

BROOME REGIONAL RESOURCE RECOVERY FACILITY

RECONNAISSANCE FLORA & LEVEL 1
FAUNA SURVEY

PREPARED FOR: SHIRE OF BROOME



**Spectrum
ECOLOGY**



© Spectrum Ecology Pty Ltd
ABN 68 615 115 243
PO Box 314 Leederville
Western Australia 6902
Ph: (08) 9317 8233
Email: info@spectrumecology.com.au



Report Details			
Project Description:	Broome Regional Resource Recovery Park Reconnaissance Flora & Level 1 Fauna Survey		
Prepared For:	Shire of Broome		
Project ID:	1932		
Version History	Author	Reviewer	Date of Issue
Version 1	Carmel Forrester Astrid Heidrich Damien Cancilla	Damien Cancilla	15-Jan-2020
Version 2	Chris Parker Damien Cancilla	Damien Cancilla	29 Jan 2020

This document has been prepared to the requirements of the client identified on the cover page and no representation is made to any third party. It may be cited for the purposes of scientific research or other fair use, but it may not be reproduced or distributed to any third party by any physical or electronic means without the express permission of the client for whom it was prepared or Spectrum Ecology Pty Ltd.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1. INTRODUCTION	4
1.1. PROJECT BACKGROUND.....	4
1.2. SCOPE OF WORK.....	4
1.3. LEGISLATION AND GUIDANCE.....	4
1.4. BIOREGION AND CLIMATE.....	6
1.5. DISTURBANCE HISTORY.....	7
1.6. VEGETATION.....	7
1.7. GEOLOGY.....	8
1.8. LAND SYSTEMS.....	9
1.9. CONSERVATION ESTATE AND ENVIRONMENTALLY SENSITIVE AREAS.....	10
1.9.1. Literature Review & Database Searches.....	13
1.9.2. Database Searches.....	13
1.9.3. Literature Review.....	13
2. METHODOLOGY	16
2.1. FIELD SURVEY TIMING.....	16
2.2. PROJECT TEAM AND LICENSES.....	16
2.3. RECONNAISSANCE FLORA AND VEGETATION ASSESSMENT.....	16
2.3.1. Field Methodology and Sampling Effort.....	16
2.3.2. Vegetation and Condition Mapping.....	20
2.3.3. Nomenclature, Specimen Identification and Lodgement.....	20
2.3.4. Significant Flora and Vegetation Definitions.....	21
2.3.5. Limitations and Constraints.....	21
2.4. LEVEL 1 FAUNA ASSESSMENT.....	23
2.4.1. Fauna Habitat Mapping.....	23
2.4.2. Limitations and Constraints.....	24
2.5. DATA FOR THE INDEX OF BIODIVERSITY SURVEY'S FOR ASSESSMENTS (IBSA).....	24
3. RESULTS	25
3.1. FLORA DESKTOP STUDY.....	25
3.2. VEGETATION DESKTOP STUDY.....	25
3.3. FLORA.....	28
3.3.1. D2 Study Area.....	28
3.3.2. G1 Study Area.....	29
3.4. VEGETATION.....	32
3.4.1. D2 Study Area.....	34
3.4.2. G1 Study Area.....	34
3.5. TERRESTRIAL FAUNA.....	39
3.5.1. Fauna Habitats.....	39
3.5.2. Vertebrate Fauna.....	39

3.5.3.	Conservation Significant Fauna.....	40
3.5.4.	Short Range Endemic Invertebrates.....	47
4.	DISCUSSION.....	52
4.1.	FLORA.....	52
4.1.1.	D2 Study Area.....	52
4.1.2.	G1 Study Area.....	54
4.2.	VEGETATION.....	55
4.2.1.	D2 Study Area.....	55
4.2.2.	G1 Study Area.....	56
4.3.	FAUNA.....	57
4.3.1.	Fauna Habitats.....	57
4.3.2.	Conservation Significant Fauna.....	57
4.3.3.	Invertebrate SRE Fauna.....	58
5.	CONCLUSIONS.....	59
5.1.	FLORA.....	59
5.2.	VEGETATION.....	59
5.3.	TERRESTRIAL FAUNA.....	59
6.	RECOMMENDATIONS.....	60
6.1.	FLORA.....	60
6.2.	FAUNA.....	60
7.	NATIVE VEGETATION CLEARING PRINCIPLES.....	61
8.	REFERENCES.....	66

TABLES

Table 1.1:	Vegetation Associations Mapped within the Study Areas.....	7
Table 1.2:	Geological Units of the Study Area (1:250,000).....	8
Table 1.3:	Protected Areas in the Vicinity (50 km) of the Study Area.....	10
Table 1.4:	Details of database searches.....	13
Table 1.5:	Details of the Literature Review Reports.....	13
Table 1.6:	Likelihood of Occurrence Criteria.....	14
Table 2.1:	Project Team and Licences.....	16
Table 2.2:	Reconnaissance Flora and Vegetation Assessment Survey Technique.....	17
Table 2.3:	Vegetation Condition Scale and Criteria.....	20
Table 2.4:	Limitations and Constraints of the Study – Flora.....	21
Table 2.5:	Limitations and Constraints of the Study – Fauna.....	24
Table 3.1:	Significant Flora Likelihood of Occurrence from Database Searches and Literature Review.....	25
Table 3.2:	Priority and Threatened Ecological Communities Recorded from the Database Searches.....	26
Table 3.3:	Vegetation Types Described at the Study Areas.....	33
Table 3.4:	Conservation Significant Fauna Species Potentially Occurring at the Study Area.....	41
Table 3.5:	WA Museum Invertebrate Database Search Results.....	48
Table 4.1:	Priority Flora with High Likelihood in the Vicinity of the D2 Study Area.....	52

Table 4.2: Priority Flora with High Likelihood in the Vicinity of the G1 Study Area..... 54
 Table 7.1: Native Vegetation Clearing Principles..... 61

MAPS

Map 1.1: Location of the Study Areas5
 Map 1.2: Conservation Estate Locations 12
 Map 1.3: Survey Areas of the Literature Review..... 15
 Map 2.1: Flora and Vegetation – Sampling Effort at the D2 Study Area..... 18
 Map 2.2: Flora and Vegetation – Sampling Effort at the G1 Study Area..... 19
 Map 3.1: DBCA Flora and Vegetation Database Search Results 27
 Map 3.2: Significant Flora Known from the Vicinity of the D2 Study Area 30
 Map 3.3: Significant Flora Known from the Vicinity of the G1 Study Area..... 31
 Map 3.4: Vegetation Type Mapped at the D2 Study Area 35
 Map 3.5: Vegetation Condition Mapped at the D2 Study Area 36
 Map 3.6: Vegetation Type Mapped at the G1 Study Area..... 37
 Map 3.7: Vegetation Condition Mapped at the G1 Study Area 38
 Map 3.8: DBCA Fauna Database Search Results..... 46
 Map 3.9: WA Museum SRE Invertebrate Database Results 51

FIGURES

Figure 1.1: IBRA Classification of the Study Areas.....6
 Figure 1.2: Climate Data from Broome Airport (BOM Station #003003) from 1940 to 2019.....7
 Figure 1.3: Pre-European Vegetation Units at the Study Area8
 Figure 1.4: Geological Mapping of the Study Areas.....9
 Figure 1.5: Land Systems of the Study Area 10
 Figure 3.1: Typical Habitat Recorded from the Study Areas..... 39

APPENDICES

Appendix A: Likelihood of Occurrence of Significant Flora 68
 Appendix B: Relevé Site Data Collection Sheet..... 71
 Appendix C: Relevé Site Data..... 73
 Appendix D: Species List – Flora 76

EXECUTIVE SUMMARY

The Shire of Broome is investigating two sites ('D2' and 'G1') for the placement of the Broome Regional Resource Recovery Park. As part of the site investigations, a range of hydrogeological and geotechnical works are required which will require some impact to and removal of native vegetation. Approximately 25ha will be disturbed within D2 and 30ha within G1 to establish trial pits, bores and temporary tracks.

The Shire of Broome commissioned Spectrum Ecology to undertake a Reconnaissance Flora and Level 1 Fauna Assessment at each of the proposed sites to support an application for a Native Vegetation Clearing Permit for the preliminary site investigations required for the Project, including comments on the Clearing Principles. A subsequent phase two field survey is scheduled to follow this Reconnaissance survey if development of the site continues.

The Study Areas are located in the Pindanland IBRA subregion within the larger Dampierland region. D2 Study Area is 122 ha and located 9 km north of Broome township on the southwest side of the McGuigan and Broome – Cape Leveque Road intersection. The G1 Study Area is located along the north side of the Broome Road (Great Northern Highway), 32 km northeast of Broome township. Both sites are in Pindan plains, set back from the coast, dunes and mangroves.

The climate near Broome is dry, hot and tropical, divided into a dry and wet season. The dry season runs from April to November, with very little rain and the wet season is from December to March, during which time the region receives most of the year's rainfall. The field survey was conducted on the 26 November by one botanist. Conditions were dry. In the 12 months preceding the survey, the region received half as much rainfall as the expected median.

Flora

Eight previous surveys within 20 km of the study areas and the database searches returned six Priority Flora taxa either Recorded from, or with High Likelihood of occurrence in the study areas. They were:

- *Corymbia paractia* (P1), Previously Recorded;
- *Jacquemontia* sp. Broome (P1), High Likelihood of occurrence;
- *Glycine pindanica* (P3), High Likelihood of occurrence;
- *Polymeria* sp. Broome (P3), High Likelihood of occurrence;
- *Seringia katatona* (P3), High Likelihood of occurrence;
- *Terminalia kumpaja* (P3), High Likelihood of occurrence;

A total of 45 taxa from 18 families and 34 genera were recorded during the survey. No flora of conservation significance were recorded during the current field survey. Additional surveys with better seasonal conditions are required to conclusively determine presence/absence of flora with High Likelihood of occurrence. Particularly *Corymbia paractia* (P1), *Jacquemontia* sp. Broome (P1) and *Polymeria* sp. Broome (P3). A survey conducted after sufficient rainfall in the period of March to May when the herbaceous species are flowering would enable confirmation of the presence of absence of these species. Impact to *C. paractia* can be minimised by avoiding the clearing of Eucalupt/*Corymbia* species during sight investigation activities.

Vegetation

The study areas are not located within any Conservation Estates or Environmentally Sensitive Areas, however the Yawuru Birragun Conservation Reserve is located directly adjacent to the D2 Study Area. Both study areas are located to the north of a large Environmentally Sensitive Area (ESA) that comprises the Roebuck Bay and associated Roebuck Plain areas. Conservation Estate and ESAs within the vicinity

Twelve ecosystems of conservation significance consisting of 118 records were identified from the database search. These include:

- Monsoon (vine) thickets on coastal sand dunes of the Dampier Peninsula, federally listed as Threatened and state listed as Vulnerable;
- Roebuck bay mudflats, state listed as Vulnerable;
- 87 records of Priority 1 communities;
- 17 records of Priority 3; and
- One record of a Priority 4 community.

The north-western corner of the D2 Study Area intersects the Priority 1 Priority Ecological Community Mangarr (Minyjuru) (Unique Code 17327). This community represents the relict dune system dominated by extensive stands of Minyjuru (Mangarr) *Sersalisia* (formerly *Pouteria*) *sericea*. The habitat observed within the D2 Study Area is not typical of the habitat associated with the characteristic species, *Sersalisia sericea*. Additional survey effort in the area of D2 within the PEC buffer zone will confirm the presence or absence of this PEC; however, the 30 ha infrastructure footprint does not currently impact this area.

Three vegetation types were recorded from the study areas (two in G1 and one in D2). Each of them are common and reflect the 750.1 Vegetation Association Unit from the Pre-European Beard mapping. Vegetation Type 1 is the known habitat for Priority 1 species, *Corymbia paractia*, this vegetation type is considered significant as it plays a role in refuge for conservation significant flora.

No conservation significant vegetation was recorded from the G1 Study Area.

Fauna

Both study areas are dominated by Pindan Shrubland habitats which consist of open to sparse *Acacia* sp. shrubland over tussock grassland. The literature review and database search identified 53 mammal, 165 bird, 81 reptile and 15 amphibian species that could occur in the region surrounding the study areas. Results of the literature review identified 31 conservation significant fauna species (12 mammal, 15 bird and 5 reptile species). Both study areas do not include any marine or wetland habitats and all species that utilise these habitat types have been excluded from the assessment including an additional 61 conservation significant bird species and two mammal species that are associated with marine, shoreline and wetland environments.

The Greater Bilby (*Macrotis lagotis*) is considered to have a high likelihood of occurrence within both the D2 and G1 Study Areas. The Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*), Northern Brushtail Possum (*Trichosurus vulpecula arnhemensis*), Bare-rumped Sheath-tail Bat (*Saccolaimus saccolaimus nudicluniatu*) and Northern Coastal Free-tailed Bat (*Mormopterus (Ozimops) cobourgianus*) are considered to have a medium likelihood of occurrence in the Study Areas. Of the 15 conservation significant bird species identified, six species (Gouldian Finch (*Erythrura gouldiae*), Oriental Cuckoo (*Cuculus optatus*), Barn Swallow (*Hirundo rustica*), Fork-tailed Swift (*Apus pacificus*), Grey Falcon (*Falco hypoleucos*) and Peregrine Falcon (*Falco peregrinus*)) are considered to have a medium likelihood of

occurrence. The Dampierland Goanna (*Varanus sparnus*) is considered to have a medium likelihood of occurrence.

The WA Museum (WAM) Short Range Endemic (SRE) invertebrate database search identified 16 taxa of Arachnida, one Crustacea taxa and two Mollusca taxa. Of the SRE taxa identified from the WAM database searches, only four taxa have a high likelihood of occurrence and eight are considered to have a medium likelihood of occurrence.

Clearing of either Study Area is not expected to significantly impact any terrestrial vertebrate fauna species identified during this study. Preclearing searches for evidence of active Greater Bilby burrows should be completed immediately prior to any clearing activities. With the exception of the Northern Brushtail Possum, any individuals present within the clearance area are expected to flee the area immediately prior to clearing due to the high noise and vibrations associated with clearing activities. Clearing activity conducted in either Study Area is not expected to have a significant impact on any SRE invertebrate taxa due to the widely distributed habitats present with the study area.

1. INTRODUCTION

1.1. Project Background

The Shire of Broome is investigating two sites ('D2' and 'G1') for the placement of the Broome Regional Resource Recovery Park (RRRP) (the Project) (Map 1.1). As part of the site investigations, a range of hydrogeological and geotechnical works are required which will require some impact to and removal of native vegetation (approximately 25 ha for D2 and 30 ha for G1). The disturbance to the vegetation will include access tracks, boreholes and trial pits.

The Shire of Broome commissioned Spectrum Ecology to undertake a Reconnaissance Flora and Level 1 Fauna Survey at each of the proposed sites to support an application for a Native Vegetation Clearing Permit (NVCP) for the preliminary site investigations required for the Project.

1.2. Scope of Work

The scope of work was to complete a Reconnaissance Flora and Vegetation and Level 1 Fauna Assessment. The following is a brief technical report and survey data that satisfies the relevant regulatory guidance statements and documents the results, findings and limitations of the survey.

1.3. Legislation and Guidance

Flora and fauna in Western Australia are protected by various legislation, including:

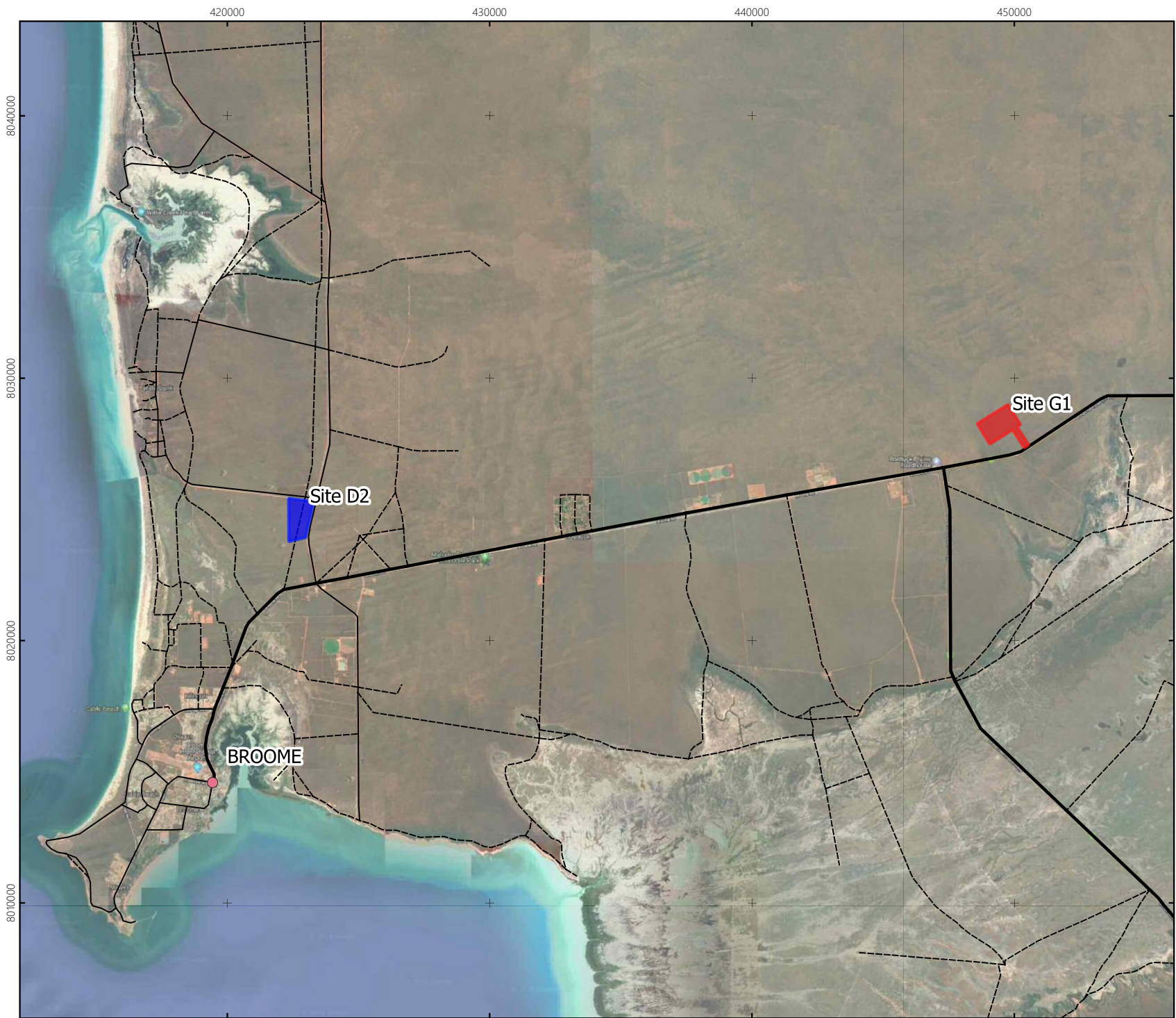
- Biodiversity Conservation Act 2016 (BC Act), which replaced the Wildlife Conservation Act 1950 (WC Act) as of 1 January 2019 (Western Australian Government, 2016);
- Environmental Protection Act 1986 (EP Act); and
- Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The surveys are compliant with Reconnaissance flora and vegetation survey guidelines and Level 1 fauna survey guidelines, as outlined in:

- EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016b);
- EPA Technical Guidance: Terrestrial Fauna Surveys (EPA 2016c); and
- EPA Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016d).

