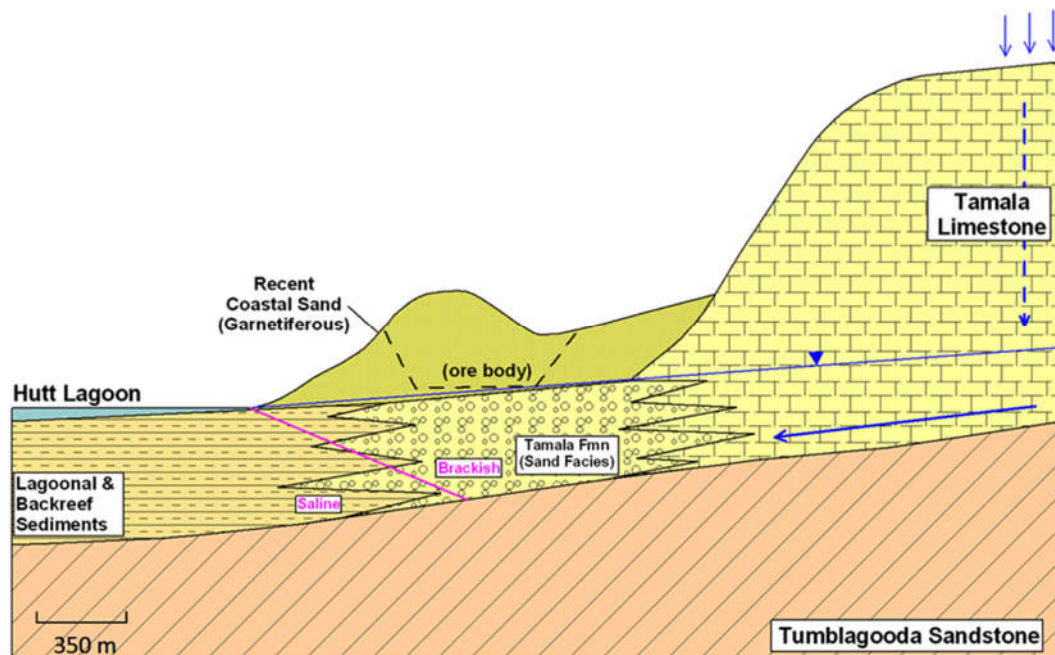


Figure 2 Geology and sub-surface flow

Water table contours were sub-parallel to the Hutt Lagoon, and water table elevation ranged from 6 m AHD in the east to 1 m AHD along the edge of the Hutt Lagoon. The water table has small seasonal fluctuations, generally less than 1 m between winter and summer.

Local groundwater flows in a southwesterly direction and discharge over a hypersaline saltwater wedge extending from the eastern edge of the Hutt Lagoon. Groundwater recharge originates from rainfall during winter months and cyclonic rainfall events (URS, 2013). The Hutt Lagoon essentially acts as a hydraulic sink creating a barrier between tidal flows and the groundwater system.

4.1.1 Local Groundwater Monitoring

Groundwater abstraction is undertaken under the Department of Water and Environmental Regulation (DWER) Groundwater Licence 62130(4). A licence condition requires GMA to undertake regular groundwater monitoring of the borefield, including production bores and monitoring bores. The monitoring bore network comprises 34 monitoring bores, and as part of the groundwater monitoring program, fortnightly and monthly monitoring of groundwater standing water levels and salinity profiling is undertaken. Monitoring bore HM24 is located within the mapped vegetation type 3, and monthly monitoring (salinity profiling and standing water levels) data is collected (Figure 1). Salinity profiling involves using a logger and lowering down at a constant rate to measure TDS concentrations within the different groundwater columns. The purpose of this, monitoring migration of the saltwater interface because of groundwater abstraction (GMA, 2013)

Monitoring data collected from HM24 demonstrates that the TDS levels range from 2,500 to 5,000 mg/L (Figure 3). The TDS concentrations are generally brackish and significantly lower than the Hutt Lagoon water parameters provided in section 3.

5 Conclusions

After reviewing available site data, GMA considers that vegetation type 3 mapped within clearing application (CPS 8934/1) does not align with the Saltmarsh TEC/PEC. This conclusion is based on the following:

- The TDS concentration within HM24 is distinctively different from the Hutt Lagoon. (more representative of brackish water). The groundwater within HM24 is more representative of brackish water whilst the Hutt Lagoon is representative of a hypersaline environment.
- The long-term trends and low concentrations of TDS suggest the groundwater beneath vegetation type 3 is not subject to any form of tidal influence.
- The hydraulic gradient of local groundwater determined from GMA's monitoring bore network does not suggest tidal influences
- The groundwater flow direction is south-westerly and into the Hutt Lagoon. The Hutt Lagoon essentially acts as a hydraulic sink creating a barrier between tidal flows and the groundwater system.

6 Reference

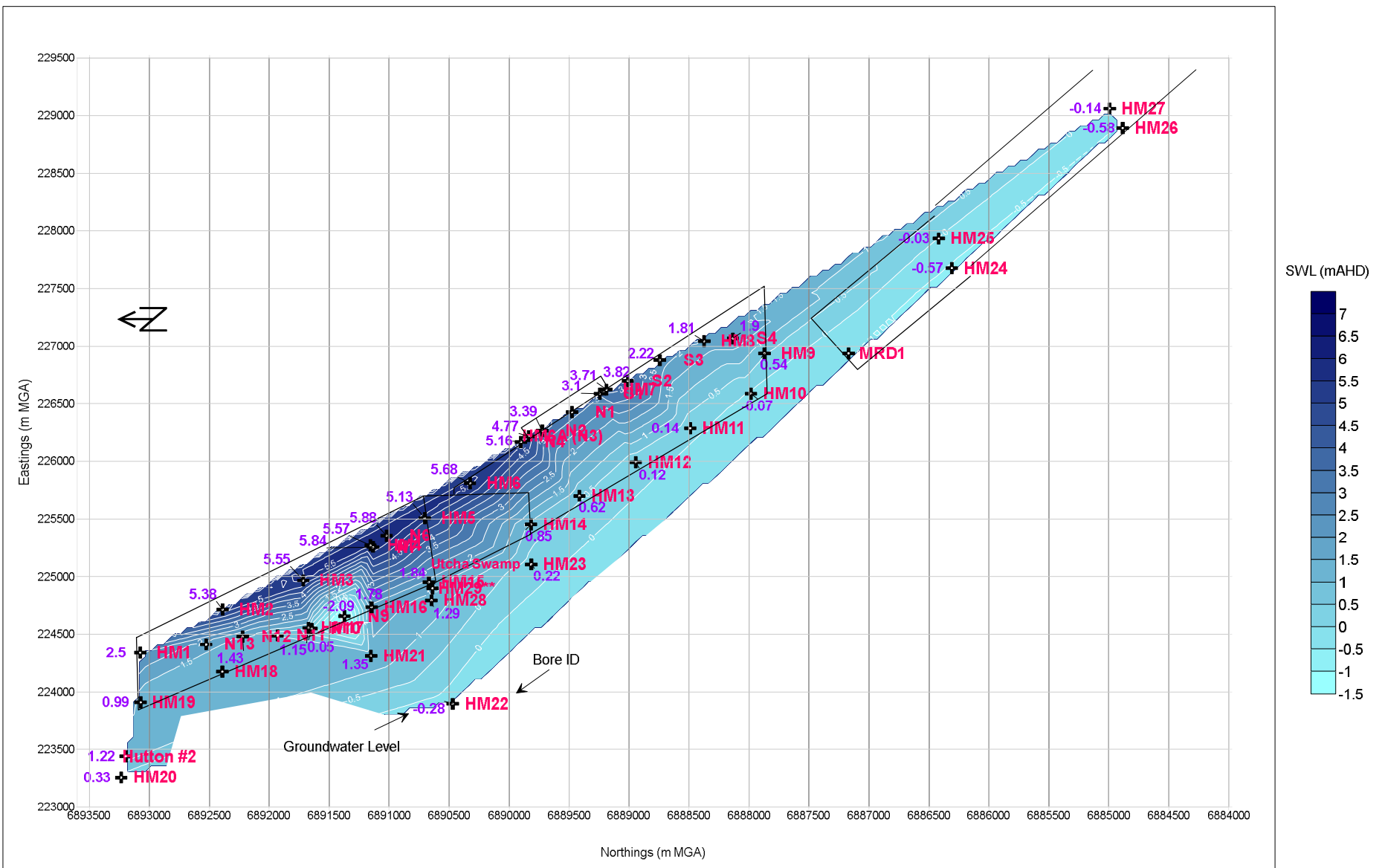
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GMA GARNET
PTY LTD