This assessment is also consistent with the following guidelines:

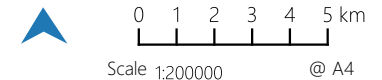
- EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002);
- EPA Environmental Factor Guideline: Flora and Vegetation (EPA 2016a);
- National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual (ESCAVI, 2003);
- EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004); and
- EPA & DEC Technical Guide: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA and DEC, 2010).



Legend

- Site D2
- Site G1

- Roads**
- Principal Road
 - Minor Road
 - Track



Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter

Author: CF Approved: AH Date: 14-01-2020

Location of the Study Areas

Proposed Waste Facility

1.4. Bioregion and Climate

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia into regions based on dominant landscape, climate, lithology, geology, landform and vegetation (Thackway and Cresswell, 1995).

The study area is located in the Pindanland (DAL02) IBRA subregion within the larger Dampierland (DAL) region. The Pindanland subregion comprises the western half of Dampierland, including the sandplains of the Dampier Peninsula, extending south along the hinterland of Eighty Mile Beach and north to include the paleodelta of the Fitzroy River (Graham, 2002). It is further described as having a fine-textured sand-sheet with low dunes covered by pindan vegetation, being the coastal, semi-arid, north-western margin of the Canning Basin (Graham, 2002). Inland vegetation typically consists of *Triodia* spp. (spinifex) or *Chrysopogon* spp. (ribbon grass) grasslands under *Acacia* spp. open shrub with low open woodlands of *Eucalyptus* spp.

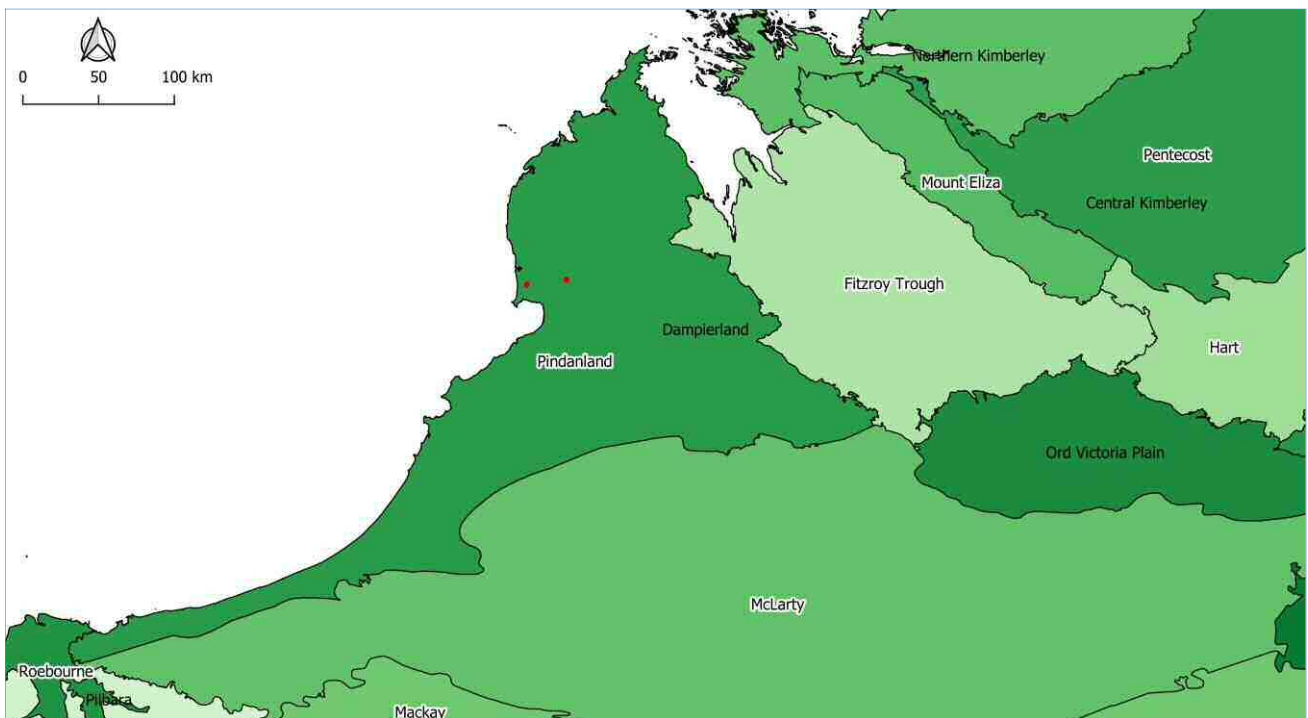


Figure 1.1: IBRA Classification of the Study Areas

The climate near Broome is dry, hot and tropical, divided into a dry and wet season. The dry season runs from April to November, with very little rain and daily temperatures around 30°C. During the wet season, from December to March, average temperatures are a few degrees higher along with erratic, often heavy rainfall, high humidity and the possibility of tropical cyclones. The annual average rainfall is 628.1mm, however the range of recorded annual rainfall is highly variable, from as low as 132mm up to 1599mm (Bureau of Meteorology, 2019).

Climate data recorded by the Broome Airport BOM Station (#003003) is presented in Figure 1.2. Seasonal conditions in the wet season prior to the survey were more dry than usual. Rainfall recorded twelve months prior to mobilisation (Dec 2018 – Nov 2019) was 295.8 mm, which represents less than half of the annual median rainfall recorded by the station (624 mm). In particular, the six months preceding the survey (May 2019 – Nov 2019) received 13 % of the monthly median, a total of 4.8 mm from a median of 65.3 mm for that period (1940-2019).

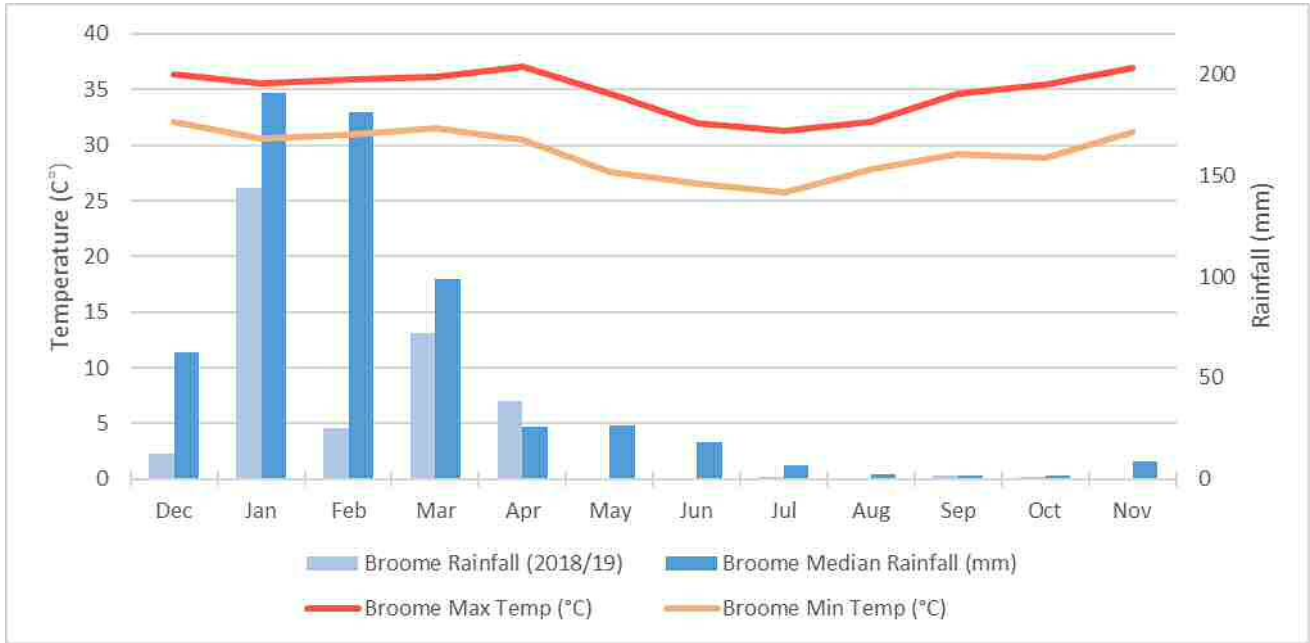


Figure 1.2: Climate Data from Broome Airport (BOM Station #003003) from 1940 to 2019

1.5. Disturbance History

The dominant land uses for the Pindanland subregion include grazing on native pastures, unallocated crown land, and crown reserves (Graham, 2002). Both study areas are located within 6 km of the Broome town site and are bordered either by Broome Road or Broome-Cape Leveque Road respectively. Both roads are frequently used, particularly Broome Road, which is bituminised and is the main access road into and out of Broome. At the time of survey, the most recent fire within the study area appears to have occurred over five years ago.

1.6. Vegetation

Pre-European vegetation mapping was originally undertaken by Beard at various scales across the state and has since been updated to be consistent with the National Vegetation Information System (NVIS) descriptions at a scale of 1:250,000 (DPIRD 2019).

One unit (750.1) has been mapped for both the study areas. The units are listed in Table 1.2 and shown in Figure 1.3. State-wide vegetation statistics are available for these units which list pre-European extent, current extent, area in DBCA managed lands etc., and is a useful tool to determine if a vegetation unit is rare or otherwise significant (Government of Western Australia, 2019).

The Beard vegetation unit recorded at the study areas is the second largest vegetation unit described for Dampierland on of the most prominent Pindanland vegetation units.

Table 1.1: Vegetation Associations Mapped within the Study Areas

Sub-association	NVIS Level V Vegetation Description	Area in Study Area (ha)	% of Study Area	Pre-European Whole State (ha)	Current Extent State (ha)	% Remaining	% of Current Extent in DBCA Land
750.1	<i>Acacia tumida</i> shrubland with grey box and cabbage gum medium woodland over ribbon grass & curly spinifex	D2 – 122 G1 – 124	D2 – 100% G1 – 100%	1,221,911.24	1,218,020.52	99.68	2.73

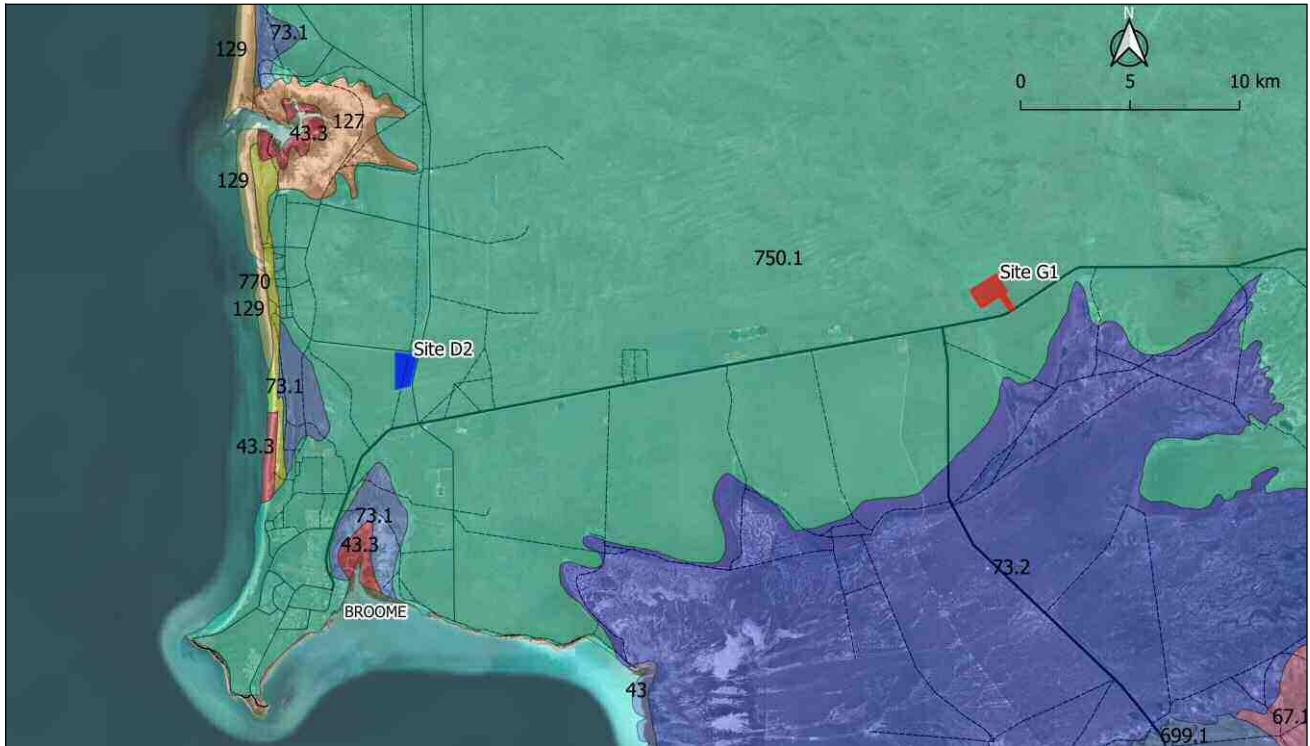


Figure 1.3: Pre-European Vegetation Units at the Study Area

1.7. Geology

The geology of Western Australia has been mapped at a scale of 1:50,000, 1:100,000 and 1:250,000. The township of Broome has been mapped to the finer scale 1:50,000 with the surrounding region limited to a 1:250,000 scale (Figure 1.4). Finer scale geology mapping is only available for the D2 Study Area.

The D2 Study Area occurs within the Sm10 (1:50k) and Qz (1:250k) geological units. Both units are described as homogenous fine grained red sands. The G1 Study Area is located over two geological units (Qs & Qa) both of which comprise of sand, although the Qa system consists of more fine water deposited material associated with the Roebuck plains system. Both geological units occur extensively in the surrounding region. The units are listed in Table 1.2 and shown in Figure 1.2.

Table 1.2: Geological Units of the Study Area (1:250,000)

Code	Description	Area in Study Area (ha)	% of Study Area
D2 Study Area			
Sm10	SILTY SAND - red, fine-grained, sub-rounded quartz, variable silt content, homogeneous	122	100%
Qz	Red sand, fine to medium; minor silt; aeolian	122	100%
G1 Study Area			
Qs	Sand, silt; minor gravel: mixed alluvial and aeolian	81.4	66%
Qa	Sand, silt, clay; minor gravel: alluvial and lacustrine	42.6	34%

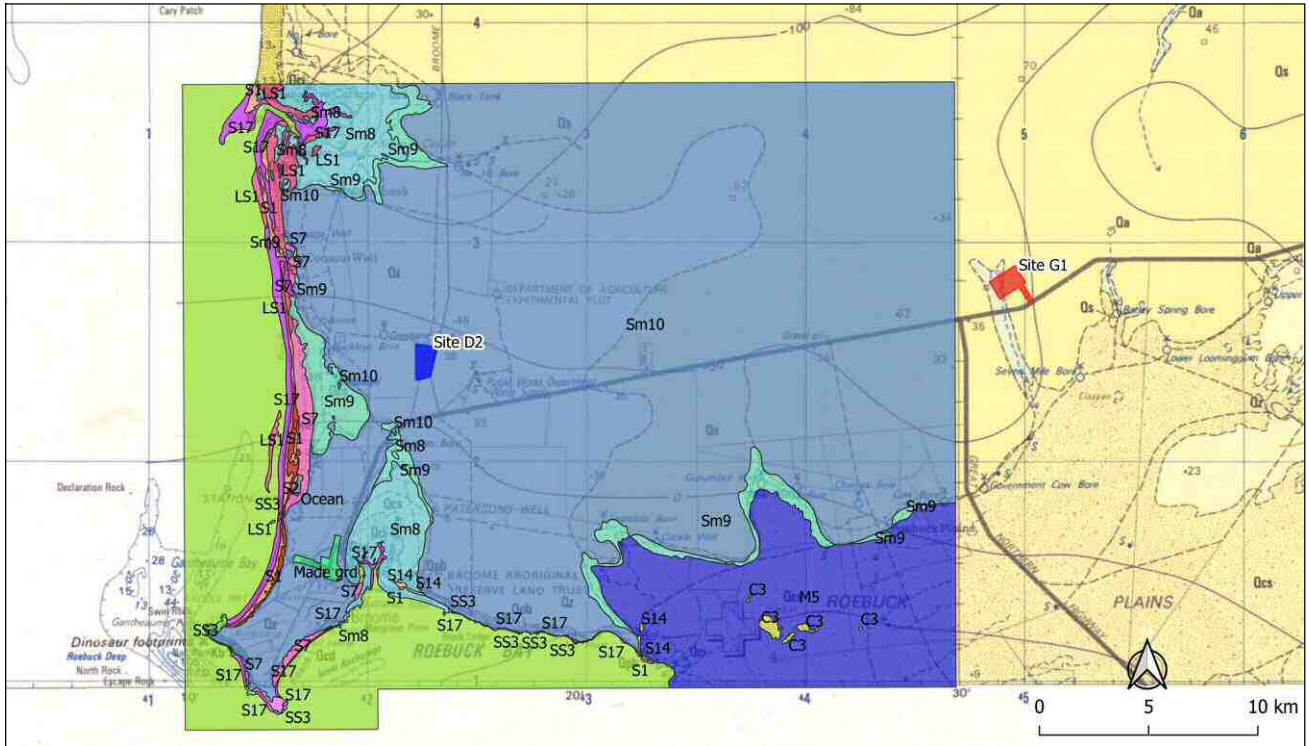


Figure 1.4: Geological Mapping of the Study Areas

1.8. Land Systems

Both study areas lie across the boundary between Yeeda and Wanganut land systems (Schoknecht and Payne, 2011). The Yeeda land system is dominated by red sandplains supporting pindan vegetation with dense Acacia shrubs, scattered bloodwood and grey box trees and curly spinifex and ribbon grass. The Wanganut land system is dominated by low-lying sandplain and dunefields with through-going drainage (Schoknecht and Payne, 2011).

- Yeeda: Sandplains and occasional dunes with shrubby spinifex grasslands or pindan woodlands.
- Wanganut: Sandplains and dunes with pindan woodlands and spinifex/tussock grasslands.

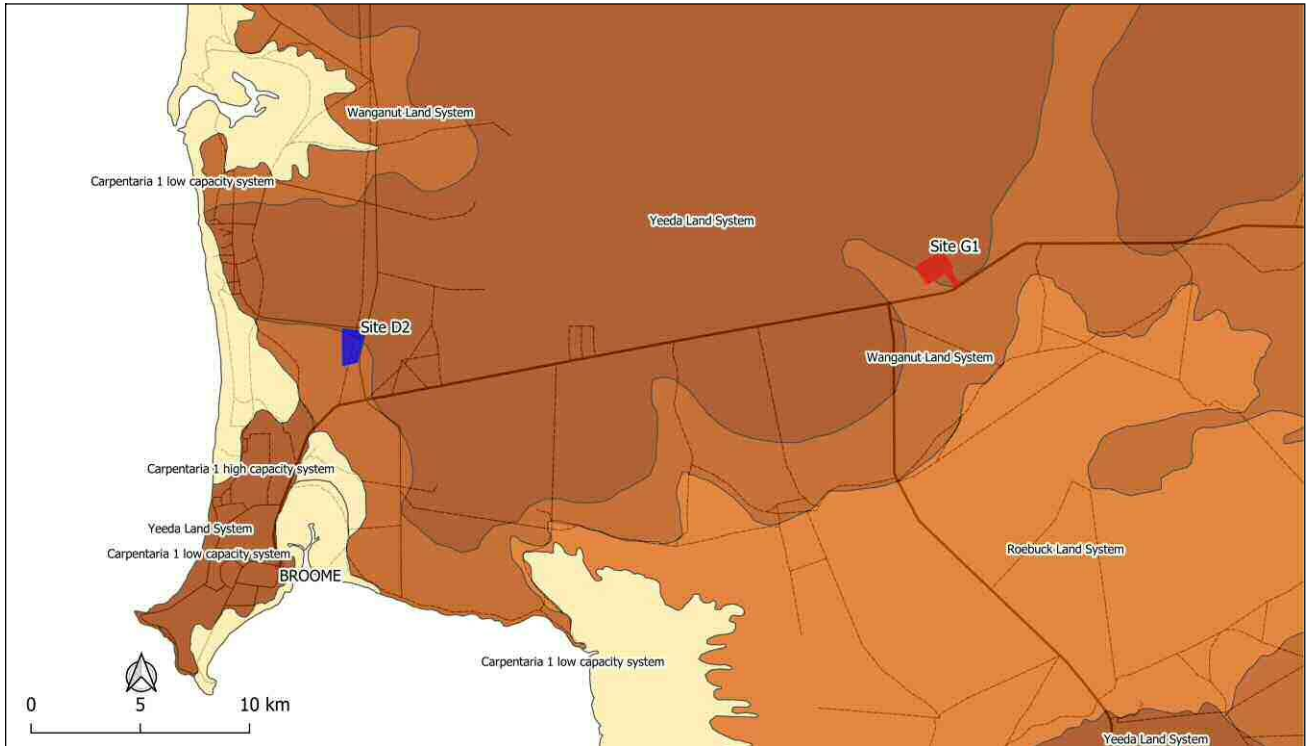


Figure 1.5: Land Systems of the Study Area

1.9. Conservation Estate and Environmentally Sensitive Areas

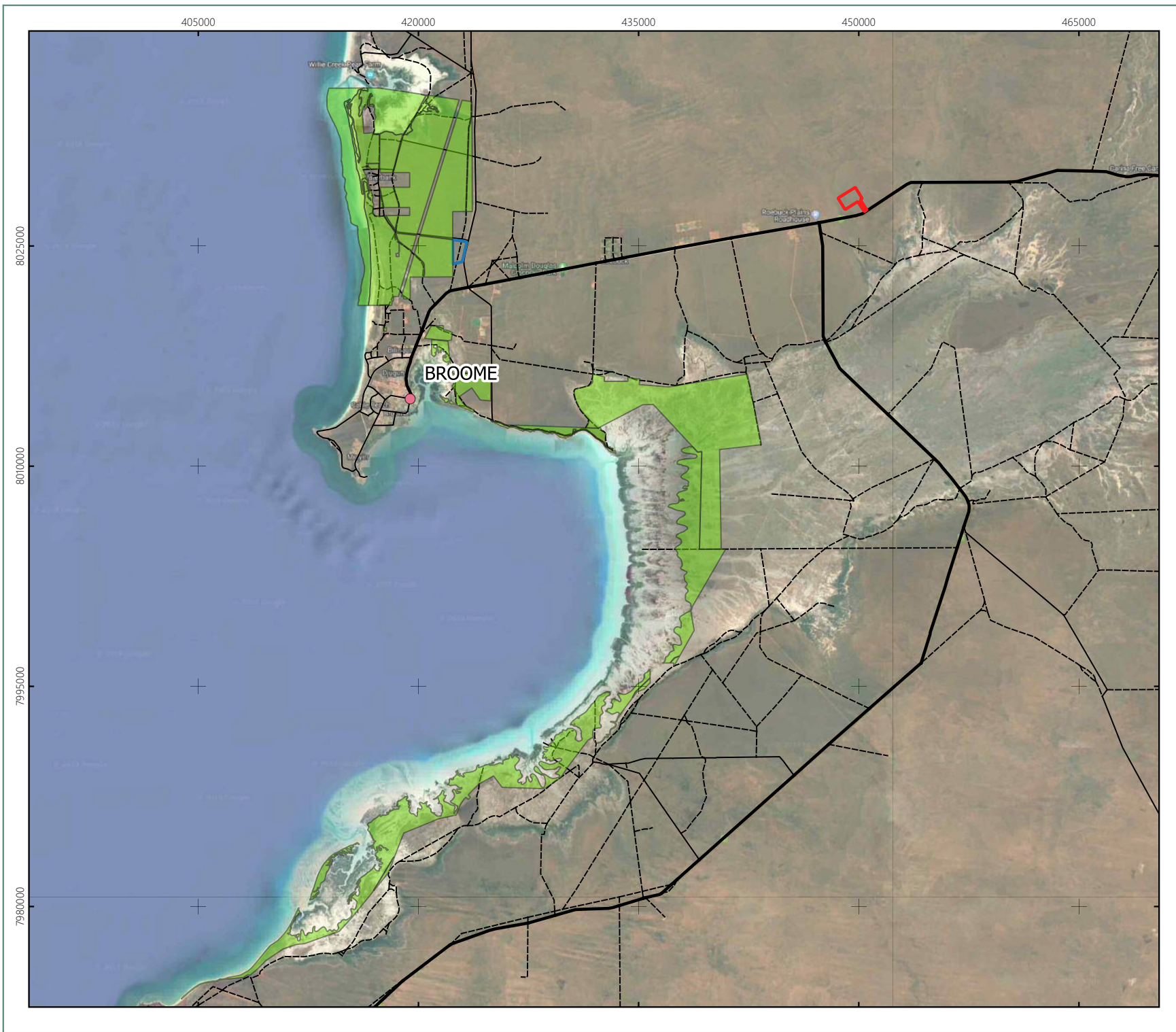
Searching the Collaborative Australian Protected Area Database (CAPAD), several small state protected areas were found located within 50km of the study area. These protected areas and their approximate distance from the study area are listed in Table 1.3.

Table 1.3: Protected Areas in the Vicinity (50 km) of the Study Area

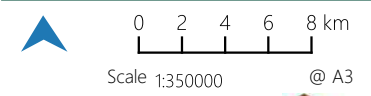
Reserve Name (Protected Area ID)	Relevant to the Study Area		Comment (Jurisdiction/Size)
	Distance	Direction	
5(1)(h) Reserves			
Broome Bird Observatory (WA_41066)	D2 – 13.8 km G1 – 23.9 km	Southeast Southwest	Western Australia, 2.7 ha
Broome Wildlife Centre (WA_47964)	D2 – 6.5 km G1 – 32.3 km	Southwest West southwest	Western Australia, 5.0 ha
Unnamed (WA_51105)	D2 – 11.9 km G1 – 26.6 km	South Southwest	Western Australia, 317.0 ha
Yawuru Conservation Estate (WA_51162)	D2 – 5.5 km G1 – 30.5 km	West West	Western Australia, 2515.6 ha
Unnamed (WA_51497)	D2 – 4.6 km G1 – 28 km	South Southwest	Western Australia, 716.5 ha
Unnamed (WA_51583)	D2 – 11.9 km G1 – 13.3 km	Southeast Southwest	Western Australia, 4896.0 ha
Unnamed (WA_51617)	D2 – 13.6 km G1 – 24.9 km	Southeast Southwest	Western Australia, 5.7 ha

Reserve Name (Protected Area ID)	Relevant to the Study Area		Comment (Jurisdiction/Size)
	Distance	Direction	
Unnamed (WA_51932)	D2 – 19.4 km G1 – 20.8 km	Southeast Southwest	Western Australia, 5778.5 ha
Yawuru Birragun Conservation Park (WA_52354)	D2 – Directly adjacent G1 – 25km	West West	Western Australia, 7223.8 ha

The study areas are not located within any Conservation Estates or Environmentally Sensitive Areas, however the Yawuru Birragun Conservation Reserve is located directly adjacent to the D2 Study Area. Both study areas are located to the north of a large ESA that comprises the Roebuck Bay and associated Roebuck Plain areas. Conservation Estate and ESAs within the vicinity are mapped in Map 1.3.



- Legend**
- Site D2
 - Site G1
 - Conservation Estates
- Roads**
- Principal Road
 - Minor Road
 - Track



Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter

Author: CF Approved: DC Date: 14-01-2020

Conservation Estate Locations

Proposed Waste Facility

1.9.1. Literature Review & Database Searches

A desktop review of all relevant and available flora, vegetation and terrestrial fauna data sources was undertaken prior to the field survey to determine the species and communities that are likely to occur in the study area. This review included searches of relevant databases and a review of relevant literature from the surrounding region.

1.9.2. Database Searches

The database searches completed for this project are listed in Table 1.4:

Table 1.4: Details of database searches

Data Source	Custodian	Details
Threatened Flora Database	Department of Biodiversity, Conservation and Attractions (DBCA)	Buffer: 50 km around a central point
Threatened Fauna Database		Buffer: 10 km around D2; 15 km around G1
Threatened Ecological Communities Data Base		Buffer 50 km around a central point
Invertebrate Fauna Databases	Western Australian Museum	Arachnids & Myriapods, Crustacea and Mollusca. Results provided from Dampier Peninsula
Commonwealth Protected Matters Search Tool (PMST)	Department of the Environment and Energy (DoEE)	Date: 13/11/19 Buffer: 40 km
NatureMap	Department of Parks and Wildlife / Western Australian Museum	Date: 13/11/19 Centre point: 17°54'10"S, 122°20'17"E Buffer: 40 km

1.9.3. Literature Review

A desktop review of all relevant and available literature was undertaken prior to the field assessment. The following previous survey reports were searched to determine species and conservation significance likely to occur in the study area. The Index of Biodiversity Surveys and Assessments (IBSA) was also utilised to access available previous assessment reports from the surrounding region. Details of each report are summarised in Table 1.5 and survey areas are mapped in Map 1.3.

Table 1.5: Details of the Literature Review Reports

Report Title	Level of Assessment	Field Survey Timing
Mamabulanjin Orchard Flora and Fauna Survey (GHD, 2019).	Detailed and targeted flora & vegetation. Level 1 and targeted fauna.	1-2 May 2019 (flora & vegetation). 5-6 May 2019 (fauna).
Distribution, ecology and cultural importance of Gunurru or Cable Beach Ghost Gum <i>Corymbia paractia</i> in the Broome area, Western Australia (Environs Kimberley, 2018).	Targeted survey and distribution mapping of Cable Beach Ghost Gum <i>Corymbia paractia</i> .	November – December 2016 (flowering period).
Broome Road Industrial Area Targeted Survey (GHD, 2018).	Targeted flora survey (<i>Polymeria</i> sp. Broome and <i>Jacquemontia</i> sp. Broome).	24-27 April 2017, 10-12 May 2017.
Flora, Vegetation and Fauna Assessment – Broome Asparagus Farm (AECOM, 2017).	Detailed (single phase) flora & vegetation, Level 1 fauna.	8-12 May 2017 (Flora).

Report Title	Level of Assessment	Field Survey Timing
Broome Landfill Flora, Vegetation and Fauna Survey (Astron, 2017a).	Level 2 flora & vegetation, Level 1 fauna.	2-3 November 2016 (Flora & Fauna). 3-5 April 2017 (Flora).
Proposed Broome Landfill – Targeted Greater Bilby Survey (Astron, 2017b).	Targeted Greater Bilby survey.	Field: 4-6 April 2017.
Broome Motorplex Environmental Site Investigation (GHD, 2016)	Level 2 (single phase) flora & vegetation, Level 2 (single phase) and targeted fauna.	20 November 2015 (fauna) 14-15 December 2015 (fauna) 15-24 March 2016 (fauna) 18-24 March 2016 (flora & vegetation)
Broome North – Northern Portion (Area B). Preliminary Environmental Impact Assessment and Biological Survey (GHD, 2009).	Level 1 flora & vegetation and Level 1 vertebrate fauna.	Field: 3-6 June 2008.

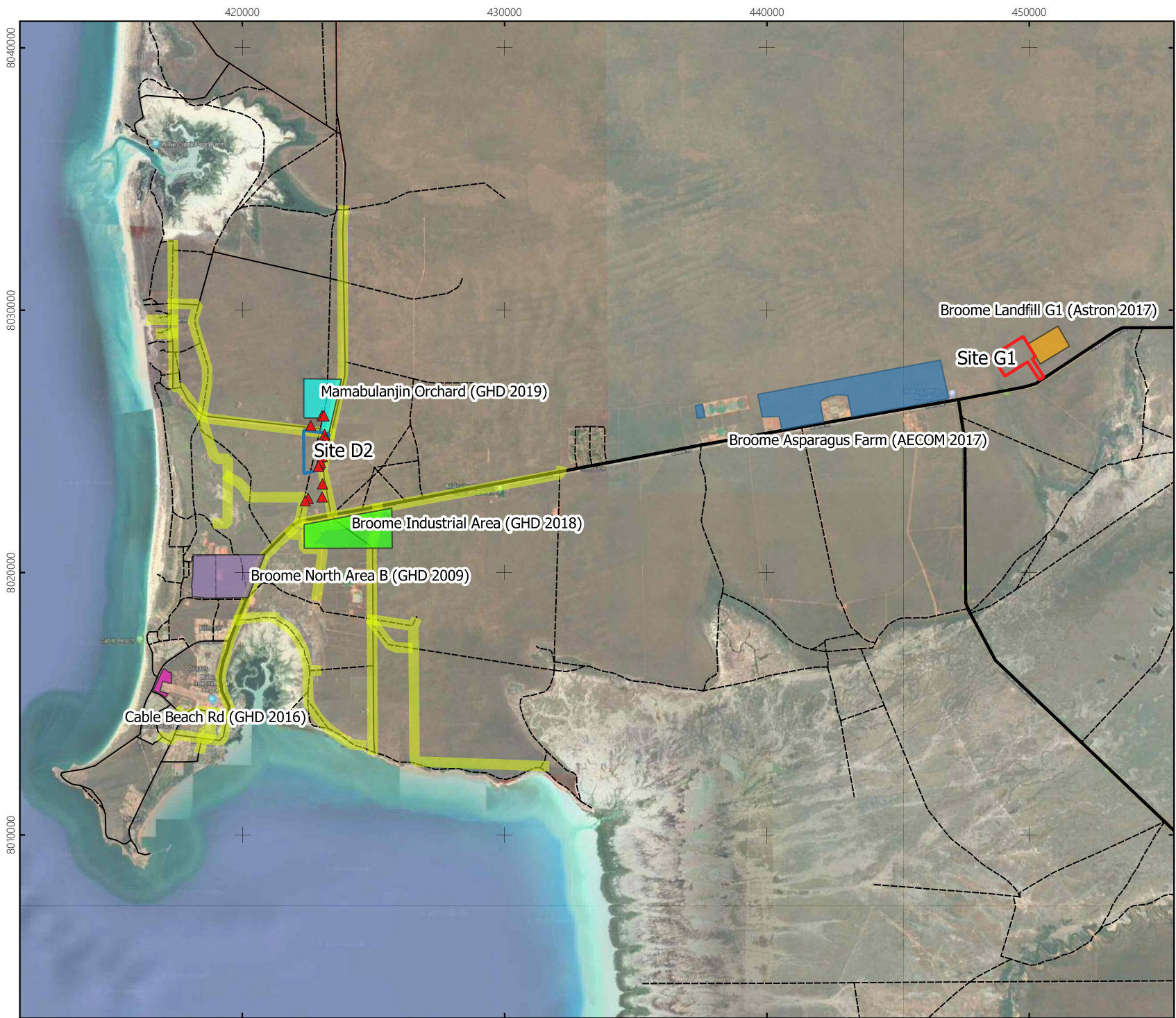
The results of the literature review identified species that are listed under the current legislative framework. A preliminary assessment of each significant species identified in the above database searches was completed prior to undertaking the field survey, with the following information provided:

- Conservation status (EPBC Act, BC Act, DBCA listing);
- Description of species habitat requirements and presence of this habitat within the study area;
- Summary of relevant records including source of record (DBCA, previous report etc) and accuracy of the record location; and

Likelihood of occurrence criteria assigned and justification of likelihood of occurrence that considers known habitats, survey effort etc. The likelihood of occurrence was determined based on the criteria outlined in Table 1.6.

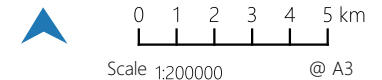
Table 1.6: Likelihood of Occurrence Criteria

Likelihood	Flora & Vegetation Criteria	Fauna Criteria
Recorded	Species or community recorded within study area.	Species recorded within the Study Area within the previous ten years.
High	Species or community recorded in close proximity to study area and suitable habitat occurs in the study area.	Species recorded within or in proximity to the Study Area within the previous 20 years. Suitable habitat occurs in the Study Area.
Medium	Species or community recorded outside the study area but within 20 ^o km suitable habitat occurs in the study area.	Species recorded within or in proximity to the Study Area more than 20 years ago. Species recorded outside the Study Area but within 40 km. Suitable habitat occurs in the Study Area.
Low	Species or community rarely or not recorded within 20 ^o km of the study area. Suitable habitat does not occur within or in close proximity to the study area.	Species rarely or not recorded within 40 km of the Study Area. Suitable habitat does not occur within or in proximity to the Study Area.
Very Low	N/A	Species not recorded within 40 km despite multiple recent surveys. Suitable habitat does not occur within the Study Area. Species considered locally extinct.