HOSE MINE AND LYNTON BOREFIELD
GROUNDWATER MONITORING SUMMARY
JANUARY TO DECEMBER 2019

AECOM
www.aecom.com

Project No: 60628417

Last Modified: 14 April 2020

Scale (metres)

0 1000 2000 3000

MGA94

HOSE MINE AREA
GROUNDWATER LEVELS
DECEMBER 2019

FIGURE 3-37



Please do not hesitate to let me know need any further information.

A handwritten signature in black ink, appearing to read 'SPetts'.

Kind Regards

Steven Petts
Environmental Coordinator
+61 99 236017

APPENDIX F – Earth Stewardship Flora and Vegetation Survey (2020)



GMA Garnet Pty Ltd:

Hose Mining Operations – Vegetation Survey

September 2020

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Document Status

Revision	Author(s)	Reviewer	Date	Approved for Issue	Distributed To	Date
A – Draft	J Foster	K Foster	02/09/2020			
A – Final				J Foster	GMA Garnet	07/09/2020

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1 Introduction

GMA Garnet Pty Ltd (GMA) requires survey of eight areas of vegetation within the vicinity of the Hose Mining Operations, located east of George Grey Drive, Yallabatharra.

1.1 Scope of Works

The scope of works included:

- A Level 1 vegetation survey using a series of relevés and wandering transects. It also included survey of non-permanent 10 m x 10 m quadrats (where suitable¹);
- Mapping of vegetation communities and tabular description of vegetation types and condition;
- Supply of survey data and GIS shapefiles; and
- Production of a short report detailing outcomes of vegetation survey.

1.2 Project Background – Hose Operations Area Vegetation

Vegetation in the vicinity of the Hose Mining Operations area consists of areas of cleared paddocks, trees planted as shelter-belts, locations where regrowth has occurred as part of natural recovery and/or rehabilitation efforts, and areas of native vegetation (Figure 1).


¹ Although included in the original scope, the survey of 10 m x 10 m quadrats was excluded from the field survey due to the small areal extent of vegetation present within the survey areas.



Figure 1 - Survey Areas

Hose Operations Vegetation Survey - August 2020

Legend

 GMA Garnet Survey Area

Google Hybrid

2 Methodology

2.1 Desktop Review (GMA)

GMA Garnet has completed the desktop review of the Hose Mining Operations area.

2.2 Field Survey

A single season reconnaissance vegetation assessment (Level 1) of the survey area was conducted by experienced botanist Joshua Foster on the 20 August 2020. The field survey was undertaken to ground-truth the results of the desktop review, identify and describe the vegetation types and assess vegetation condition.

The survey methodology employed for the survey was undertaken with reference to the EPA (2016) *Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* and the EPA (2004) *Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*.

2.2.1 Collection of Data

Survey methods involved the sampling of relevés located in identified vegetation types, wandering transects and through opportunistic sampling. The survey area was traversed on foot and by vehicle. Twenty-six relevés were assessed within the survey areas. The location of the relevés was based on aerial photography, and each site was *in situ*, through observations of vegetation during the field assessment. Field data for each relevé was recorded on a pro-forma data sheet and included the parameters detailed in Table 1. The locations of the relevés surveyed are indicated in Figure 2.


Table 1: Data collected during the field surveys

Aspect	Data collected
Collection Attributes	Personnel/recorder; survey date, photograph of the relevé site.
Location	Co-ordinates recorded in GDA94 datum using a hand-held Global Positioning System (GPS) tool to accuracy approximately ± 5 m.
Vegetation Condition	Vegetation condition was assessed using the condition rating scale as adopted by the EPA (2016).
Disturbance	Level and nature of disturbances.
Flora Taxa	List of all species within the relevé.

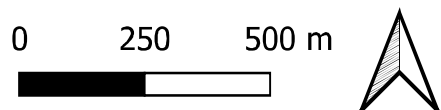


Figure 2 - Survey Sites
Hose Operations Vegetation Survey - August 2020

Legend

 GMA Garnet Survey Area

Google Hybrid



earth stewardship

2.2.2 Vegetation Types

Vegetation types were identified and boundaries delineated using a combination of aerial photography, topographical features and field observations. The vegetation types were described from vegetation existing at the time of survey.

Vegetation types were described based on structure, dominant taxa and cover characteristics as defined by relevé observations. Vegetation type descriptions broadly follow the National Vegetation Inventory System (NVIS) and are broadly consistent with NVIS Level V (Association) (ESCAVI, 2003). The mapping of vegetation types has been undertaken at a scale suitable for this project.

2.2.3 Vegetation Condition

The vegetation condition of the survey area was assessed and mapped in accordance with the vegetation condition rating scale for the South Western and Interzone Botanical Provinces (EPA, 2016). The scale recognises the intactness of vegetation and consists of six rating levels.

2.2.4 Flora Identification and Nomenclature

A flora inventory was compiled from taxa recorded in the relevés, and from opportunistic records made throughout the survey areas.

Flora taxa were well known to the botanist and all were identified in the field. No taxa were required to be collected for later identification.

Nomenclature used in this report follows that used by the Western Australian Herbarium.

2.3 Limitations

The services undertaken by Earth Stewardship in connection with preparing this report were limited to those specifically detailed in the report and are subject to the limitations set out in the report. The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report (including flora taxa nomenclature and listings).

The EPA (2016) Technical Guide states that vegetation and reports in Western Australia should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with this field survey are discussed in Table 2.

Table 2: Survey Limitations

Aspect	Constraint	Comment
Sources of desktop information and availability of additional broader scale information	Minor	Adequate information is available for the survey areas and surrounding locale.
Scope of survey (i.e. what life forms were sampled)	Nil	Vascular flora taxa were sampled during the survey. Non-vascular flora taxa were not assessed as part of survey.