Legend

- Site D2
- Site G1
- ▲ Broome Motorplex Sites (GHD 2016)
- Targeted Corymbia (Environs Kimb 2018)
- Broome North Area B (GHD 2009)
- Broome Asparagus Farm (AECOM 2017)
- Broome Industrial Targeted (GHD 2018)
- Broome Landfill G1 RevA (Astron 2017)
- Cable Beach Rd East (GHD 2016)
- Mamabalanjin Orchard (GHD 2019)
- Roads**
- Principal Road
- Minor Road
- Track



Scale 1:200000 @ A3
 Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter



Author: CF Approved: DC Date: 14-01-2020

Survey Areas of the Literature Review

Proposed Waste Facility

Map

Prepared for
 Shire of Broome | Talis

1.3

2. METHODOLOGY

2.1. Field Survey Timing

The survey was undertaken on 26 November 2019 by Spectrum Senior Ecologist, Chris Parker (1 day). Figure 1.2 shows the rainfall recorded for the 12 months prior to the survey (December 2018 to November 2019) compared to the median rainfall (1981-2010). The three-month period prior to the survey (September - November 2019) had characteristically very low rainfall after an unusually dry wet season (BOM 2019).

2.2. Project Team and Licences

Spectrum Ecology staff involved with this assessment are listed in Table 2.1, along with their role, years of experience and relevant licences.

Table 2.1: Project Team and Licences

Staff	Role	Experience	Licences
Chris Parker (Senior Ecologist)	Field Assessment, Reporting, Data analysis	10 years	Flora: FB6200 0009
Damien Cancilla (Principal Zoologist)	Reporting, Data Analysis, QA	12 years	N/A
Carmel Forrester (Botanist)	Reporting, Data Analysis	5 years	N/A

2.3. Reconnaissance Flora and Vegetation Assessment

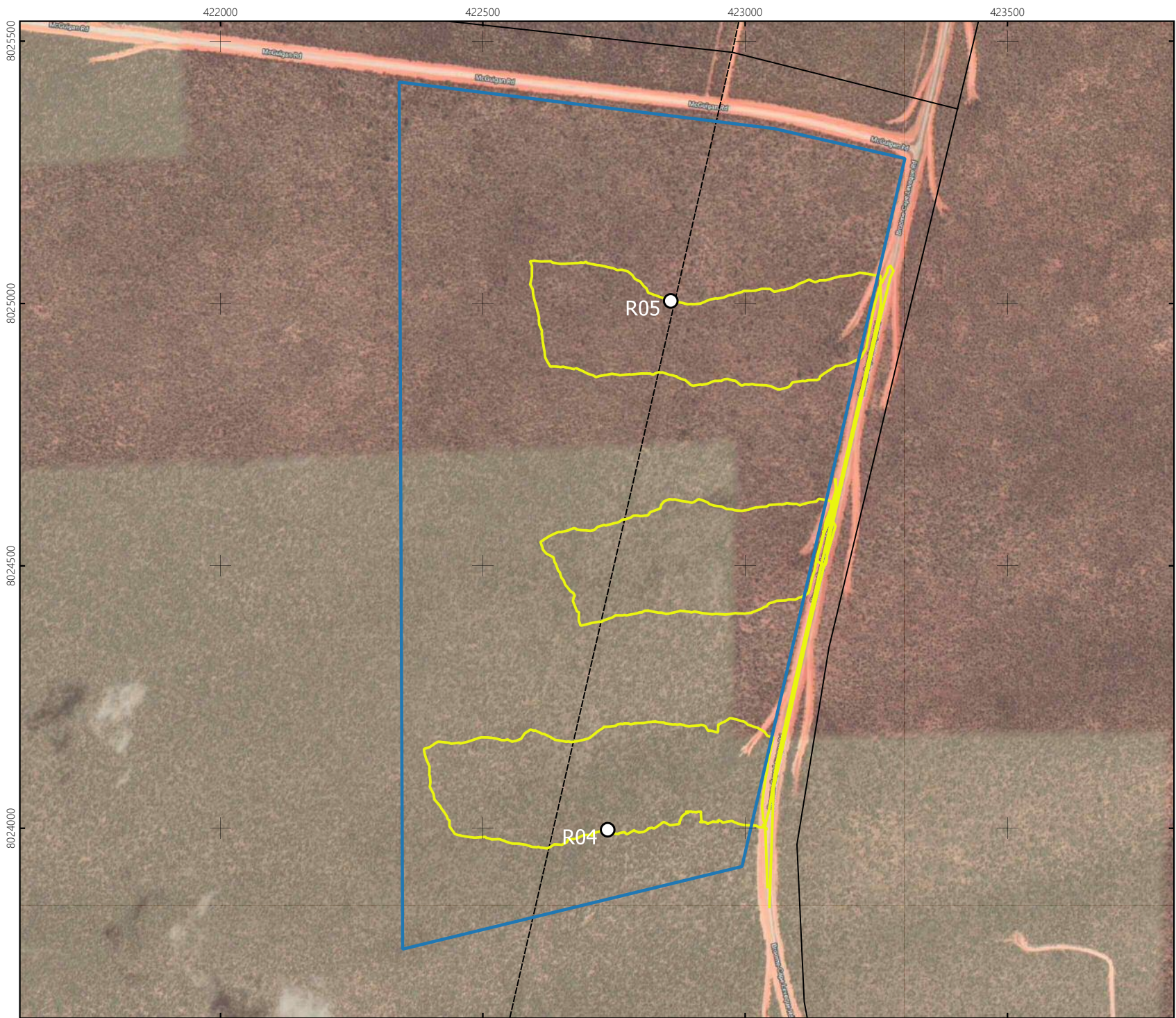
2.3.1. Field Methodology and Sampling Effort

A Reconnaissance level flora and vegetation assessment was conducted at the Study Areas. This was considered appropriate as it is the preliminary investigation into environmental values of the study area and some of the study areas and surrounding areas have been previously assessed as Detailed flora and vegetation survey and targeted flora survey. A second phase in the months following the wet season (February – April) will provide more clarity on populations of Priority Flora with High Likelihood of occurrence (see Section 4.1 for further discussion).

A combination of relevés, traverses and opportunistic sampling is appropriate for reconnaissance level surveys as stipulated in the guidance statement (EPA 2016b) and these survey techniques are described in Table 2.2. Comprehensive relevé data collection information is included in Appendix B. Information on vegetation mapping was collected at relevé sites and also opportunistically whilst traversing through the Study Areas. During the survey, five relevés were sampled within the study areas; including two relevés at D2 Study Area, three relevés in G1 Study Area (site information is described in Appendix C). Relevés, mapping sites, traverses and vehicle tracks are mapped in Map 2.1.

Table 2.2: Reconnaissance Flora and Vegetation Assessment Survey Technique

Survey Technique	Description
Relevés	Relevés are a low intensity survey technique for gathering information for low-intensity flora and vegetation surveys. Information collected at each relevé includes: <ul style="list-style-type: none"> • Site code, date, location, botanist; • A photograph; • Vegetation condition and disturbances (including fire); • Landform including; slope, soil, rock type, aspect; and • Flora and vegetation information; dominant cover, structure and species count where necessary.
Traverses	A traverse is an unmarked route along which data is collected. Traverses are useful for identifying the boundaries and characteristics of vegetation types, selecting sites for detailed survey, and targeting significant flora or vegetation. <p>Information recorded along a traverse is as for the relevé, with the addition of noting vegetation changes and relationships between vegetation and substrate.</p>
Opportunistic Sampling	Flora and vegetation not recorded through other sampling methods was opportunistically sampled as encountered in the study area. Opportunistic sampling also included recording locations of significant, introduced (weed) and unknown species.
Targeted Sampling	Areas likely to support significant flora or vegetation were targeted during the survey, including areas with existing records of significant flora. Areas were selected based on existing records from database searches, geology, vegetation mapping and known Environmentally Sensitive Areas. Where possible, unusual and restricted geological features within the study area were sampled. <p>When potentially significant flora were encountered during the survey, sufficient information was recorded to complete a Threatened and Priority Flora Report Form (TPRF).</p>

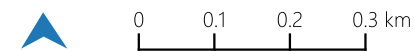


Legend

- Site D2
- Releve Site Locations
- Transects Walked During the Survey

Roads

- Principal Road
- Minor Road
- Track



Scale 1:10000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter



Author: CF Approved: DC Date: 15-01-2020

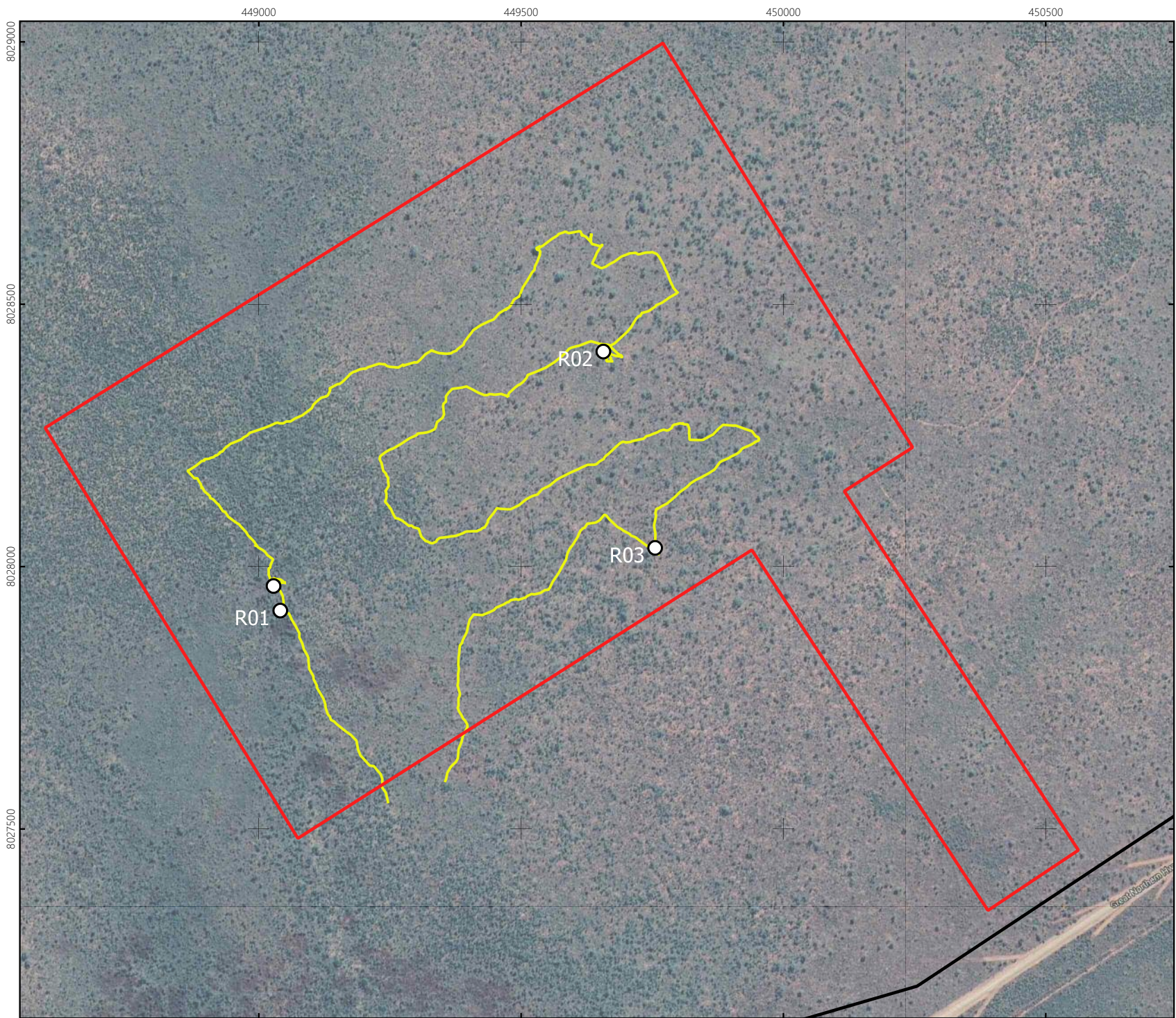
**Flora and Vegetation
 Sampling Effort at the
 D2 Study Area**

Proposed Waste Facility

Map

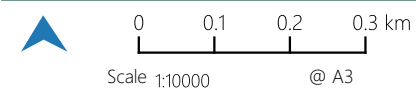
Prepared for
 Shire of Broome | Talis

2.1



Legend

- Site G1
 - Releve Site Locations
 - Transects Walked During the Survey
- Roads**
- Principal Road
 - Minor Road
 - Track



Scale 1:10000 @ A3
 Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter



Author: CF Approved: DC Date: 15-01-2020

**Flora and Vegetation
 Sampling Effort at the
 G1 Study Area**
 Proposed Waste Facility

2.3.2. Vegetation and Condition Mapping

The data collected from relevés, traverses, as well as general field notes, observations and aerial photography were used to map the vegetation across the study areas. Vegetation was classified structurally based on the dominant species. The vegetation classification is consistent with NVIS Level V – association vegetation descriptions (referred to as a ‘vegetation unit’ for the local scale in this report). This level of description provides information on the dominant growth form, height and cover for up to three species for each of the upper, mid and ground strata (ESCAVI, 2003).

Vegetation condition was recorded at relevés and where areas of different vegetation condition were observed from both ground truthing and aerial imagery. The vegetation condition was mapped across the study area at the same scale as the vegetation mapping. Vegetation condition ratings follow the scale recommended for the interzone botanical province (EPA 2016b), summarised in Table 2.3.

Table 2.3: Vegetation Condition Scale and Criteria

Vegetation Condition	Disturbance Criteria
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered with obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback logging and/or grazing.
Good	Vegetation structure significantly altered by 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 the vegetation is no longer intact, that 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 and shrubs.

2.3.3. Nomenclature, Specimen Identification and Lodgement

Flora nomenclature used in this report is consistent with the Western Australian Herbarium’s plant census, provided on FloraBase (Western Australian Herbarium, 2019) and is current at the time of report preparation.

Flora specimens were collected of any suspected or known significant flora and to confirm species recorded during the relevés for vegetation mapping. Specimens were identified using the appropriate taxonomic keys and where required, relevant taxonomic experts at the Western Australian Herbarium.

Specimens are vouchered with the Western Australian Herbarium as per guidance; when they represent new populations of threatened or priority flora, new occurrences of TECs or PECs, individuals that have atypical characteristics, or bioregional range extensions.

2.3.4. Significant Flora and Vegetation Definitions

Flora and vegetation can be considered significant for a range of reasons.

Significant flora can include:

- Being identified as threatened (state listed WC Act and/or nationally listed EPBC Act);
- Being identified as priority species: Priority 1 to 4 (DBCA 2019);
- Locally endemic or association with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- New species or anomalous features that indicate a potential new species;
- Representative of the range of a species (particularly, at the extremes of range recently discovered range extensions, or isolated outliers of the main range);
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids; and
- Relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Significant vegetation can include:

- Identified as Threatened Ecological Community (TEC) (state listed WC Act and/or nationally listed EPBC Act);
- Priority Ecological Community (PEC) (DBCA 2017);
- Restricted distribution;
- Degree of historical impact from threatening processes;
- A role as a refuge; and
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

2.3.5. Limitations and Constraints

Survey specific limitations and constraints for the flora and vegetation reconnaissance assessment for the Study Areas are discussed in Table 2.4.

Table 2.4: Limitations and Constraints of the Study – Flora

Limitation	Constraint	Comment
Availability of contextual information at a regional and local scale.	No	There were several surveys identified in the Literature Review and available from the IBSA database in close proximity (20 km) to the study areas (see Table 1.5). These surveys gave excellent local and regional contextual information, particularly for conservation significance. For historical context, Beard mapping has been used, however this mapping is conducted at a coarse scale (1:250,000) and can only provide an approximate comparison.
Competency/experience of the team carrying out the survey, including experience in the bioregion surveyed.	No	Botanist Chris Parker has ten years experience in conducting botanical surveys throughout Western Australia, including experience within the Dampier Peninsula and Kimberly bioregion.
Restrictions to, or functionality of survey equipment and tools to complete the flora and vegetation assessment.	No	There were no restrictions to or compromised functionality of survey equipment or tools that would adversely effect the flora and vegetation equipment during the current survey.

Limitation	Constraint	Comment
Proportion of flora recorded and/or collected, any identification issues.	Somewhat	<p>Proportion of flora collected was consistent with expectations for this type of survey and survey timing in the context of other surveys of a similar level and seasonality.</p> <p>There were four Priority Flora species (three ephemeral and one tree), listed with High Likelihood to occur in the study areas and not expected to be flowering at the time of the survey. They are:</p> <ul style="list-style-type: none"> • <i>Corymbia paractia</i> (P1); • <i>Jacquemontia</i> sp. Broome (P1); • <i>Glycine pindanica</i> (P3); and • <i>Polymeria</i> sp. Broome (P3). <p>Without adequate floristic material these four Priority Flora are either absent (existing in the substrate as root stock or seed) or difficult to distinguish from similar species.</p> <p>Presence of these taxa is more likely to be confirmed during surveys conducted in the months directly following the wet season (February to April). This has somewhat limited the results of the flora recorded during the survey.</p> <p>Plants were identified by taxonomist Udani Sirisena who has botanical and taxonomic experience throughout Western Australia. Where there were complexities specialist taxonomists at the Western Australian herbarium were consulted.</p> <p>Six specimens were unable to be confirmed or left with a query on their species confirmation due to poor quality material. This can also be contributed to the seasonal conditions.</p>
Survey effort and extent.	No	<p>Prior to the field survey, quadrat sites were selected to represent the diversity of vegetation and geology present at the study area. This was sufficient to map and classify the vegetation of the study area for the Reconnaissance assessment.</p> <p>All the vegetation types identified are common for this area. The Study Area was adequately assessed in accordance with the Guidance Statement Guidelines</p>
Access restrictions within the survey area.	No	<p>There were no access limitations in the flora and vegetation survey.</p>
Survey timing, rainfall, season of survey.	Yes	<p>The field survey timing was considered appropriate season for a flora and vegetation survey conducted in the Kimberley Botanical Province. However conditions were very dry and the wet season preceding the survey received less than half the median rainfall. This effected the flowering of <i>Corymbia paractia</i>. Without adequate floristic material, this taxa cannot be conclusively identified.</p> <p>Six specimens were unable to be conclusively identified due to poor quality material. Four priority flora were either not expected to be flowering at the time of the survey or not flowering due to seasonal conditions.</p> <p>This placed a limitation on confirming presence of Priority flora with a High Likelihood of occurrence.</p>
Disturbance that may have affected the results of survey such as fire, flood or clearing.	No	<p>Some areas of the G1 Study Area were recorded as recently burnt. However adequate interpretation of flora and vegetation composition was obtained in the context of a Reconnaissance Survey.</p>

2.4. Level 1 Fauna Assessment

The terrestrial fauna survey was consistent with a Level 1 survey as described in Technical Guidance: Terrestrial Fauna Surveys (EPA 2016c) and Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016d). The guidance suggests selective low-intensity sampling of the fauna and fauna habitats to verify the accuracy of the desktop assessment, with a focus on any conservation significant fauna identified as likely to be present.

2.4.1. Fauna Habitat Mapping

Fauna habitat mapping identifies areas of vegetation and land features that are distinguishable from other areas. Typically, each fauna habitat supports a characteristic fauna assemblage that is adapted to the features of the fauna habitat. Fauna habitat types are identified and described for each bore field based on the following information:

- General vegetation type (Shepherd, Beeston and Hopkins, 2001);
- Vegetation units mapped within the study area;
- Vegetation structure;
- Landforms;
- Geological units;
- Soil substrate;
- Aerial imagery;
- Fauna assemblage; and
- Field observations.

2.4.2. Limitations and Constraints

Limitations and constraints of the fauna and fauna habitat assessment are summarised in Table 2.5.

Table 2.5: Limitations and Constraints of the Study – Fauna

Limitation	Constraint	Comment
Availability of data and information	No	There were no restrictions on the required information, and all the relevant databases were accessed.
Competency/experience of the survey team, including experience in the bioregion survey	No	Senior Ecologist Chris Parker has 8 years of experience completing ecological surveys, plus extensive experience surveying fauna in the Dampierland region of WA in his previous role working with Yawuru country managers.
Scope of the survey, e.g. where faunal groups were excluded from the survey	No	The field survey consisted of a level 1 fauna survey. No constraints were experienced completing the survey.
Timing, weather and season.	No	The assessment of fauna habitats and recording of secondary evidence of fauna species was not compromised. Targeted searches for the Greater Bilby can be completed at any time of the year (DSEWPac 2011; Southgate <i>et al.</i> , 2018).
Disturbances which may have affected results. (e.g. fire, flood)	No	No disturbances were recorded during the survey.
Proportion of fauna identified, recorded or collected.	No	All vertebrate fauna species encountered were identified in the field. Level 1 survey methods do not require the identification of all fauna species present within the study area.
Adequacy of the survey intensity and the proportion of the survey achieved (e.g. extent to which the area was surveyed).	No	A level 1 survey was adequate to identify the presence of the threatened fauna and the fauna habitat present within the study area. Sufficient information is available to determine likely habitat use by other conservation significant fauna species. All components of a level 1 fauna survey were completed.
Access problems.	No	No access restrictions were experienced within the study area.
Problems with data and analysis, including sampling biases.	No	No limitations were experienced during the data analysis and sampling.
Other	No	

2.5. Data for the Index of Biodiversity Survey's for Assessments (IBSA)

The Environmental Protection Authority has given instruction that all biological surveys collecting data on biodiversity submit the report and associated raw data to IBSA as an IBSA data package.

All survey data for the study areas has been provided electronically with this report to comply with IBSA data package standards.

3. RESULTS

3.1. Flora Desktop Study

Twenty-three significant taxa were identified during the flora database searches and Literature Review. These are summarised in Table 3.1 with the likelihood of occurrence analysis provided in Appendix A. Records are mapped in Map 3.1. Coordinates of mapped records are available upon request.

Table 3.1: Significant Flora Likelihood of Occurrence from Database Searches and Literature Review

Likelihood	Cons Sig	Species
Recorded	Priority 1	<i>Corymbia paractia</i>
High	Priority 1	<i>Jacquemontia</i> sp. Broome (A.A. Mitchell 3028)
	Priority 3	<i>Glycine pindanica</i> , <i>Polymeria</i> sp. Broome (K.F. Kenneally 9759), <i>Seringia katatona</i> , <i>Terminalia kumpaja</i>
Medium	Threatened	<i>Seringia exastia</i>
	Priority 1	<i>Ipomoea tolmerana</i> subsp. <i>occidentalis</i>
	Priority 3	<i>Aphyllodium glossocarpum</i> , <i>Bonamia oblongifolia</i> , <i>Goodenia byrnesii</i> , <i>Stylidium pindanicum</i> , <i>Tephrosia pedleyi</i> , <i>Tetragonia coronata</i>
Low	Priority 1	<i>Thespidium basiflorum</i> , <i>Aphyllodium parvifolium</i>
	Priority 2	<i>Gomphrena pusilla</i>
	Priority 3	<i>Fuirena incrassata</i> , <i>Acacia monticola</i> x <i>tumida</i> var. <i>kulparn</i> , <i>Lophostemon grandiflorus</i> subsp. <i>grandiflorus</i> , <i>Nymphoides beaglensis</i> , <i>Stylidium costulatum</i>
	Priority 4	<i>Pittosporum moluccanum</i>

3.2. Vegetation Desktop Study

Twelve ecosystems of conservation significance consisting of 118 records were identified from the database search. These include:

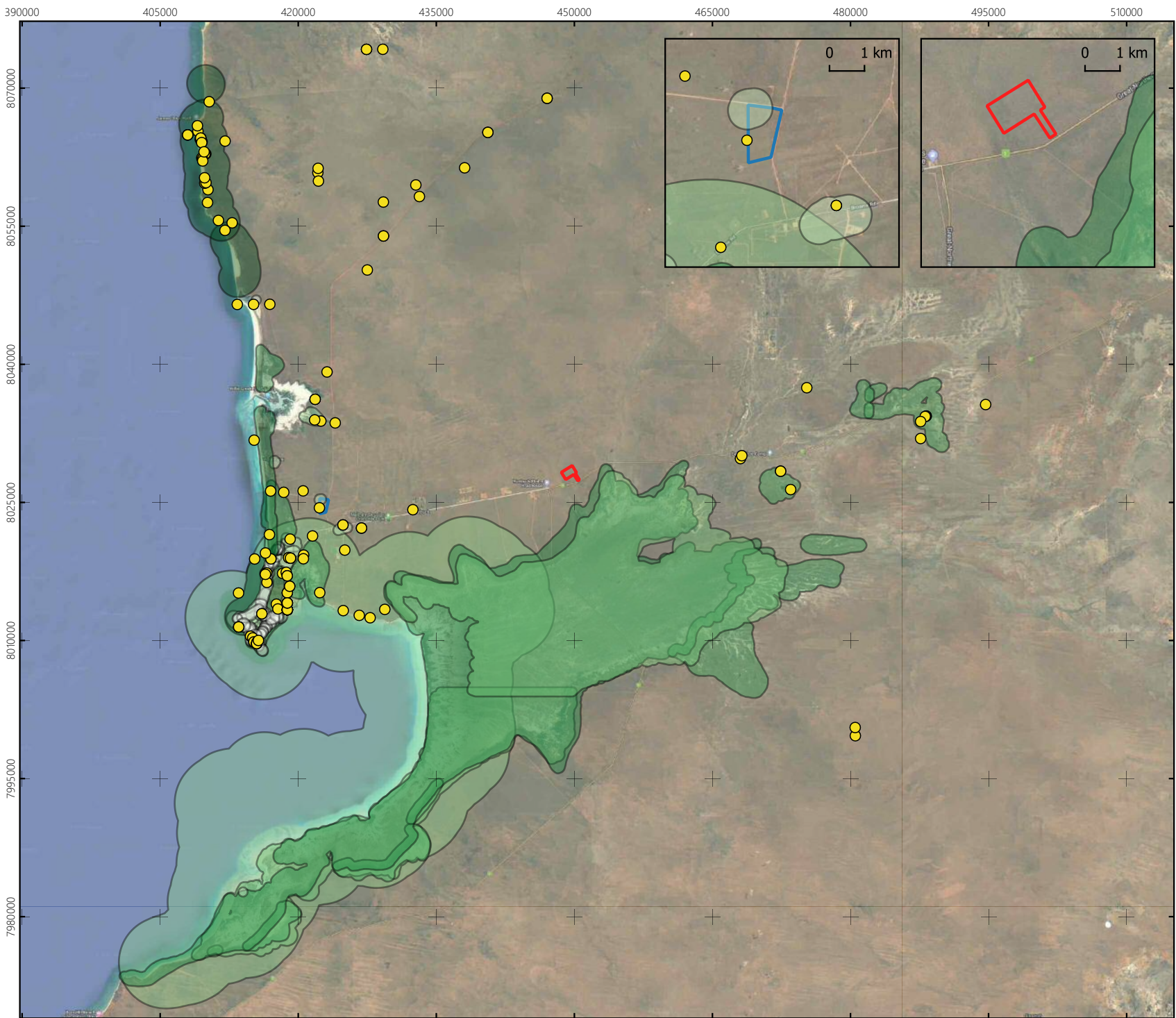
- Monsoon (vine) thickets on coastal sand dunes of the Dampier Peninsula, federally listed as Threatened and state listed as Vulnerable;
- Roebuck bay mudflats, state listed as Vulnerable;
- 87 records of Priority 1 communities;
- 17 records of Priority 3; and
- One record of a Priority 4 community.

These Priority and Threatened Ecological Communities are listed in Table 3.2 and mapped in Map 3.1.

Table 3.2: Priority and Threatened Ecological Communities Recorded from the Database Searches.

Name	Description	Conservation Category [^]	No. of records	Proximity to the D2 Study Area	Proximity to the G1 Study Area
Vine thickets	Monsoon (vine) thickets on coastal sand dunes of Dampier Peninsula	Vulnerable [^] Threatened ⁺	11	closest record is 7 km south west	<20 km
Roebuck Bay mudflats	Species-rich faunal community of the intertidal mudflats of Roebuck Bay	Vulnerable [^]	1	500 m south	8 km south west
<i>Corymbia paractia</i>	<i>Corymbia paractia</i> dominated community on dunes	Priority 1 [^]	65	Adjacent to the north and west of study area and upto 15 km to the south west	<20 km
Dwarf pindan heath	Dwarf pindan heath community of Broome coast	Priority 1 [^]	2	14 km to the south west	<20 km
Mangarr (Minyjuru)	Relict dune system dominated by extensive stands of Minyjuru (Mangarr) <i>Sersalisia</i> (formerly <i>Pouteria</i>) <i>sericea</i> .	Priority 1 [^]	19	closest record within study area, and 2 - 7 km northwest, southwest, southeast.	<20 km
Vegetation Association 770	Kimberley Vegetation Association 770	Priority 1 [^]	1	4.8 km west	<20 km
Eighty Mile Land System	Eighty Mile Land System	Priority 3 [^]	1	more than 20 km	<20 km
Roebuck Land System	Roebuck Land System	Priority 3 [^]	3	11 km to the south west	2.8 km south east
Vegetation Association 37	Kimberley Vegetation Association 37	Priority 3 [^]	3	more than 20 km	<20 km
Vegetation Association 67	Kimberley Vegetation Association 67	Priority 3 [^]	6	more than 20 km	<20 km
Vegetation Association 73	Kimberley Vegetation Association 73	Priority 3 [^]	4	3 km to the south and west, and 10 km to the south east	2.4 km south east
Nimalarica Claypan	Nimalarica Claypan Community (previously Nimalaica)	Priority 4 [^]	1	8 km north	<20 km

[^] - State Protected. ⁺ - Commonwealth Protected

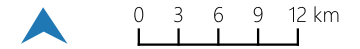


Legend

- Site D2
- Site G1
- Conservation Significant Flora

Conservation Significant Vegetation

- Corymbia paractia
- Dwarf pindan heath
- Eighty Mile Land System
- Mangarr (Minyjuru)
- Nimalarica Claypan
- Roebuck Bay mudflats
- Roebuck Land System
- Vegetation Association 37
- Vegetation Association 67
- Vegetation Association 73
- Vegetation Association 770
- Vine thickets



Scale 1:570000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter



Author: CF Approved: AH Date: 15-01-2020

DBCA Flora and Vegetation Database Search Results

Proposed Waste Facility

Map

Prepared for
 Shire of Broome | Talis

3.1

3.3. Flora

A total of 45 taxa from 18 families and 34 genera were recorded during the survey. The most species rich family was Fabaceae with nine taxa. The most species rich genus were *Acacia* with four taxa and *Corymbia* with three taxa. A representative species list is included in Appendix D. No introduced species were recorded during the survey. No Threatened or Priority Flora were recorded during the field survey.

Several surveys from the Literature Review were conducted with excellent seasonal timing, assessing vegetation in the months directly following the wet season, February to April. Ten Priority Flora were identified from the Database searches and Literature Review surveys to occur in the vicinity (20 km) of the study areas; three Priority 1, four Priority 3 and three taxa that have since been delisted:

- *Aphyllodium parvifolium* (P1), Medium Likelihood of occurrence;
- *Corymbia paractia* (P1), Previously Recorded;
- *Jacquemontia* sp. Broome (P1), High Likelihood of occurrence;
- *Glycine pindanica* (P3), High Likelihood of occurrence;
- *Polymeria* sp. Broome (P3), High Likelihood of occurrence;
- *Seringia katatona* (P3), High Likelihood of occurrence;
- *Terminalia kumpaja* (P3), High Likelihood of occurrence;
- *Phyllanthus eremicus* (delisted);
- *Pterocaulon intermedium* (delisted); and
- *Triodia caelestialis* (delisted).

The literature review found *Corymbia paractia* (P1) was previously recorded from the northern and eastern boundaries of the D2 Study Area during. Five Priority Flora found during the desktop survey are listed with a High Likelihood of occurrence in the study areas (see Appendix A). Significant and introduced flora information is detailed for each of the study areas, below.

3.3.1. D2 Study Area

There were no introduced species recorded during the survey at the D2 Study Area.

There were no Threatened flora species recorded during the survey at the D2 Study Area.

There were no Priority flora recorded during the current field survey at the D2 Study Area.

A recent Targeted flora survey for Priority One Flora, *Corymbia paractia* identified several locations of this species to occur on the boundary north and east of the D2 Study Area along the roadside reserves (Environs Kimberley, 2018). *Corymbia paractia* is recorded at the boundary and highly likely to occur throughout the D2 Study Area, considering the geology, presence of associated vegetation and records at the boundary of the D2 Study Area (see Appendix A and Map 3.2).

The field survey could not confirm the presence of *C. paratica* at the D2 Study Area due to insufficient floristic material. When flowering and fruiting material is absent, the Priority One species is difficult to distinguish from the co-occurring, dominant species *C. flavescens*. Although the survey was undertaken during the optimal flowering time for these species, dry seasonal conditions resulted in no individuals observed flowering. Below average rainfall in the year preceding the survey may have contributed to insufficient floristic material (see Section 1.4).

Five Priority Flora with a High Likelihood of occurrence are known to occur in the vicinity (20km) of the D2 Study Area, as identified from the desktop survey. They are illustrated in Map 3.2 and listed below:

- *Jacquemontia* sp. Broome (P1);

- *Glycine pindanica* (P3);
- *Polymeria* sp. Broome (P3);
- *Seringia katatona* (P3); and
- *Terminalia kumpaja* (P3).

3.3.2. G1 Study Area

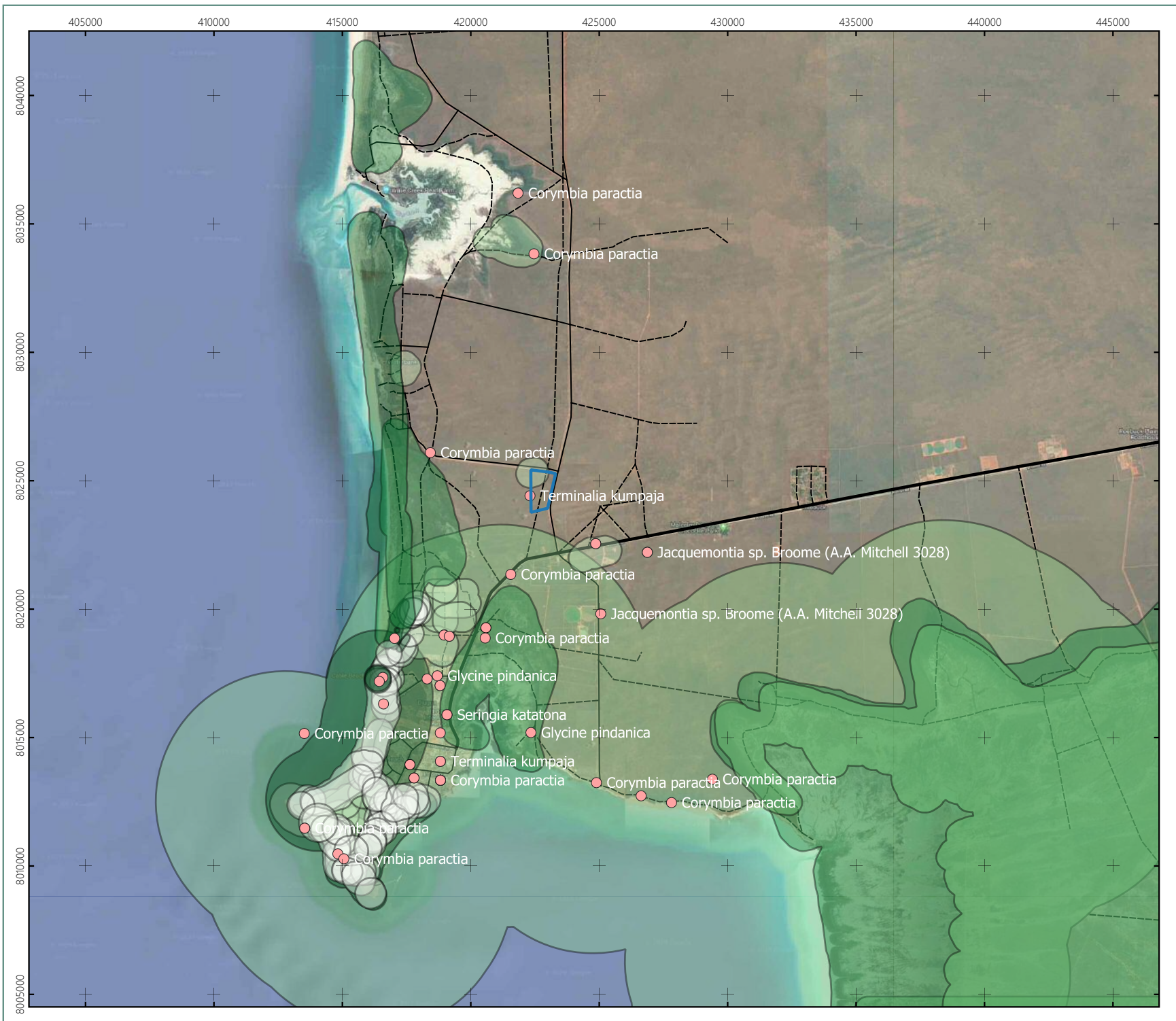
There were no introduced species recorded during the survey at the G1 Study Area.

There were no Threatened flora species recorded during the survey at the G1 Study Area.

There were no Priority flora recorded during the survey at the G1 Study Area.

Two Priority flora are known to occur in the vicinity (20 km) of the G1 Study Area as identified from the desktop survey. They are illustrated in Map 3.3 and listed below;

- *Jacquemontia* sp. Broome (P1); and
- *Polymeria* sp. Broome (P3).