Aspect	Constraint	Comment
Proportion of flora collected and identified (based on sampling, timing and intensity).	Minor	<p>The vegetation survey was undertaken on the 20 August 2020.</p> <p>Flora identification was undertaken by Joshua Foster in the field.</p> <p>Survey of the area was completed during the best period for identification of flowering plants at the location in the Mid West of Western Australia (i.e. mid-August), following the majority of Winter rainfall. The timing of the survey also maximised the potential for record of any conservation flora considered possible to occur in the local area.</p>
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed).	NA	<p>The survey areas were traversed on foot and vehicle. Information gained from the survey was extrapolated across those small sections of the survey area not traversed to assist with determining the vegetation types for the entire survey areas.</p>
Mapping reliability	Nil	<p>High resolution aerial imagery was available. Data was recorded in the field using hand-held GPS tools (Garmin GPS). Some atmospheric factors and other sources of error can affect the accuracy of GPS receivers. The Garmin GPS units used for this survey are considered accurate to within ± 5 m on average. Therefore, the data points consisting of coordinates recorded from the GPS may contain inaccuracies.</p>
Timing/weather/season/cycle	Moderate	<p>The field survey was conducted in August (Winter). The EPA (2016) preference for surveys in the South-western botanical province is in the season following greatest rainfall. The survey was designed to identify vegetation types and flora taxa. This survey timing was considered acceptable for this purpose.</p>
Disturbances (e.g. fire, flood, accidental human intervention)	Minor	<p>The majority of the survey area has been impacted to some degree by past and current disturbances including clearing, grazing by livestock feral and native animals, weed infestation, infrastructure development (roads), mining, and agricultural activities.</p>
Intensity and resources (in retrospect, was the intensity adequate)	Nil	<p>The vascular flora of the survey area was sampled with reference to the EPA (2016) Technical Guide. The survey was considered to be a reconnaissance survey due level of the survey.</p> <p>The survey areas were sufficiently covered by the botanist during the survey.</p>
Access restrictions	Nil	<p>No access problems were encountered during the survey. GMA (land manager) readily provided access to the survey areas, with GMA Environmental Co-ordinator (Steven Petts) accompanying Joshua Foster on the field survey. The survey areas were readily accessed on foot and vehicle.</p>

Aspect	Constraint	Comment
Experience levels	Nil	Joshua Foster is suitably qualified and has over fifteen years' experience conducting surveys in the Mid West. He has over 20 years' experience in undertaking ecological surveys within Western Australia.

3 Desktop Review

The desktop review was completed by GMA Garnet (attached).

4 Field Survey Results

4.1 Survey Areas

Eight survey areas were assessed during the field survey.

Survey Area	Location
1	Main Entrance and Haul Road Intersection
2	Topsoil Stockpile West
3	Office West
4	Powerline Corridor
5	Topsoil Stockpile North
6	Old Pit boundary - Weather Station
7	Hose Access Road
8	Loading Zone - Western Strip

4.1.1 Survey Area Notes

Survey Area 1 – This is located at the main entrance to the Hose mining operations. It comprises the access to the Hose plant, existing and proposed roads (Vegetation Type 1 (VT1))(Figure 3a). It supports a large area of paddock with isolated native plants (VT2), and shelter belt planting of *Eucalyptus utilis* (Coastal Moort) on the Hose access road. There are some small patches of regrowth (VT3) of *Acacia rostelifera* between an old fenceline and the Hose access road. Of note, aerial photography indicates that the small patch of dense *Acacia rostelifera* shrubland (VT5) present at the corner of the Hose access road and George Grey Drive has only been present since 2011.

Survey Area 2 – This is a topsoil pile at the western side of the Hose mining operations. This now supports a very dense *Acacia rostelifera* shrubland (VT5), which is also noted after review of aerial photography to have become established from previously cleared paddock, grown within the past seven years (Figure 3b).

Survey Area 3 – This is a small area of regrowth opposite the Hose access road at the main site office. It contains scattered native plants and planted *Eucalyptus camaldulensis* (River Gum) (Figure 3c).

Survey Area 4 – This comprises the powerline corridor, which is narrow strip behind the Hose main office. It contains mostly cleared vegetation along the powerline access tracks; but does contain some native plants from the lower limestone footslope as an open shrubland of *Acacia rostelifera* and *Grevillea argyrophylla* (VT6) (Figure 3c).

Survey Area 5 – This survey area is very degraded and consists of mostly cleared tracks (VT1) (Figure 3d). It does contain recent topsoil piles, with scattered native regrowth (VT3) plants along the piles and edges. In the central south portion of this survey area a cleared pit containing slimes and fines from the mining operation is present.

Survey Area 6 – This supports isolated native regrowth plants (VT3) on the edge of the original Hose pit, as well as access tracks and infrastructure (site weather station) (VT1) (Figure 3c).

Survey Area 7 – This is located along the western side of the Hose access road, and supports some older growth *Acacia rostellifera* Tall Shrublands (VT7) (Figure 3c). This is quite degraded due to adjacent infrastructure, weed infestation, and agricultural activities. The survey area was historically at least partially cleared (as indicated by aerial photography from 2003). The lack of fire to support vegetation type renewal has caused the *Acacia* to senesce and community to degrade further. Other parts of this area are previously cleared along old pit areas, for mining access, infrastructure (water bores) and a topsoil pile, now support regrowth (VT3).

Survey Area 8 – This survey area is located on the eastern side of cleared paddocks, adjacent to the ore load-out area, and consists of regrowth vegetation (VT3), in a location unable to be maintained as cleared paddock (i.e. steep slope) (Figure 3c).

4.2 Vegetation

4.2.1 Types and Condition

Vegetation within the survey areas is dominated by *Acacia rostellifera* (Summer-scented Wattle) and introduced pasture grasses and herbs. Seven vegetation types (VT1-7) were recorded from the survey areas, delineated by density, plant height and species composition, associated with topography and underlying geology and disturbance history (Figure 3a-d; and, Table 3). The vegetation types are described from vegetation existing at the time of survey. Condition is indicated in Figure 4a-d).

Four vegetation types: VT1, VT2, VT3 and VT4, are synonymous with a high level of disturbance, being:

- VT1: Cleared Tracks and Infrastructure
- VT2: Paddocks
- VT3: Regrowth
- VT4: Artificial Planting

Both VT1 and VT2 are typically cleared, with some scattered native plants. Paddocks within the Hose area are required to be maintained as pasture, in accordance with original mine closure planning.

Vegetation Type 4 (Artificial planting) consists of a narrow band of planted *Eucalyptus utilis* (Coastal Moort), used as a shelter belt along the Hose access road. Regrowth of some native plants (as well as weedy species) occurs in the shelter belt areas.

Regrowth areas (VT3) occur where freshly stored topsoil piles are beginning to support natural regrowth, or in areas not maintained for mining or agricultural purposes, e.g. along the edges of old mine pits and transport corridors. Older areas of regrowth along the edges of mining and infrastructure typically support a narrow band of *Acacia rostellifera* over scattered native shrubs but is dominated by weedy species in the understorey.

Vegetation Types 1, 2, and 4 are considered to be Completely Degraded (Figure 4a-d). Vegetation Type 3 contains some areas where the density of native shrubs and weed infestation is lower and

therefore is considered Degraded. The majority of this vegetation type remains Completely Degraded.

In Survey Area 2, the regrowth has been unchecked, and the vegetation on older topsoil storage has resulted in a dense shrubland of *Acacia rostellifera* (VT5) (Figure 3b). The vegetation on this topsoil store is less than ten years old, and in Good condition due to its density causing repression of weeds (Figure 4b). A similar stand of *Acacia rostellifera* mapped as VT5 is present in Survey Area 1, where natural regrowth has also occurred on a previously cleared location (Figure 3a). A high level of grazing from pigs and kangaroos is present, particularly in Survey Area 2.