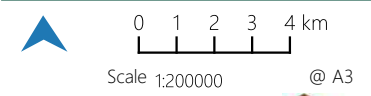


Legend

- Site D2
- Flora from the Database Search
- High Likelihood of Occurrence

Broome_Spectrum_TecPecSearchResults_17122019

- Corymbia paractia
- Dwarf pindan heath
- Eighty Mile Land System
- Mangarr (Minyjuru)
- Nimalarica Claypan
- Roebuck Bay mudflats
- Roebuck Land System
- Vegetation Association 37
- Vegetation Association 67
- Vegetation Association 73
- Vegetation Association 770
- Vine thickets

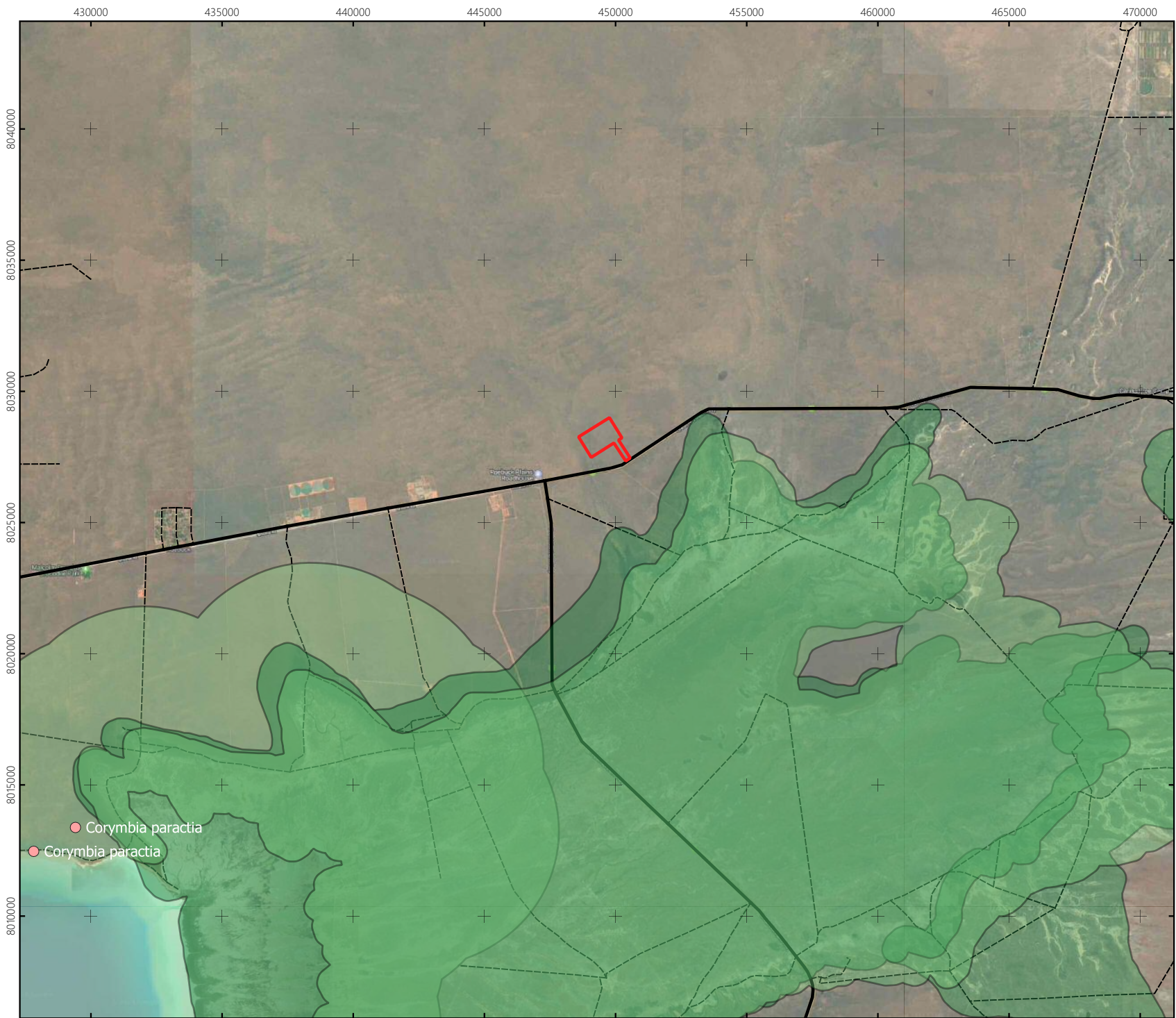


Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter

Author: CF Approved: DC Date: 15-01-2020

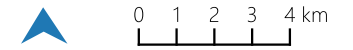
Significant Flora and Vegetation known from the Vicinity of the D2 Study Area

Proposed Waste Facility



Legend

- Site G1
- Flora from the Database Search
- High Likelihood of Occurrence
- Broome_Spectrum_TecPecSearchResults_17122019
- Corymbia paractia
- Dwarf pindan heath
- Eighty Mile Land System
- Mangarr (Minyjuru)
- Nimalarica Claypan
- Roebuck Bay mudflats
- Roebuck Land System
- Vegetation Association 37
- Vegetation Association 67
- Vegetation Association 73
- Vegetation Association 770
- Vine thickets



Scale 1:200000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter



Author: CF Approved: DC Date: 15-01-2020

Significant Flora and Vegetation known from the Vicinity of the G1 Study Area

Proposed Waste Facility

Map

3.3

Prepared for
 Shire of Broome | Talis

3.4. Vegetation




Three vegetation types were recorded from the study areas (two in G1 and one in D2). Each are common in the landscape and reflect the 750.1 Vegetation Association Unit from the Pre-European Beard mapping.

Vegetation types were described from the field survey identified on Pindan flat plains include:

1. *Corymbia greeniana* isolated trees over *Acacia eriopoda* open shrubland over *Chrysopogon fallax* and *Triodia* species isolated tussock and hummock grasses.
2. *Bauhinia cunninghamii* open woodland over *Acacia eriopoda* and *A. platycarpa* sparse shrubland over *Grewia rustifolia* and *Pterocaulon intermedium* isolated heath shrubs over *Chrysopogon fallax* isolated tussock grasses.
3. *Corymbia flavescens* and *C. greeniana* (+/- *Brachychiton diversifolius* ssp. *diversifolius*, *Bauhinia cunninghamii*) open woodland over *Acacia eriopoda* sparse shrubland over *Sorghum plumosum* sparse tussock grassland.

Table 3.3 outlines each of the vegetation types and details which types were present in each of the study areas.

Table 3.3: Vegetation Types Described at the Study Areas

Vege Type	Description	Sites	Presence in D2 Study Area	Presence in G1 Study Area	Representative Photograph
Pindan Flat Plain					
1	<i>Corymbia greeniana</i> isolated trees over <i>Acacia eriopoda</i> open shrubland over <i>Chrysopogon fallax</i> and <i>Triodia</i> species isolated tussock and hummock grasses.	R04 R05	Present	Not Present	
2	<i>Bauhinia cunninghamii</i> open woodland over <i>Acacia eriopoda</i> and <i>A. platycarpa</i> sparse shrubland over <i>Grewia rustifolia</i> and <i>Pterocaulon intermedium</i> isolated heath shrubs over <i>Chrysopogon fallax</i> isolated tussock grasses.	R01	Not Present	Present	
3	<i>Corymbia flavescens</i> and <i>C. greeniana</i> (+/- <i>Brachychiton diversifolius</i> ssp. <i>diversifolius</i> , <i>Bauhinia cunninghamii</i>) open woodland over <i>Acacia eriopoda</i> sparse shrubland over <i>Sorghum plumosum</i> sparse tussock grassland.	R02 R03	Not Present	Present	

3.4.1. D2 Study Area

One Vegetation Type was described from the D2 Study Area; Vegetation Type 1. This vegetation type was derived from flat Pindan Plains and is mapped in Map 3.4.

1. *Corymbia greeniana* isolated trees over *Acacia eriopoda* open shrubland over *Chrysopogon fallax* and *Triodia* species isolated tussock and hummock grasses.

3.4.1.1. Significant Vegetation

No vegetation communities identified as a Threatened Ecological Communities were recorded at the D2 study area.

The north-western corner of the D2 Study Area intersects the Priority 1 Priority Ecological Community Mangarr (Minyjuru) (Unique Code 17327). This community represents the relict dune system dominated by extensive stands of Minyjuru (Mangarr) *Sersalisia* (formerly *Pouteria*) *sericea*.

Vegetation Type 1 is the known habitat for Priority 1 species, *Corymbia paractia*, this vegetation type is considered significant as it plays a role in refuge for conservation significant flora.

3.4.1.2. Vegetation Condition

The vegetation condition at the D2 Study Area was recorded entirely as Excellent and is mapped in Map 3.5. There were little to no signs of disturbance.

3.4.2. G1 Study Area

Two Vegetation Types were described from the G1 Study Area; Vegetation Types 2 and 3. These vegetation types were derived from flat Pindan Plains and are mapped in Map 3.6.

2. *Bauhinia cunninghamii* open woodland over *Acacia eriopoda* and *A. platycarpa* sparse shrubland over *Grewia rustifolia* and *Pterocaulon intermedium* isolated heath shrubs over *Chrysopogon fallax* isolated tussock grasses.
3. *Corymbia flavescens* and *C. greeniana* (+/- *Brachychiton diversifolius* ssp. *diversifolius*, *Bauhinia cunninghamii*) open woodland over *Acacia eriopoda* sparse shrubland over *Sorghum plumosum* sparse tussock grassland.

3.4.2.1. Significant Vegetation

There were no vegetation types identified as a TEC/PEC or significant due to historical impact from threatening processes, or which provide a function to maintain ecological integrity of a significant ecosystem.

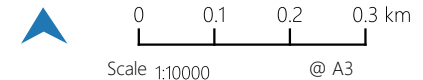
3.4.2.2. Vegetation Condition

The vegetation condition at the G1 Study Area was recorded entirely as Excellent and is mapped in Map 3.7. There were little to no signs of disturbance. Signs of fire were recorded throughout, with approximately 80% of the area burnt as recently as within a year and with the remainder being burnt less than 5 years ago. Low grazing in the western end of the G1 Study Area near R01 was noted. Vegetation structure remains intact.



Legend

- Site D2
 - Releve Site Locations
 - Transects Walked During the Survey
- Vegetation Types**
- 1: *C. greeniana* over Acacia open shrubland
 - 2: *Bauhinia* open woodland over Acacia shrubland
 - 3: *C. flavescens* and *C. greeniana* open woodland
- Roads**
- Principal Road
 - Minor Road
 - Track



Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter



Author: CF Approved: DC Date: 15-01-2020

Vegetation Types Mapped at the D2 Study Area

Proposed Waste Facility

Map

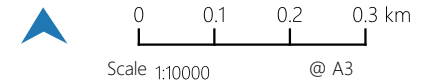
Prepared for
 Shire of Broome | Talis

3.4



Legend

- Site D2
 - Excellent Condition
 - Releve Site Locations
 - Transects Walked During the Survey
- Roads**
- Principal Road
 - Minor Road
 - Track



Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter



Author: CF Approved: DC Date: 15-01-2020

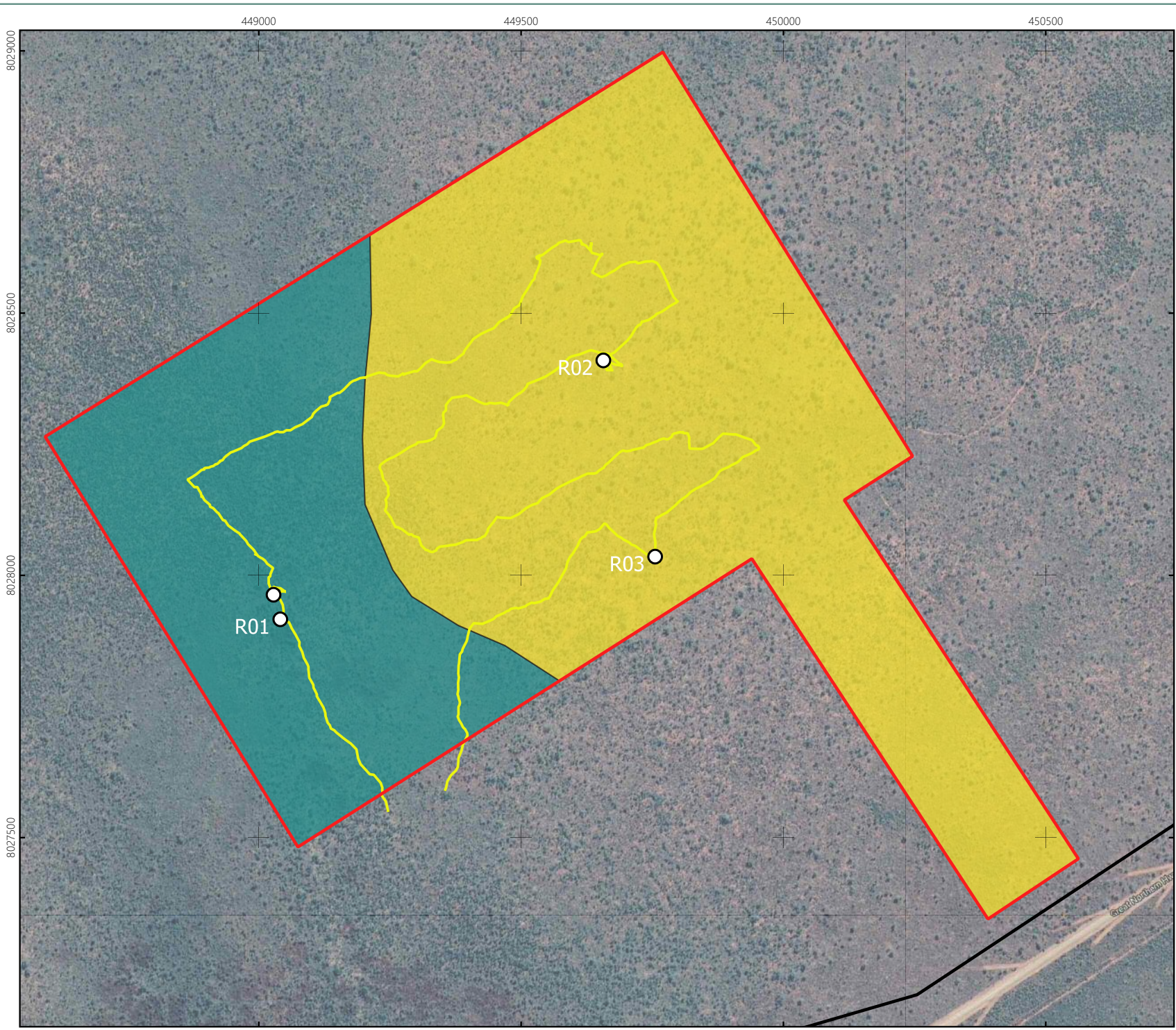
Vegetation Condition Mapped at the D2 Study Area

Proposed Waste Facility

Map

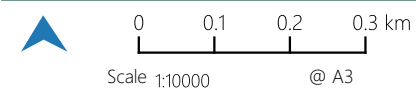
Prepared for
 Shire of Broome | Talis

3.5



Legend

- Site G1
 - Releve Site Locations
 - Transects Walked During the Survey
- Vegetation Types**
- 1: C. greeniana over Acacia open shrubland
 - 2: Bauhinia open woodland over Acacia shrubland
 - 3: C. flavescens and C. greeniana open woodland
- Roads**
- Principal Road
 - Minor Road
 - Track



Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter

Author: CF Approved: DC Date: 15-01-2020

Vegetation Types Mapped at the G1 Study Area

Proposed Waste Facility

Map

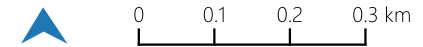
Prepared for
 Shire of Broome | Talis

3.6



Legend

- Site G1
- Excellent Condition
- Releve Site Locations
- Transects Walked During the Survey
- Roads**
- Principal Road
- Minor Road
- Track



Scale 1:10000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter



Author: CF Approved: DC Date: 15-01-2020

Vegetation Condition Mapped at the G1 Study Area

Proposed Waste Facility

Map

Prepared for
 Shire of Broome | Talis

3.7

3.5. Terrestrial Fauna

3.5.1. Fauna Habitats

Both study areas are dominated by Pindan Shrubland habitats which consist of open to sparse *Acacia* sp. shrubland over tussock grassland, which is mostly homogenous with a natural patchiness in tree, shrub and grass density. Pindan Shrubland habitat was relatively consistent across both study areas and the surrounding region. The fire age across the study area varied from recently burnt to approximately five years. The habitat is characterised by a low-density of *Corymbia* spp. and *Bauhenia cunninghamii* trees, over medium to high density *Acacia eriopoda* and *A. platycarpa* shrubland. The grass layer is typically low to high density *Sorghum plumosom* and *Chrysopogon fallax* on a flat plain of orange sandy clay (Figure 3.1). Leaf litter and wood litter is generally sparse and accumulate only under trees.

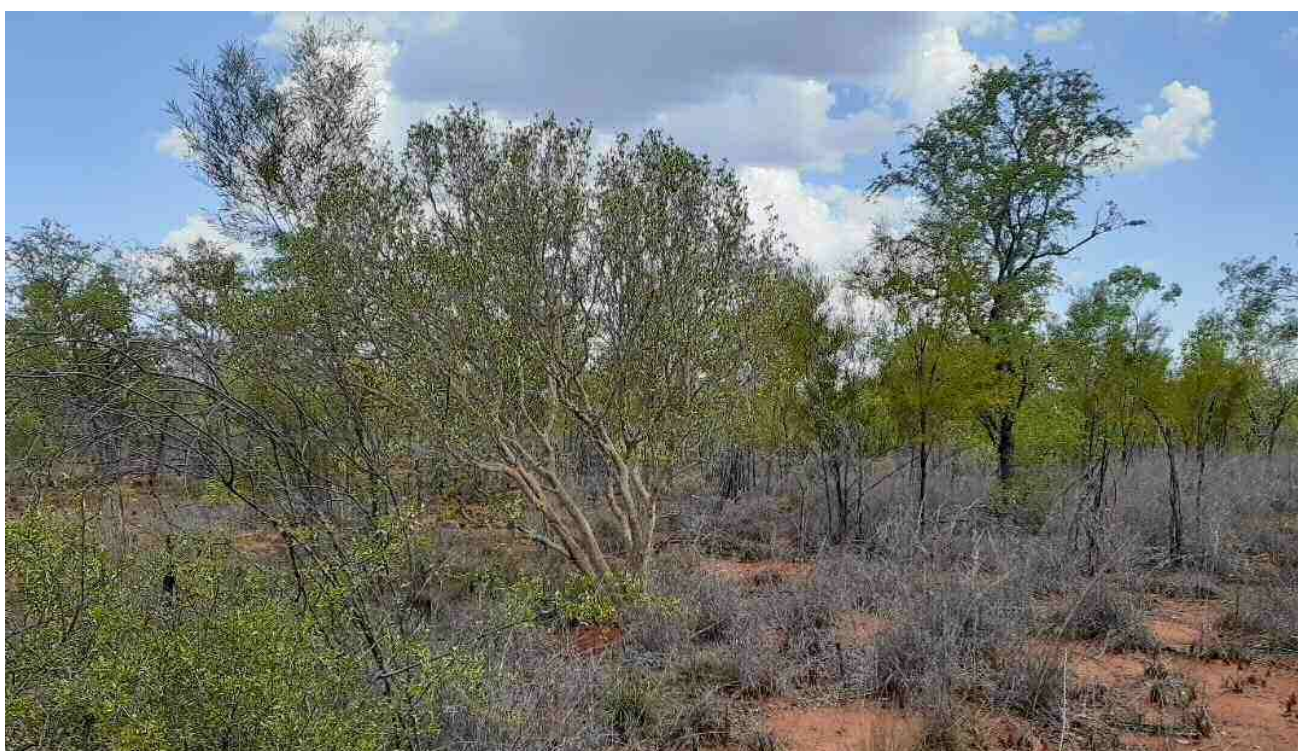


Figure 3.1: Typical Habitat Recorded from the Study Areas

3.5.2. Vertebrate Fauna

The literature review and database search identified 53 mammal, 165 bird, 81 reptile and 15 amphibian species that could occur in the region surrounding the study areas. Both study areas do not include any marine or wetland habitats and all species that utilise these habitat types have been excluded from the assessment. Due to the small size of each study area, only a small fraction of the identified species would utilise the study area on an ongoing basis, although all species could potentially occur at some point in time.