Vegetation Type 7 occurs as an older, Degraded version of *Acacia rostellifera* shrublands (Figure 3c and Figure 4c). The narrowness of the area, combined with repeated disturbance from mining, infrastructure maintenance and agricultural activities has resulted in a vegetation decline. The lack of community renewal through fire has resulted in a post-climax community which now consists of senescing large shrubs, scattered remnant mid-storey native shrub species, and a significant infestation of understorey weedy grasses and herbs. A high level of grazing from pigs and kangaroos is present.

Vegetation Type 6 is also Degraded but differs from Vegetation Type 7 in the presence of *Grevillea argyrophylla* and its occurrence on the lower limestone slopes (Figure 3a,c and d; and, Figure 4a,c and d). This vegetation type is limited in extent and is severely impacted in the local area from historical clearing and current grazing by livestock, feral and native fauna.

4.2.2 Comparison to Other Surveys



No vegetation types recorded within the survey areas are considered to approach the under-represented Beard Vegetation Association (BVA) 371 (*Acacia rostellifera* low forest) (described in Beard and Burns, 1976), due to the level of lack of correct community structure and high level of degradation from current and historical impacts. The Good condition vegetation of Vegetation Type 5 *Acacia rostellifera* Dense Shrublands cannot be considered to be close to the BVA 371 as both recorded areas (in Survey Area 1 and 2) support a community less than 10 years old (Figure 3a and b; and, Figure 4a and b).


Vegetation in the survey areas is considered to be broadly comparable to a lower structural version of that described by GHD (2020) as:



- VT01: *Acacia rostellifera* Open Woodland to Woodland, and
- Rehabilitation Areas that contain fragmented vegetation resembling VT01.

The lack of records of *Melaleuca cardiophylla* (in this survey), and the fact that areas surveyed were lower in the landscape dismiss the possibility that vegetation types recorded in this survey are comparative to either BVA 17 (Shrublands, *Acacia rostellifera*) or GHD (2020) VT02: *Melaleuca cardiophylla* shrubland to open shrubland.

Table 3: Survey Area Vegetation Types

Vegetation Type	Short Description	Description	Example Photograph	Condition	Survey Areas	Relevé locations
VT1	Cleared Tracks and Infrastructure	Completely cleared tracks and mining infrastructure. May contain some scattered native plants, but generally dominated by weedy species.		Completely Degraded	1, 3, 4, 5, 6, 7, 8	R13, R18
VT2	Paddocks	Completely cleared paddocks with scattered native plants, including <i>Acacia rostellifera</i> , <i>Commicarpus australis</i> , <i>Alyogyne hakeifolia</i> . Dominated by pasture grasses and weeds, including <i>*Avena barbata</i> , <i>*Bromus diandrus</i> , <i>*Sonchus oleraceus</i> , <i>*Cenchrus ciliaris</i> , <i>*Euphorbia terracina</i> , <i>*Reichardia tingitana</i> , <i>*Helianthus annuus</i> .		Completely Degraded	1	R1, R3, R6 (north), R10

Vegetation Type	Short Description	Description	Example Photograph	Condition	Survey Areas	Relevé locations
VT3	Regrowth	Areas of <i>Acacia rostellifera</i> (typically over weeds) along non-maintained edges of mine pits, roads, infrastructure. Also includes recently installed topsoil stockpiles. Where taller and denser, regrowth occurs in thin strips of vegetation, particularly along the edges of the original mine, and ore loading area.		Completely Degraded to Degraded	1, 3, 4, 5, 6, 7, 8	R9, R11, R15, R16, R17, R19, R20, R22, R23, R25, R26

Vegetation Type	Short Description	Description	Example Photograph	Condition	Survey Areas	Relevé locations
VT4	Artificial Planting	Strip of <i>Eucalyptus utilis</i> (Coastal Moort), planted as wind shelter belt, along the Hose mine access road. Regrowth <i>Acacia rostellifera</i> and weed species are also present		Completely Degraded	1, 4	R6 (south)
VT5	<i>Acacia rostellifera</i> Dense Shrublands	Dense shrublands of <i>Acacia rostellifera</i> over <i>Alyogyne hakeifolia</i> over <i>Rhagodia</i> spp., <i>Tetragonia implexicoma</i> , <i>Pimelea microcephala</i> over mixed weed species on topsoil mounds and an area of regrowth.		Good	1, 2	R4, R5, R7, R8

Vegetation Type	Short Description	Description	Example Photograph	Condition	Survey Areas	Relevé locations
VT6	<i>Acacia rostellifera</i> Open Shrublands on Limestone	Open Shrubland of <i>Acacia rostellifera</i> over <i>Grevillea argyrophylla</i> with scattered <i>Diplolaena grandiflora</i> , <i>Androcalva gaudichaudii</i> , <i>Scaevola tomentosa</i> , <i>Enchylaena tomentosa</i> over mixed weed species on lower limestone footslopes.		Completely Degraded	1, 4	R2, R12, R14
VT7	<i>Acacia rostellifera</i> Tall Shrubland	Tall Shrubland to Open Woodland of <i>Acacia rostellifera</i> over <i>Templetonia retusa</i> , <i>Commicarpus australis</i> , <i>Rhagodia</i> spp., <i>Alyxia buxifolia</i> , <i>Enchylaena tomentosa</i> over mixed weed species		Degraded	7	R21, R24

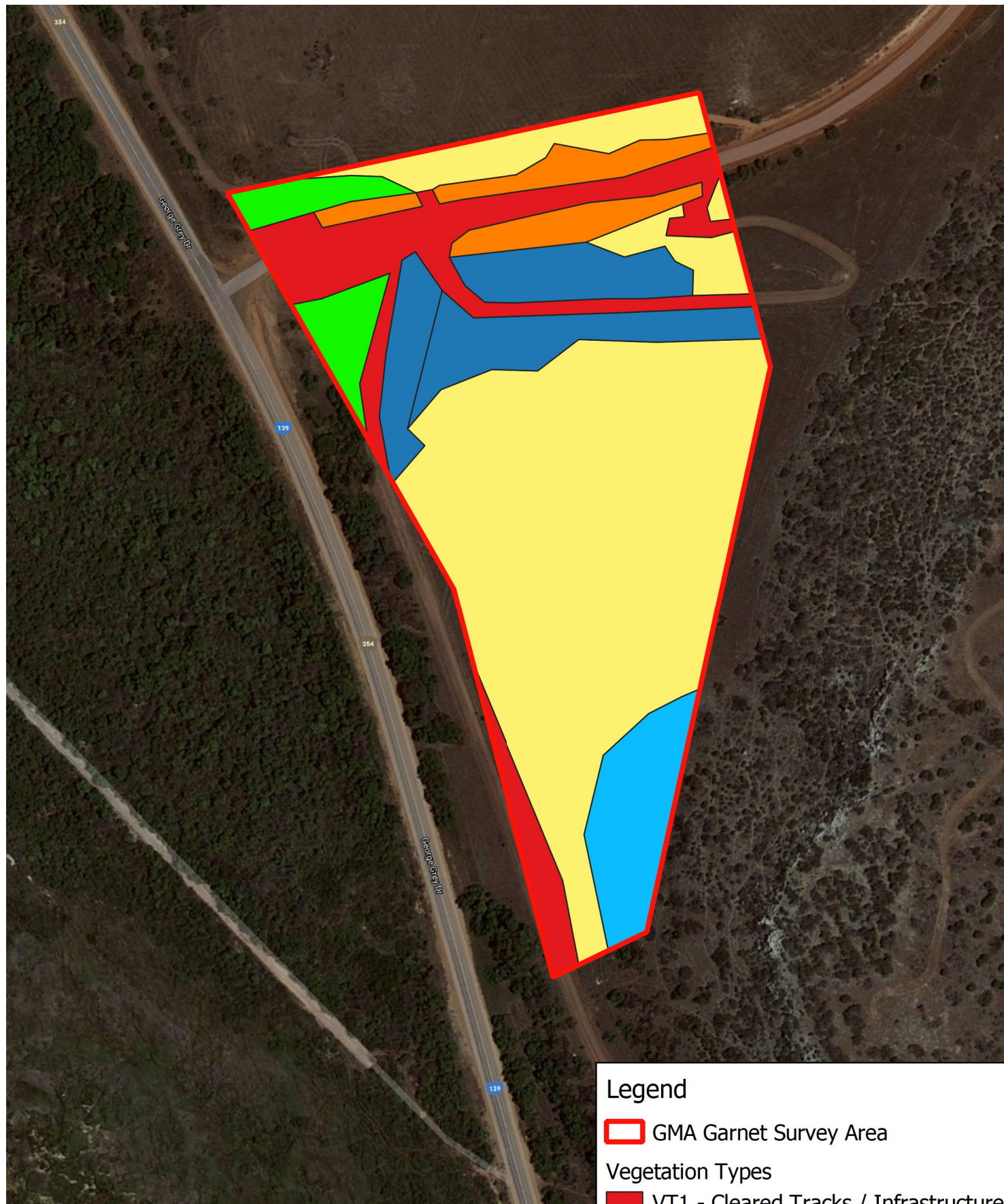


Figure 3a - Vegetation Types
Survey Area 1

Hose Operations Vegetation Survey - August 2020

0 25 50 m



earth
stewardship

Legend

 GMA Garnet Survey Area

Vegetation Types

VT1 - Cleared Tracks / Infrastructure

VT2 - Paddocks

VT3 - Regrowth

VT4 - Artificial Planting

VT5 - Dense Shrublands

VT6 - Open Shrublands on Limestone

VT7 - Tall Shrubland

Google Hybrid




Figure 3b - Vegetation Types
Survey Area 2


Hose Operations Vegetation Survey - August 2020





Legend


 GMA Garnet Survey Area


Vegetation Types


 VT1 - Cleared Tracks / Infrastructure


 VT2 - Paddocks

 VT3 - Regrowth

 VT4 - Artificial Planting

 VT5 - Dense Shrublands

 VT6 - Open Shrublands on Limestone

 VT7 - Tall Shrubland

Google Hybrid

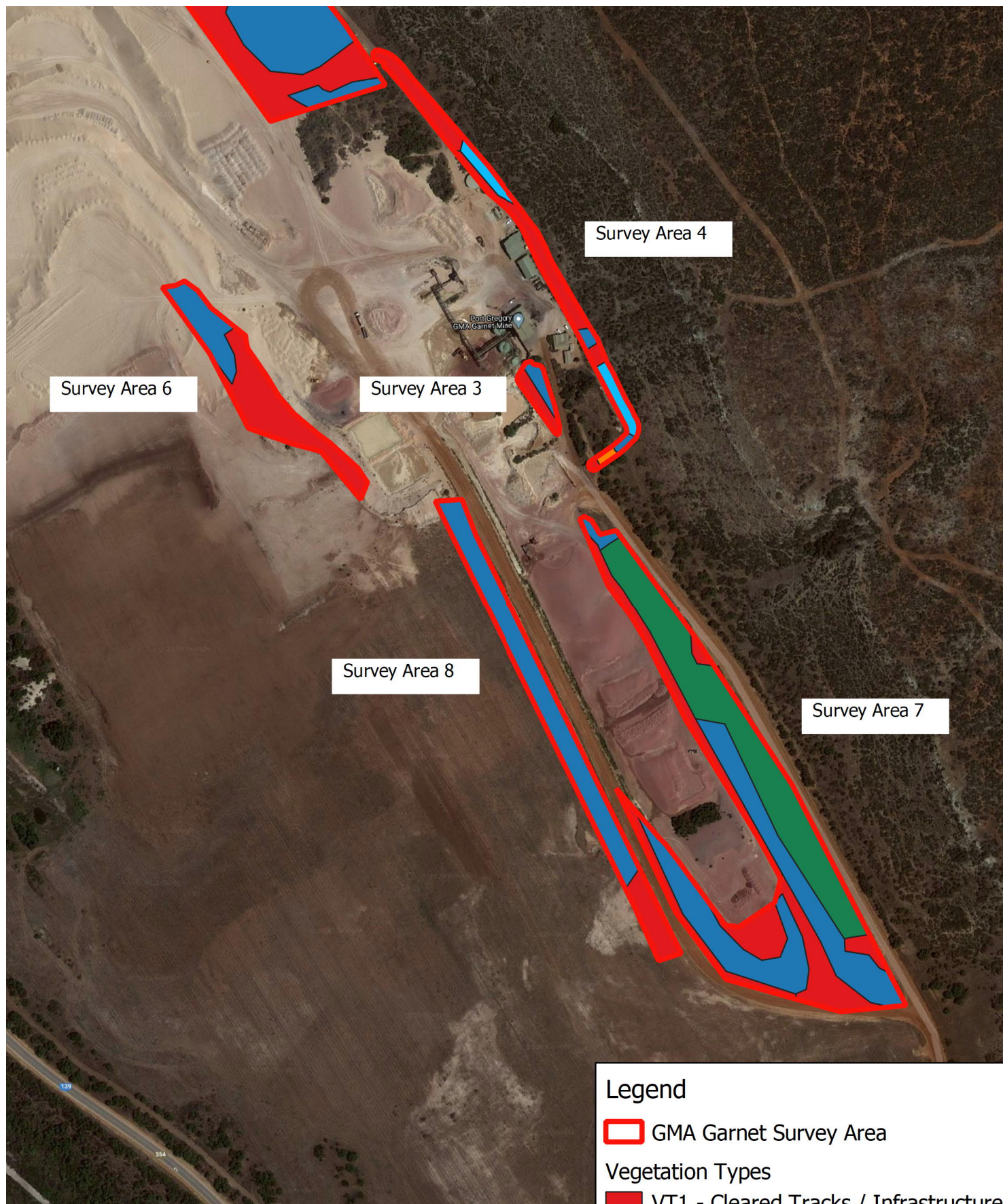


Figure 3c - Vegetation Types
Survey Areas 3, 4, 6, 7, 8
Hose Operations Vegetation Survey - August 2020

Legend

GMA Garnet Survey Area

Vegetation Types

- VT1 - Cleared Tracks / Infrastructure
- VT2 - Paddocks
- VT3 - Regrowth
- VT4 - Artificial Planting
- VT5 - Dense Shrublands
- VT6 - Open Shrublands on Limestone
- VT7 - Tall Shrubland