3.5.3. Conservation Significant Fauna

Results of the literature review identified 32 conservation significant fauna species (12 mammal, 15 bird and 5 reptile species). An additional 61 conservation significant bird species and two mammal species that are associated with marine, shoreline and wetland environments were also identified however due to the location of the survey areas and a lack of water bodies associated with both survey areas, these species have been excluded from the assessment. The remaining fauna species that were reported in the DBCA Threatened Fauna Database Search are shown in Map 3.8.

The Greater Bilby (*Macrotis lagotis*) is considered to have a high likelihood of occurrence within both the D2 and G1 Study Areas due to the high number of recent records in the surrounding region and the suitability of the habitat present. The nomadic nature of this species means that it can move into areas quickly in response to resource availability. The Northern Brushtail Possum (*Trichosurus vulpecula arnhemensis*) is considered to have a medium likelihood of occurrence as it is commonly recorded in the Broome township and it is known to utilise the Pindan Shrubland habitats surrounding the town. Both the Bare-rumped Sheath-tail Bat (*Saccolaimus saccolaimus nudicluniatu*s) and Northern Coastal Free-tailed Bat (*Mormopterus (Ozimops) cobourgi*anus) are considered to have a medium likelihood of occurrence due to previous records and habitats present in the study areas however they are expected to mostly utilise habitats within the D2 Study Area for foraging. The Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*) is typically only recorded south of the Great Northern Hwy, however potentially suitable scats have recently been recorded by Yawuru country managers near the D2 Study Area and the habitats within the Study Areas is considered to be suitable for this species.

Of the 15 conservation significant bird species identified, six species are considered to have a medium likelihood of occurrence. The Gouldian Finch (*Erythrura gouldiae*) has historically been recorded from the region although they are typically only recorded from the northern half of the Dampier Peninsula. They are considered to have a medium likelihood of occurrence due to the suitable foraging habitat that occurs in the survey area and the Gouldian Finches ability to move significant distances to utilise food resources as they develop in response to rainfall events. The Oriental Cuckoo (*Cuculus optatus*), Barn Swallow (*Hirundo rustica*) and Fork-tailed Swift (*Apus pacificus*) are migrant species that have been recorded on several occasions around Broome, however their use of the survey area would be infrequent and only for foraging. The Grey Falcon (*Falco hypoleucos*) and Peregrine Falcon (*Falco peregrinus*) have also been recorded from the region surrounding the survey area, however their use of the habitats within this area would be limited to hunting prey bird species.

The Dampierland Goanna (*Varanus sparnus*) is the only conservation significant reptile species that is considered to potentially occur in the survey area. A medium likelihood was given due to the presence of suitable habitat (pindan shrubland) and several records from the surrounding region. This species has only been recently described and exact habitat requirements are currently not well understood.

Table 3.4: Conservation Significant Fauna Species Potentially Occurring at the Study Area

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC	BC	DBCA			
Mammals						
Northern Quoll <i>Dasyurus hallucatus</i>	EN	EN	-	Dissected rocky escarpments, gorges and granite boulder piles with access to surface water. Also utilise surrounding eucalypt forest/woodland and drainage lines.	NatureMap (one record in Broome)	Low Only one record and no suitable habitat exists in the study areas.
Kimberley Brush-tailed Phascogale <i>Phascogale tapoatafa kimberleyensis</i>	VU	VU	-	Tall open forest/woodland dominated by <i>Eucalyptus</i> and <i>Corymbia</i> spp. with suitable tree hollows. Typically drier habitats and not rainforest.	NatureMap (one historical record 30km south)	Low Only one historical record although habitat in the study areas could be considered suitable.
Greater Bilby <i>Macrotis lagotis</i>	VU	VU	-	Variety of habitats with suitable soil substrates and availability of food resource plants species. Habitats can include hummock grassland, acacia shrubland, open woodland and cracking clays.	High number of Greater Bilby records from, NatureMap, DBCA and several other surveys in the region.	High Commonly recorded across the region with recent records from adjacent to the study areas.
Golden Bandicoot <i>Isodon auratus auratus</i>	VU	VU		Margins of rainforests lined with sandstone in the Northern Kimberley. Eucalypt woodlands in the Yampi Peninsula. Recorded from spinifex and tussock grasslands in arid deserts, as well as tropical forests and woodlands in semi-arid areas.	One historical (written) record from Broome, accuracy 50 km, NatureMap	Low Only one historic record within 40km, other records on the Dampier Peninsular occur over 50 km from Broome.
Bare-rumped Sheathtail Bat <i>Saccolaimus saccolaimus nudicluniatus</i>	VU	-	P3	Distribution appears to be coastal. Lowland areas, typically in a range of woodland, forest and open environments. One recent record from Pinnacle Creek in the central Kimberley.	One historic (1982) record from NatureMap and PMST, potential habitat may be present within the area	Medium Historic record 25 km north of D2 Study Area. Has been recorded from pindan habitat on the Dampier Peninsula previously (McKenzie <i>et. al.</i> 2018).
Northern Brushtail Possum <i>Trichosurus vulpecula arnhemensis</i>	-	VU	-	Dry forest/woodland dominated by <i>Eucalyptus</i> and <i>Corymbia</i> spp. with suitably large trees, hollows and developed understory. Low fire frequency is often associated with suitable habitat.	NatureMap, DBCA (numerous records in Broome and inland), and it has been recorded on one other survey in the region (Western Wildlife; Duchess Paradise 2011).	Medium Several records nearby and suitable habitat occurs within the study areas.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC	BC	DBCA			
Northern Coastal Free-tailed Bat <i>Mormopterus (Ozimops) cobourgianus</i>	-	-	P1	Western Australian populations are associated with mangrove communities with roosts only recorded from <i>Avicennia marina</i> , however Northern Territory populations also utilise woodland habitats.	DBCA (one record in 2016, within the D2 study area).	Medium One record within the D2 Study area although no suitable mangrove habitat present within either study area, May utilise woodland habitats.
Yellow-lipped Cave Bat <i>Vespadelus douglasorum</i>	-	-	P2	Tropical woodlands, often along streams lined with Melaleuca and Pandanus. Utilises sandstone and limestone caves, usually near water.	Beagle Bay survey (ecologia 2005)	Low Nearest records over 100km north, no suitable habitat in the study areas
Spectacled Hare-wallaby <i>Lagorchestes conspicillatus leichardti</i>	-	-	P4	Inhabits grasslands, open forests, open woodlands and tall shrublands and shelters during the day under grass tussocks. Long unburnt areas considered most suitable.	NatureMap (many records further inland), Potential scats recorded from a recent survey in the region.	Medium Previously recorded from the region to the east and south-east. Suitable habitat occurs in both Study Areas.
Scaly-tailed Possum <i>Wyulda squamicaudata</i>	-	-	P4	Structurally complex, rocky landscapes with deep crevices for shelter and open woodland, closed forest and rainforest pockets which supply a variety of fruiting trees.	NatureMap (one record from 1970 in Broome)	Low Only one historical record within 40km, distribution typically restricted north of the Dampier. No suitable habitat.
Short-tailed Mouse <i>Leggadina lakedownensis</i>	-	-	P4	Acacia shrubland, samphire, woodlands, and stony ranges. Also Spinifex and tussock grassland on cracking clays in the Pilbara region.	Thunderbird (ecologia 2016b), Duchess Paradise (Western Wildlife 2011)	Low Although suitable habitat exists within the study area, the nearest records are over 80km away
Golden-backed Tree-rat <i>Mesembriomys macrurus</i>	-	-	P4	Recorded from a variety of habitats including Eucalypt open forests with tussock grass understorey, rainforest patches on a variety of landforms and soils, eucalypt woodlands with hummock grass understorey, rugged sandstone scree, beaches, and blacksoil plains with pandanus.	One historical (written) record from Broome, accuracy 50 km (DBCA), NatureMap	Low Only one historic record within 40km, No other records on the Dampier Peninsular. Current distribution typically restricted to north and east of Derby.
Birds						
Gouldian Finch <i>Erythrura gouldiae</i>	EN	-	P4	Wooded rocky hills with adjoining flat country. Key habitat attribute is annual spear grasses or perennial sorghum in the understorey during the dry season.	PMST, NatureMap	Medium Two historical records in the area (1973), suitable habitat occurs in the Study Areas.

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC	BC	DBCA			
Red Goshawk <i>Erythrotriorchis radiatus</i>	VU	VU	-	Coastal and sub-coastal areas in wooded/forested lands and riverine forests of tropical and warm-temperate Australia. Vegetation types include eucalypt woodland, open forest, tall open forest, gallery rainforest, swamp sclerophyll forest, and rainforest margins.	PMST, NatureMap	Low One historic record from Broome, distribution typically restricted to north of the Dampier Peninsula.
Princess Parrot <i>Polytelis alexandrae</i>	VU	-	P4	Sand dunes and sand flats in the arid zone with open savanna woodlands and shrublands that usually consist of scattered stands of <i>Eucalyptus</i> , <i>Casuarina</i> or <i>Allocasuarina</i> trees; an understorey of shrubs such as <i>Acacia</i> (especially <i>A. aneura</i>), <i>Cassia</i> , <i>Eremophila</i> , <i>Grevillea</i> , <i>Hakea</i> and <i>Senna</i> ; and a ground cover dominated by <i>Triodia</i> species. Also riverine or littoral areas	PMST, NatureMap	Low One 20-year-old record from Broome, no suitable habitat in the study areas
Masked Owl (Northern) <i>Tyto novaehollandiae kimberli</i>	VU	-	P1	Riparian forest, rainforest, open forest, Melaleuca swamps and the edges of mangroves. Require tall trees with suitable hollows for nesting and roosting and adjacent areas for foraging as they remain in territory all year.	PMST, NatureMap	Low No records of this subspecies exist on the Dampier Peninsula. No suitable habitat in the Study Areas.
Oriental Pratincole <i>Glareola maldivarum</i>	IA	IA	-	Typically utilise inland ephemeral wetland habitat types when present. Can also be found foraging in adjacent open grassland habitats	PMST, NatureMap	Low Multiple records along Roebuck Plains, no suitable habitat present within Study Areas
Oriental Cuckoo <i>Cuculus optatus</i>	IA	IA	-	Mixture of forest and woodland habitats across Eurasia.	PMST, NatureMap	Medium Several records nearby and suitable habitat occurs within the Study Areas
Red-rumped Swallow <i>Cecropis daurica</i>	IA	IA	-	Vagrant species occurs across Europe, Africa and Asia. Typical swallow behavior hawking insects over a variety of habitats.	PMST, NatureMap	Low This vagrant is only rarely recorded in northern WA
Barn Swallow <i>Hirundo rustica</i>	IA	IA	-	Open country in coastal lowlands, often near freshwater wetlands, paperbark Melaleuca woodland, mesophyll shrub thickets and tussock grassland. Also recorded from urban areas perched on overhead wires.	PMST, DBCA (19 records), NatureMap	Medium Many records within 40km and suitable habitat occurs within the study area

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC	BC	DBCA			
Fork-tailed Swift <i>Apus pacificus</i>	IA	IA	-	Nomadic, almost entirely aerial lifestyle over a variety of habitats; associated with storm fronts.	PMST, DBCA (19 records), NatureMap	Medium Many records within 40km and suitable habitat occurs within the study area, however almost entirely aerial lifestyle
White-throated Needletail <i>Hirundapus caudacutus</i>	IA	IA		Nomadic, almost entirely aerial lifestyle over a variety of habitats; although most often over wooded areas and shrublands.	One record from Broome Bird Observatory (2000) NatureMap	Low Vagrant. Few records from the region.
Grey Wagtail <i>Motacilla cinerea</i>	IA	IA	-	Occurs across Eurasia in a variety of habitats associated with moving water (rivers, streams). Some individuals migrate as far south as northern Australia.	PMST, NatureMap (recent records from northern edge of Roebuck Plain)	Low Vagrant. Few records from Roebuck Plain, no suitable habitat present within study area
Yellow Wagtail <i>Motacilla flava</i>	IA	IA	-	Occurs across Europe, Western Asia and Africa. Occurs across a variety of damp or wet habitats with low vegetation, such as damp meadows, marshes, waterside pastures etc.	PMST, NatureMap (one record from Broome).	Low Vagrant. One record from Broome, no suitable habitat present
Grey Falcon <i>Falco hypoleucos</i>	-	VU	-	Generally open inland plains and woodland habitats.	NatureMap	Medium Several records nearby and suitable habitat occurs within the study area
Peregrine Falcon <i>Falco peregrinus</i>	-	OS	-	Widespread; coastal cliffs, riverine gorges and wooded watercourses.	DBCA (four records), NatureMap	Medium Many records within 40km and suitable habitat occurs within the study area
Letter-winged Kite <i>Elanus scriptus</i>	-	-	P4	Open country and grasslands in arid and semi-arid Australia, where there are tree-lined streams or water courses.	NatureMap	Low Two older records from 1994 from Broome, species recorded sporadically along the coast

Species	Conservation Status			Preferred Habitats	Previous Records	Likelihood of Occurrence
	EPBC	BC	DBCA			
Reptiles						
Great Desert Skink <i>Liopholis kintorei</i>	VU	VU		Generally associated with red sandplains and sand ridges. In WA also associated with <i>Triodia basedowii</i> and <i>T. schinzii</i> with some <i>Eremophila leucophylla</i> shrubs. Also gravelly undulating plain with scattered Black Gidgee (<i>Acacia pruinocarpa</i>) or Mulga over <i>Triodia basedowii</i> and low shrubs.	One historical (written) record from Great Sandy Desert, NatureMap	Low Only one historic record within 40km. Current distribution typically restricted to Central Desert regions
Dampierland Goanna <i>Varanus sparnus</i>	-	-	P1	Recently described species, with current records from Pindan Shrubland habitats located across the Dampier Peninsula.	NatureMap, a few recent surveys on the Dampier Peninsula have recorded this species.	Medium Previous records nearby and suitable habitat occurs within the study area.
Dampierland Plain Slider <i>Lerista separanda</i>	-	-	P2	Recorded from coastal dunes and inland sand dunes south to the northern Pilbara.	NatureMap (records from Broome)	Low Coastal species which is very rarely inland of Broome.
Dampierland Burrowing Snake <i>Simoselaps minimus</i>	-	-	P2	Limited habitat information available. Previously recorded from coastal dunes on the Dampier Peninsula.	NatureMap, one record from Broome and northern coast	Low Records are from along the coast and no suitable habitat present within the study area
Northwestern Coastal Ctenotus <i>Ctenotus angusticeps</i>	-	-	P3	Landward fringe of salt marsh communities in samphire shrubland or marine couch grassland (Maryan et al. 2013) in the intertidal zone along mangrove margins.	DBCA (nine recent records in dunes/mangrove areas), NatureMap	Low Records from the coast, no suitable habitat within the study area

Legend

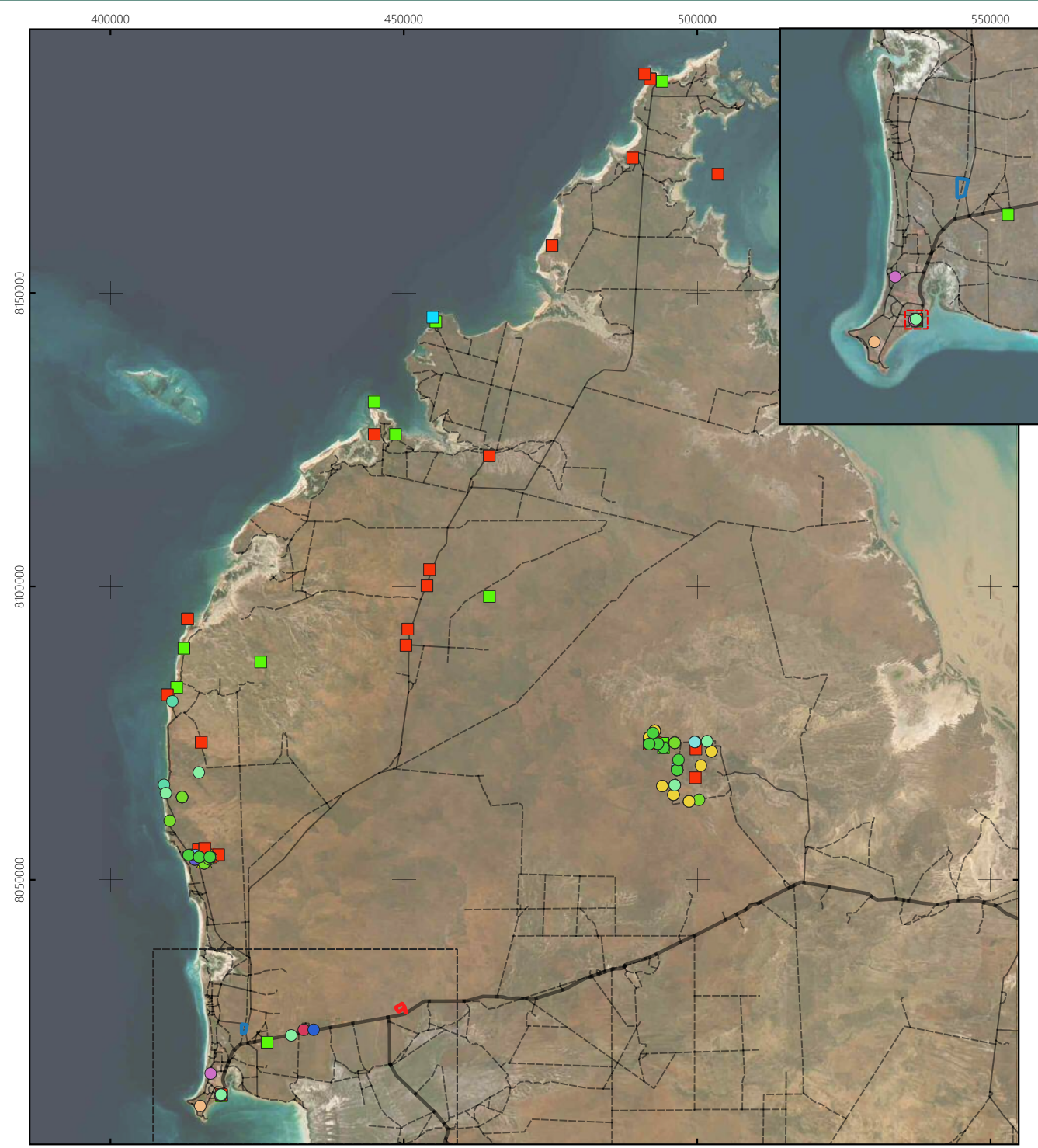
- WAM Arachnida**
- Aname 'MYG231'
 - Aname 'MYG284'
 - Aname 'MYG388'
 - Beierolpium 'sp. indet. (juvenile 3/1) small'
 - Conothele 'MYG543'
 - Conothele 'MYG613'
 - Conothele 'MYG614'
 - Conothele 'MYG615'
 - Conothele 'MYG616'
 - Conothele 'MYG617'
 - Isometrus maculatus
 - Kwonkan 'MYG285'
 - Lychas 'JPP'
 - Synothele 'MYG179'
 - Urodacus 'fossor?'
 - Urodacus 'kraepelini'