Google Hybrid

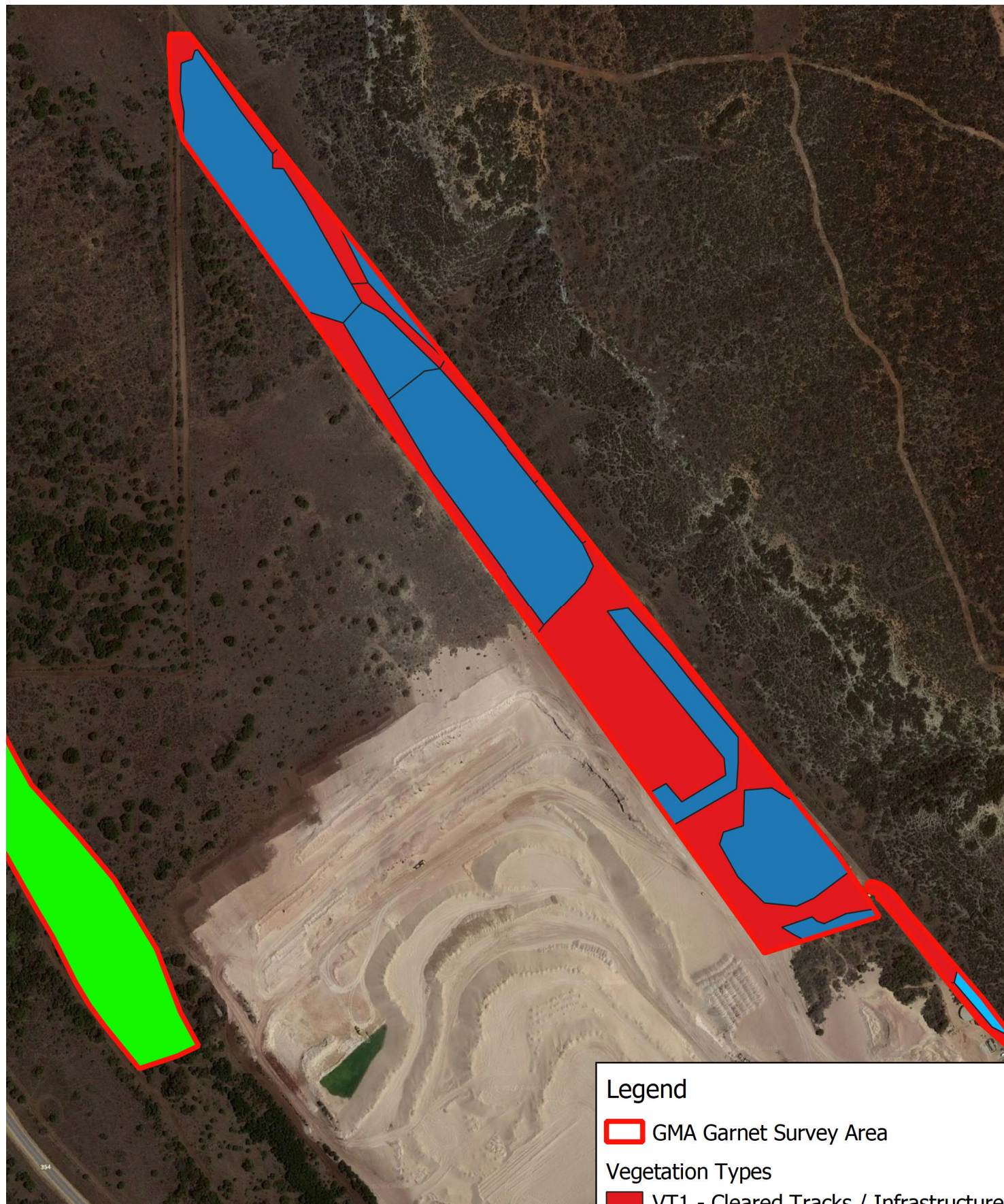


Figure 3d - Vegetation Types
Survey Area 5

Hose Operations Vegetation Survey - August 2020

0 50 100 m




earth
stewardship


Legend

 GMA Garnet Survey Area

Vegetation Types


 VT1 - Cleared Tracks / Infrastructure


 VT2 - Paddocks

 VT3 - Regrowth

 VT4 - Artificial Planting

 VT5 - Dense Shrublands

 VT6 - Open Shrublands on Limestone

 VT7 - Tall Shrubland

Google Hybrid



Figure 4a - Vegetation Condition
Survey Areas 1

Hose Operations Vegetation Survey - August 2020

Legend

- GMA Garnet Survey Area
- Vegetation Condition**
- Completely Degraded
- Degraded
- Good
- Google Hybrid



Figure 4b - Vegetation Condition
Survey Area 2

Hose Operations Vegetation Survey - August 2020



Legend

 GMA Garnet Survey Area

Vegetation Condition

 Completely Degraded

 Degraded

 Good

Google Hybrid






Figure 4d - Vegetation Condition
Survey Area 5


Hose Operations Vegetation Survey - August 2020




Legend

 GMA Garnet Survey Area

Vegetation Condition

 Completely Degraded

 Degraded

 Good

Google Hybrid

4.3 Flora

4.3.1 List of Recorded Flora Taxa

A list of flora taxa recorded by Survey Area is included in Table 4.

A total of 73 flora taxa from 35 families were recorded from the survey areas. Of the taxa recorded, 29 were weed/introduced flora, dominated by pasture grasses and weeds. An additional two species were recorded in the survey areas that had been deliberately planted for shelter belt purposes.

Most dominant families included Poaceae (grasses; 10 taxa); Asteraceae (daisies; 8 taxa); Chenopodiaceae (chenopods; 7 taxa); and Fabaceae (peas, wattles; 6 taxa).

4.3.2 Conservation Significant Flora

No Threatened species pursuant to the Environment Protection and Biosecurity Conservation Act 1986 (EPBC Act) were recorded during the survey of the survey area.

No plant taxa gazetted as Threatened (Declared Rare) pursuant to the Biodiversity Conservation Act 2017 (BC Act) were recorded in the survey area.

No Priority Flora taxa were recorded in the Survey Areas during the field assessment.

The Grey Copperburr (*Sclerolaena diacantha*) was recorded in the Survey Areas (VT2 – Paddocks). This record is a minor extension to the known range – 75 km west of the nearest known record. This species is widespread across Western Australia and not considered to be of conservation significance.

4.3.3 Significant Weed Species

Echium plantagineum (Paterson's Curse) is listed as a Declared Pest (s22(2)) of the Biosecurity and Agriculture Management Act 2007 (BAM Act), and is widespread in the local and regional area. Control of this pest into areas where infestations do not occur, is considered warranted.

Table 4 **Flora List by Survey Area**

Family	Genus	Species	Common Name	Status	Survey Area							
					1	2	3	4	5	6	7	8
Aizoaceae	<i>Mesembryanthemum</i>	<i>crystallinum</i>	Iceplant	*							x	
Aizoaceae	<i>Tetragonia</i>	<i>implexicoma</i>	Bower Spinach		x		x		x	x	x	x
Amaranthaceae	<i>Ptilotus</i>	<i>divaricatus</i>	Climbing Mulla-mulla						x			
Aphanopetalaceae	<i>Aphanopetalum</i>	<i>clematideum</i>			x							
Apocynaceae	<i>Alyxia</i>	<i>buxifolia</i>	Dysentery Bush					x			x	
Asparagaceae	<i>Acanthocarpus</i>	<i>preissii</i>	Prickle Lily			x			x		x	
Asteraceae	<i>Helianthus</i>	<i>annuus</i>	Sunflower	*							x	x
Asteraceae	<i>Lactuca</i>	<i>serriola</i>	Prickly Lettuce	*	x							
Asteraceae	<i>Olearia</i>	<i>axillaris</i>	Coast Daisybush				x	x				
Asteraceae	<i>Olearia</i>	sp. Kennedy Range							x	x	x	
Asteraceae	<i>Reichardia</i>	<i>tingitana</i>		*	x		x		x	x	x	x
Asteraceae	<i>Sonchus</i>	<i>oleraceus</i>	Common Sowthistle	*	x		x		x		x	x
Asteraceae	<i>Urospermum</i>	<i>picroides</i>	False Hawkbit	*		x						
Asteraceae	<i>Verbesina</i>	<i>encelioides</i>	Golden Crownbeard	*			x			x	x	
Boraginaceae	<i>Echium</i>	<i>plantagineum</i>	Paterson's Curse	*DP	x				x		x	x
Brassicaceae	<i>Sisymbrium</i>	<i>orientale</i>	Indian Hedge Mustard	*	x	x	x		x	x	x	
Chenopodiaceae	<i>Atriplex</i>	<i>isatidea</i>	Coast Saltbush				x					
Chenopodiaceae	<i>Chenopodium</i>	<i>murale</i>	Nettle-leaf Goosefoot	*	x							
Chenopodiaceae	<i>Enchylaena</i>	<i>tomentosa</i>	Barrier Saltbush		x		x	x		x	x	x
Chenopodiaceae	<i>Rhagodia</i>	<i>latifolia</i>			x	x			x			x
Chenopodiaceae	<i>Rhagodia</i>	<i>preissii</i> subsp. <i>obovata</i>			x	x			x	x	x	
Chenopodiaceae	<i>Salsola</i>	<i>tragus</i>	Roly Poly		x				x	x		x
Chenopodiaceae	<i>Sclerolaena</i>	<i>diacantha</i>	Grey Copperburr	RE	x			x				
Convolvulaceae	<i>Convolvulus</i>	<i>remotus</i>			x	x				x	x	x
Convolvulaceae	<i>Cuscuta</i>	<i>epithymum</i>	Lesser Dodder	*	x				x			
Cucurbitaceae	<i>Citrullus</i>	<i>lanatus</i>	Pie Melon	*		x			x			
Dioscoreaceae	<i>Dioscorea</i>	<i>hastifolia</i>	Yam								x	
Euphorbiaceae	<i>Adriana</i>	<i>quadripartita</i>	Bitter Bush			x		x				
Euphorbiaceae	<i>Euphorbia</i>	<i>drummondii</i>	Caustic Weed		x							x
Euphorbiaceae	<i>Euphorbia</i>	<i>tannensis</i>	Gascoyne Spurge							x		x
Euphorbiaceae	<i>Euphorbia</i>	<i>terraccina</i>	Geraldton Carnation Weed	*	x						x	
Fabaceae	<i>Acacia</i>	<i>rostellifera</i>	Summer-scented Wattle		x	x	x	x	x	x	x	x
Fabaceae	<i>Kennedia</i>	<i>prostrata</i>	Running Postman							x	x	

Family	Genus	Species	Common Name	Status	Survey Area							
					1	2	3	4	5	6	7	8
Fabaceae	<i>Lupinus</i>	<i>cosentinii</i>	Blue Lupin	*	x							
Fabaceae	<i>Medicago</i>	<i>polymorpha</i>	Burr Medic	*	x							
Fabaceae	<i>Melilotus</i>	<i>indicus</i>		*	x				x			
Fabaceae	<i>Templetonia</i>	<i>retusa</i>	Cockies Tongue		x	x				x	x	
Geraniaceae	<i>Erodium</i>	<i>cygnorum</i>	Blue Heronsbill		x	x			x		x	
Goodeniaceae	<i>Goodenia</i>	<i>berardiana</i>							x			
Goodeniaceae	<i>Scaevola</i>	<i>tomentosa</i>			x			x			x	
Lamiaceae	<i>Westringia</i>	<i>dampieri</i>						x				
Loranthaceae	<i>Amyema</i>	<i>miraculosa</i>						x				
Malvaceae	<i>Alyogyne</i>	<i>hakeifolia</i>			x	x		x		x	x	x
Malvaceae	<i>Androcalva</i>	<i>gaudichaudii</i>			x			x	x			
Malvaceae	<i>Lasiopetalum</i>	<i>angustifolium</i>						x				
Myrtaceae	<i>Eucalyptus</i>	<i>camaldulensis</i>	River Gum	+			x					
Myrtaceae	<i>Eucalyptus</i>	<i>utilis</i>	Coastal Moort	+	x							
Nyctaginaceae	<i>Commicarpus</i>	<i>australis</i>	Perennial Tar Vine		x				x		x	
Oxalidaceae	<i>Oxalis</i>	<i>exilis</i>	Native Soursob								x	
Pittosporaceae	<i>Pittosporum</i>	<i>ligustrifolium</i>			x						x	
Poaceae	<i>Austrostipa</i>	<i>elegantissima</i>	Showy Feathergrass								x	
Poaceae	<i>Austrostipa</i>	sp. (insufficient material)	Feathergrass			x		x				
Poaceae	<i>Avena</i>	<i>barbata</i>	Wild Oat	*	x	x	x	x	x	x	x	x
Poaceae	<i>Bromus</i>	<i>diandrus</i>	Great Brome	*	x	x			x			
Poaceae	<i>Cenchrus</i>	<i>ciliaris</i>	Buffel Grass	*	x						x	x
Poaceae	<i>Cenchrus</i>	<i>setaceus</i>	Fountain Grass	*							x	
Poaceae	<i>Cynodon</i>	<i>dactylon</i>	Couch	*							x	x
Poaceae	<i>Ehrharta</i>	<i>longiflora</i>	Annual Veldt Grass	*	x	x			x		x	
Poaceae	<i>Hordeum</i>	<i>leporinum</i>	Barley Grass	*							x	
Poaceae	<i>Paractaenum</i>	<i>novae-hollandiae</i>	Reflexed Panic Grass		x							
Polygonaceae	<i>Rumex</i>	<i>hypogaeus</i>	DoubleGee	*				x				
Primulaceae	<i>Anagallis</i>	<i>arvensis</i>	Pimpernel	*	x	x		x	x		x	
Proteaceae	<i>Grevillea</i>	<i>argyrophylla</i>						x				
Rhamnaceae	<i>Diplolaena</i>	<i>grandiflora</i>	Wild Rose		x			x				
Santalaceae	<i>Santalum</i>	<i>acuminatum</i>	Quandong					x				
Scrophulariaceae	<i>Eremophila</i>	<i>glabra</i>	Tar Bush			x						
Scrophulariaceae	<i>Myoporum</i>	<i>insulare</i>	Blueberry Tree		x							
Solanaceae	<i>Anthocercis</i>	<i>littorea</i>	Yellow Tailflower			x						

Family	Genus	Species	Common Name	Status	Survey Area							
					1	2	3	4	5	6	7	8
Solanaceae	<i>Solanum</i>	<i>nigrum</i>	Black Berry Nightshade	*	x	x				x		
Surianaceae	<i>Stylobasium</i>	<i>spathulatum</i>	Pebble Bush		x						x	
Thymelaeaceae	<i>Pimelea</i>	<i>microcephala</i>	Shrubby Riceflower		x		x	x	x		x	x
Vitaceae	<i>Clematicissus</i>	<i>angustissima</i>	Native Grape		x				x		x	
Zygophyllaceae	<i>Roepera</i>	<i>similis</i>			x				x			

Table 5 Flora List by Relevé

Family	Genus	Species	Common Name	Status	Relevé																									
					R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26
Aizoaceae	Mesembryanthemum	crystallinum	Iceplant	*																										
Aizoaceae	Tetragonia	implexicoma	Bower Spinach		x	x			x				x				x			x	x	x	x			x				
Amaranthaceae	Ptilotus	divaricatus	Climbing Mulla-mulla																x	x							x	x	x	
Aphanopetalaceae	Aphanopetalum	clematideum				x																								
Apocynaceae	Alyxia	buxifolia	Dysentery Bush													x									x			x		
Asparagaceae	Acanthocarpus	preissii	Prickle Lily								x		x						x	x					x			x		
Asteraceae	Helianthus	annuus	Sunflower	*										x									x						x	
Asteraceae	Lactuca	serriola	Prickly Lettuce	*					x																					
Asteraceae	Olearia	axillaris	Coast Daisybush											x			x													
Asteraceae	Olearia	sp. Kennedy Range																												
Asteraceae	Reichardia	tingitana		*			x	x	x		x			x	x				x	x		x	x	x	x	x	x	x	x	
Asteraceae	Sonchus	oleraceus	Common Sowthistle	*		x	x	x		x	x			x	x					x				x		x	x		x	
Asteraceae	Urospermum	picroides	False Hawkbit	*							x																			
Asteraceae	Verbesina	encelioides	Golden Crownbeard	*											x							x	x							
Boraginaceae	Echium	plantagineum	Paterson's Curse	*DP	x			x		x			x							x					x			x	x	
Brassicaceae	Sisymbrium	orientale	Indian Hedge Mustard	*		x			x	x	x		x	x				x	x	x			x	x	x	x	x			
Chenopodiaceae	Atriplex	isatidea	Coast Saltbush											x																
Chenopodiaceae	Chenopodium	murale	Nettle-leaf Goosefoot	*		x																								
Chenopodiaceae	Enchylaena	tomentosa	Barrier Saltbush			x			x	x			x		x	x						x	x	x				x	x	
Chenopodiaceae	Rhagodia	latifolia				x	x				x		x						x	x	x							x		
Chenopodiaceae	Rhagodia	preissii subsp. obovata				x			x		x		x						x	x		x	x						x	
Chenopodiaceae	Salsola	tragus	Roly Poly						x	x			x	x						x		x						x		
Chenopodiaceae	Sclerolaena	diacantha	Grey Copperburr	RE					x																					
Convolvulaceae	Convolvulus	remotus				x					x		x									x		x			x	x		
Convolvulaceae	Cuscuta	epithymum	Lesser Dodder	*			x													x	x									
Cucurbitaceae	Citrullus	lanatus	Pie Melon	*							x	x						x			x									
Dioscoreaceae	Dioscorea	hastifolia	Yam																											
Euphorbiaceae	Adriana	quadripartita	Bitter Bush								x		x						x					x			x			
Euphorbiaceae	Euphorbia	drummondii	Caustic Weed						x																			x		
Euphorbiaceae	Euphorbia	tannensis	Gascoyne Spurge																			x						x		
Euphorbiaceae	Euphorbia	terracina	Geraldton Carnation Weed	*			x			x																				
Fabaceae	Acacia	rostellifera	Summer-scented Wattle			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Fabaceae	Kennedia	prostrata	Running Postman																				x				x			
Fabaceae	Lupinus	cosentinii	Blue Lupin	*			x	x			x																			
Fabaceae	Medicago	polymorpha	Burr Medic	*			x				x																			
Fabaceae	Melilotus	indicus		*						x	x										x						x		x	
Fabaceae	Templetonia	retusa	Cookies Tongue			x						x																		
Geraniaceae	Erodium	cygnorum	Blue Heronsbill				x				x	x		x						x	x				x		x	x		
Goodeniaceae	Goodenia	berardiana																		x	x									
Goodeniaceae	Scaevola	tomentosa				x										x									x			x		
Lamiaceae	Westringia	dampieri																		x										
Loranthaceae	Amyema	miraculosa																												
Malvaceae	Alyogyne	hakeifolia					x				x			x					x											
Malvaceae	Androcalva	gaudichaudii					x							x											x	x	x	x	x	
Malvaceae	Lasiopetalum	angustifolium																												
Myrtaceae	Eucalyptus	camaldulensis	River Gum	+											x															
Myrtaceae	Eucalyptus	utilis	Coastal Moort	+							x																			
Nyctaginaceae	Commicarpus	australis	Perennial Tar Vine				x				x			x						x	x					x				
Oxalidaceae	Oxalis	exilis	Native Soursob																								x			

Family	Genus	Species	Common Name	Status	Relevé																													
					R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22	R23	R24	R25	R26				
Pittosporaceae	<i>Pittosporum</i>	<i>ligustrifolium</i>				x																						x				x		
Poaceae	<i>Austrostipa</i>	<i>elegantissima</i>	Showy Feathergrass																										x			x		
Poaceae	<i>Austrostipa</i>	sp. (insufficient material)	Feathergrass								x		x				x																	
Poaceae	<i>Avena</i>	<i>barbata</i>	Wild Oat	*		x	x	x	x	x	x	x	x	x	x			x			x	x	x	x	x	x	x	x	x	x	x	x	x	
Poaceae	<i>Bromus</i>	<i>diandrus</i>	Great Brome	*		x		x			x	x		x	x						x	x								x	x			
Poaceae	<i>Cenchrus</i>	<i>ciliaris</i>	Buffel Grass	*			x	x		x	x			x																x	x	x	x	
Poaceae	<i>Cenchrus</i>	<i>setaceus</i>	Fountain Grass	*																											x	x		
Poaceae	<i>Cynodon</i>	<i>dactylon</i>	Couch	*																										x			x	
Poaceae	<i>Ehrharta</i>	<i>longiflora</i>	Annual Veldt Grass	*					x		x	x	x	x	x					x			x	x					x	x	x	x		
Poaceae	<i>Hordeum</i>	<i>leporinum</i>	Barley Grass	*																												x		
Poaceae	<i>Paractaenum</i>	<i>novae-hollandiae</i>	Reflexed Panic Grass							x																								
Polygonaceae	<i>Rumex</i>	<i>hypogaeus</i>	DoubleGee	*																												x		
Primulaceae	<i>Anagallis</i>	<i>arvensis</i>	Pimpernel	*			x	x			x	x			x					x	x	x									x			
Proteaceae	<i>Grevillea</i>	<i>argyrophylla</i>																																
Rhamnaceae	<i>Diplolaena</i>	<i>grandiflora</i>	Wild Rose				x																											
Santalaceae	<i>Santalum</i>	<i>acuminatum</i>	Quandong																															
Scrophulariaceae	<i>Eremophila</i>	<i>glabra</i>	Tar Bush										x																					
Scrophulariaceae	<i>Myoporum</i>	<i>insulare</i>	Blueberry Tree							x																								
Solanaceae	<i>Anthocercis</i>	<i>littorea</i>	Yellow Tailflower								x			x	x																			
Solanaceae	<i>Solanum</i>	<i>nigrum</i>	Black Berry Nightshade	*			x				x																							
Surianaceae	<i>Stylobasium</i>	<i>spathulatum</i>	Pebble Bush				x						x																			x	x	
Thymelaeaceae	<i>Pimelea</i>	<i>microcephala</i>	Shrubby Riceflower			x	x						x		x					x											x		x	
Vitaceae	<i>Clematicissus</i>	<i>angustissima</i>	Native Grape				x						x																			x		
Zygophyllaceae	<i>Roepera</i>	<i>similis</i>				x																												

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