- WAM Crustacea**
- ▲ Buddelundia 'sp.43'

- WAM Mollusca**
- Quistrachia leptogramma
 - Rhagada bulgana
 - Rhagada cf. bulgana

- Site D2
- Site G1

- Roads**
- Principal Road
 - Minor Road
 - - - Track



0 10 20 30 km
Scale 1:1000000 @ A3

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Units: Meter

Author: DC Approved: AH Date: 14-01-2020

SRE Invertebrate Database Search Results

Proposed Waste Facility

Map
3.9

Prepared for
Shire of Broome | Talis

3.5.4. Short Range Endemic Invertebrates

The WA Museum SRE invertebrate database search identified 16 taxa of Arachnida; consisting of four wishbone spiders (Anamidae), one brushed trapdoor spider (Barychelidae), six mygalomorph spiders from the *Conothele* genus (Halonoproctidae), one pseudoscorpion (Olpidae) and two scorpions each from the Buthidae and Urodacidae families. The majority of the taxa identified have been recorded from projects located across the Dampier Peninsula indicating that suitable habitats could extend across the region. Five *Conothele* taxa were recorded only from the Broome townsite with the only habitat identified being remnant rainforest with two of the individuals being recorded from within urban dwellings. One record of *Urodacus* 'fossor?' was identified from the Great Northern Hwy in Pindan Shrubland habitat with six records of the very closely related *Urodacus* 'kraepelini' identified from similar habitat across the Dampier Peninsula.

Only one Crustacea taxa was identified belonging to the isopod family Armadillidae. Three records of *Buddelundia* '43' were identified from the James Price Point region.

The search of the Mollusca database identified two snail species from the Camaenidae family. Both *Quistrachia leptogramma* and *Rhagada bulgana* have been recorded across the Dampier Peninsula in woodland and shrubland habitats.

A summary of the results of the database searches and an assessment on potential impacts to each taxa based on the proposed vegetation clearing are provided in Table 3.5 and the locations mapped in Map 3.9.

Table 3.5: WA Museum Invertebrate Database Search Results

Species	Previous Records	Likelihood of Occurrence	Potential for Significant Impact
Arachnida			
Anamidae			
<i>Aname</i> 'MYG231?'	Three records from James Price Point region. All records located along the coast in dense coastal vegetation.	Low Dense coastal habitats were not recorded from the Study Areas.	Low Population has only been recorded around the James Price Point area. Habitats within the Study Areas extend across the Dampier Peninsula.
<i>Aname</i> 'MYG284'	29 records from James Price Point (11) and the Sheffield Resources Thunderbird project (18). Locations occur over 80 km apart, with individuals from James Price Point located within 5 km of the coast and Thunderbird individuals associated with the Fraser River Drainage system. Habitat described as Pindan Shrubland.	Medium Nearest record located 28 km north of the D2 Study Area. Micro habitats in the Study Areas expected to be similar to those found in the James price Point and Thunderbird projects.	Low Populations appear to extend into the Dampier Peninsula and habitats associated with these areas are extensively distributed outside of the Study Areas.
<i>Aname</i> 'MYG388'	5 records from James Price Point (1) and the Sheffield Resources Thunderbird project (4). Locations occur over 80 km apart, with individuals from James Price Point located within 2 km of the coast and Thunderbird individuals associated with the Fraser River Drainage system.	Medium Nearest record located 29 km north of the D2 Study Area. Micro habitats in the Study Areas could be similar to those found in the James price Point and Thunderbird projects.	Low Populations appear to extend into the Dampier Peninsula and habitats associated with these areas are extensively distributed outside of the Study Areas.
<i>Kwonkan</i> 'MYG285'	17 records from James Price Point (1) and the Sheffield Resources Thunderbird project (16). Locations occur over 80 km apart, with individuals from James Price Point located within 5 km of the coast and Thunderbird individuals associated with the Fraser River Drainage system. Habitat described as Pindan Shrubland.	Medium Nearest record located 29 km north of the D2 Study Area. Micro habitats in the Study Areas expected to be similar to those found in the James price Point and Thunderbird projects.	Low Populations appear to extend into the Dampier Peninsula and habitats associated with these areas are extensively distributed outside of the Study Areas.
Barychelidae			
<i>Synothele</i> 'MYG179'	One record from James Price Point region and located along the coast in a small patch of dense vegetation located within 2 km of the coast.	Low Dense coastal habitats were not recorded from the Study Areas.	Low Population has only been recorded around the James Price Point area. Habitats within the Study Areas extend across the Dampier Peninsula.
Halonoproctidae			
<i>Conothele</i> 'MYG543'	One record from James Price Point region and located along the coast in a small patch of dense vegetation located within 2 km of the coast.	Low Dense coastal habitats were not recorded from the Study Areas.	Low Population has only been recorded around the James Price Point area. Habitats within the Study Areas extend across the Dampier Peninsula.

Species	Previous Records	Likelihood of Occurrence	Potential for Significant Impact
<i>Conothele</i> 'MYG613'	One record from within the Broome town site. No habitat description available.	Medium Habitat unknown however within 10 km of the D2 Study Area.	Low Only one record from within Broome. Habitats within the Study Areas extend across the Dampier Peninsula.
<i>Conothele</i> 'MYG614'	One record from within the Broome town site in remnant rainforest habitat.	Low Remnant rainforest habitat were not recorded from the Study Areas.	Low Only one record from within Broome. Habitats within the Study Areas do not match the available habitat requirements for this taxa.
<i>Conothele</i> 'MYG615'	One record from within the Broome town site; recorded from within a house.	Medium Habitat unknown however within 10 km of the D2 Study Area.	Low Only one record from within Broome. Suitable habitat unknown although able to survive in urban areas. Habitats within the Study Areas extend across the Dampier Peninsula.
<i>Conothele</i> 'MYG616'	Three records from within the Broome town site; recorded from within a house.	Medium Habitat unknown however within 10 km of the D2 Study Area.	Low Only recorded from within Broome. Suitable habitat unknown although able to survive in urban areas. Habitats within the Study Areas extend across the Dampier Peninsula.
<i>Conothele</i> 'MYG617'	One record from within the Broome town site. No habitat description available.	Medium Habitat unknown however within 10 km of the D2 Study Area.	Low Only one record from within Broome. Suitable habitat unknown. Habitats within the Study Areas extend across the Dampier Peninsula.
Olpiidae			
<i>Beierolpium</i> 'sp. indet. (juvenile 3/1) small'	One record from James Price Point region and located along the coast in a small patch of dense vegetation located within 2 km of the coast.	Low Dense coastal habitats were not recorded from the Study Areas.	Low Population has only been recorded around the James Price Point area. Habitats within the Study Areas extend across the Dampier Peninsula.
Buthidae			
Lesser Brown Scorpion <i>Isometrus maculatus</i>	Two records from within the Broome town site. No habitat description available.	Medium Habitat unknown however within 10 km of the D2 Study Area.	Not considered an SRE Recorded from across the Australia and into Papua New Guinea. Not considered an SRE.

Species	Previous Records	Likelihood of Occurrence	Potential for Significant Impact
<i>Lychas</i> 'JPP'	21 records from James Price Point (9) and the Sheffield Resources Thunderbird project (12). Locations occur over 80 km apart, with individuals from James Price Point located within 5 km of the coast and Thunderbird individuals associated with the Fraser River Drainage system.	Medium Nearest record located 29 km north of the D2 Study Area. Micro habitats in the Study Areas could be similar to those found in the James price Point and Thunderbird projects.	Low Populations appear to extend into the Dampier Peninsula and habitats associated with these areas are extensively distributed outside of the Study Areas.
Urodacidae			
<i>Urodacus</i> 'fossor?'	One record from Great Northern Hwy approximately 11 km west of D2 (14 km east of G1). No habitat description available.	High Micro habitats in the Study Areas are expected to be similar to those found near the location of the record.	Low Recorded in proximity to the Study Areas however the Pindan Shrubland habitat occurs extensively across the region and the population is expected to be similarly distributed.
<i>Urodacus</i> 'kraepelini'	Six records from across the Dampier Peninsula including one from Broome (Liquorama Store) and one from approximately 8 km east of D2 (18 km west of G1). Habitat described as Pindan Shrubland and Open Woodland.	High Micro habitats in the Study Areas are expected to be similar to those found near the location of the record.	Low Populations appear to extend into the Dampier Peninsula and habitats associated with these areas are extensively distributed outside of the Study Areas.
Crustacea			
Armadillidae			
<i>Buddelundia</i> '43'	Three records from James Price Point region. All records located along the coast in dense coastal vegetation.	Low Dense coastal habitats were not recorded from the Study Areas.	Low Population has only been recorded around the James Price Point area. Habitats within the Study Areas extend across the Dampier Peninsula.
Mollusca			
Camaenidae			
<i>Quistrachia leptogramma</i>	25 records from across the Dampier Peninsula including one from 4 km east southeast of D2. Available habitats described include leaf litter under Ironwood trees (<i>Erythrophleum chlorostachys</i>).	High Micro habitats in the Study Areas are expected to be similar to those found near the location of the record.	Low Populations appear to occur across the Dampier Peninsula and habitats associated with these areas are extensively distributed outside of the Study Areas.
<i>Rhagada bulgana</i>	33 records from across the Dampier Peninsula including one from Broome, 11 km south southwest of D2. Available habitats described include Eucalypt Woodland and also leaf litter under Ironwood trees (<i>Erythrophleum chlorostachys</i>).	High Micro habitats in the Study Areas are expected to be similar to those found near the location of the record.	Low Populations appear to occur across the Dampier Peninsula and habitats associated with these areas are extensively distributed outside of the Study Areas.



Legend

- Site D2
- Site G
- DBCFA Threatened Fauna Database**
- VU
- IA
- OS
- P1
- P3
- P4
- Roads**
- Dual Carriageway
- Minor Road
- Principal Road
- Secondary Road
- Track



0 1 2 3 4 5 km
 Scale 1:250000 @ A4
Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter

Author: AH Approved: DC Date: 15-01-2020

DBCFA Fauna Database Search Results

Proposed Waste Facility

4. DISCUSSION

4.1. Flora

4.1.1. D2 Study Area

4.1.1.1. Threatened and Priority Flora

No Threatened or Priority Flora were recorded from the D2 Study Area during the survey.

One Threatened Flora species, *Seringia exastia* was returned in the database searches and has a Medium Likelihood of Occurrence for the study areas. Some associated species are present, however suitable geological habitat of relict dune systems is not present in the D2 Study Area.

One Priority One species, *Corymbia paractia* is classified as Recorded adjacent to the D2 Study Area as it is known to occur on the boundary of the Study Area, from the Database search results and Literature Review (see Appendix A). The Environs Kimberley targeted flora survey (2018) recorded populations of this species from within the road reserves directly north and east of the D2 Study Area. The D2 Study Area holds suitable habitat for *C. paractia*.

Species distribution mapping (Environs Kimberley 2018), indicated that populations of *C. paractia* potentially occur within the D2 Study Area, with the highest probability of occurrence located adjacent to the west. As discussed in Section 3.3.1, reproductive floristic material is needed to conclusively identify this species. Additional survey effort during more favourable seasonal conditions may aid in confirming this species' presence or absence.

There are five species classified with High Likelihood of occurrence within the study areas (see Appendix A). All have suitable habitat occurring in the D2 Study Area and have known records in the vicinity (within 20 km) of the D2 Study Area. They are discussed in Table 4.1.

Table 4.1: Priority Flora with High Likelihood in the Vicinity of the D2 Study Area

Species (Conservation Significance)	Growth Habit	Known Records within 20 km of the D2 Study Area
<i>Jacquemontia</i> sp. Broome (P1)	Prostrate perennial herb Fl: Mar-May	<ul style="list-style-type: none"> Seven WA Herbarium records Flora, Vegetation and Fauna Assessment – Broome Asparagus Farm (AECOM 2017) Broome Landfill Flora, Vegetation and Fauna Survey (ASTRON 2017) Broome Motorplex Environmental Site Investigation (GHD 2016) Broome Road Industrial Area Targeted Survey (GHD 2018)
<i>Glycine pindanica</i> (P3)	Prostrate perennial herb or climber Fl: Feb/Mar-Jun	<ul style="list-style-type: none"> 17 WA Herbarium records Five TPFL records
<i>Polymeria</i> sp. Broome (P3)	Annual herb Fl: Mar-May	<ul style="list-style-type: none"> Four WA Herbarium records Broome Motorplex Environmental Site Investigation (GHD 2016) Broome Road Industrial Area Targeted Survey (GHD 2018)
<i>Seringia katatona</i> (P3)	Shrub Fl: Mar-Apr	<ul style="list-style-type: none"> Three WA Herbarium records

Species (Conservation Significance)	Growth Habit	Known Records within 20 km of the D2 Study Area
<i>Terminalia kumpaja</i> (P3)	Tree Fl: Oct-Jan Fr: Jun-Aug	<ul style="list-style-type: none"> • Five WA Herbarium records • Broome Motorplex Environmental Site Investigation (GHD 2016)

Three of these species are herbs, seasonal in growth habit; *Jacquemontia* sp. Broome (P1), *Glycine pindanica* (P3) and *Polymeria* sp. Broome (P3). Confirmation of presence for these species would have been difficult during this survey given the poor seasonal conditions (see Section 1.4).

Populations of three Priority flora taxa, *Jacquemontia* sp. Broome (P1), *Polymeria* sp. Broome (P3) and *Terminalia kumpaja* (P3) were identified in the immediate vicinity of the D2 Study Area (within 2 km), from four studies in the Literature Review (see Table 4.1, Map 3.2 and, for locations of the survey areas, Map 1.3). Each of these surveys were conducted during the months immediately following the wet season; March to May (see Table 1.5) further illustrating the presence of these perennial herbs during optimal survey timing, post wet season.

While some of the Priority Flora discussed in Table 4.1 are detectable throughout the year and would have been identified in the Study Area if present; survey timing and poor seasonal conditions prevented the detection of the herbs; *Jacquemontia* sp. Broome (P1) and *Polymeria* sp. Broome (P3). Poor seasonal conditions also inhibited the confirmation of the presence of *Corymbia paractia* (P1) due to the lack of flowering material; despite optimal survey timing. To effectively assess the of presence/absence of these three species at the D2 Study Area, surveying during improved seasonal conditions would ensure the detectability of these species.

One other Priority Flora species, *Aphyllodium parvifolium* (P1), was recorded in the vicinity (20 km) of the D2 Study Area. This has a Medium Likelihood of occurrence. Suitable habitat for this Priority taxa is not present in the D2 Study Area.

4.1.1.2. Local and Regional Significance

The distribution of *Corymbia paractia* (P1) is endemic to the Broome Peninsula occurring throughout and directly to the west of the D2 Study Area (Environs Kimberley, 2018). Although this study did not record *C. paractia*, it is highly likely that surveying in more favourable seasonal conditions will return the presence of this species. Given the small range of this species, any impact to the populations *C. paractia* in this area holds high local and regional significance. Further definition of this population would be favourable.

Three Priority Flora, *Jacquemontia* sp. Broome (P1), *Glycine pindanica* (P3) and *Polymeria* sp. Broome (P3), are known from few records and are possibly restricted in range. Populations of these taxa hold high local and regional significance. Presence/absence of these Priority Flora should be confirmed prior to clearing. If present, impact should be avoided where possible.

The remaining two Priority Flora of High Likelihood, *Seringia katatona* (P3) and *Terminalia kumpaja* (P3), are known from more records and have a greater distribution north and south of the Dampier Peninsula. Populations of these Priority Flora hold moderate local and regional significance. Presence/absence of these Priority Flora should be confirmed prior to clearing. If present, impact should be avoided where possible.

4.1.2. G1 Study Area

4.1.2.1. Threatened and Priority Flora

No Threatened or Priority Flora were recorded from the G1 Study Area during the survey.

One Threatened Flora species, *Seringia exastia* was returned in the database searches and has a Medium Likelihood of Occurrence for the study areas. Some known associated species are present within the Study Area; however, suitable geological habitat of relict dune systems is not present in the G1 Study Area.

One Priority One species, *Corymbia paractia* is classified as Recorded from the Database search results (see Section 3.1 and Appendix A). The G1 Study Area potentially holds suitable habitat for *C. paractia*. Species distribution mapping from the Environs Kimberley targeted search (Environs Kimberley, 2018), indicated that the G1 Study Area is too far east and inland of the species' known distribution. As such, *C. paractia* has a low likelihood of occurrence within the G1 study area.

Of the five species classified with High Likelihood to occur within the study areas (see Appendix A), all have suitable habitat occurring in the G1 Study Area and two are within the vicinity (20 km) of the G1 Study Area. These are discussed in Table 4.2.

Table 4.2: Priority Flora with High Likelihood in the Vicinity of the G1 Study Area

Species (Conservation Significance)	Growth Habit	Known Records within 20 km of the G1 Study Area
<i>Jacquemontia</i> sp. Broome (P1)	Prostrate perennial herb Fl: Mar-May	<ul style="list-style-type: none"> Flora, Vegetation and Fauna Assessment – Broome Asparagus Farm (AECOM 2017)
<i>Polymeria</i> sp. Broome (P3)	Annual herb Fl: Mar-May	<ul style="list-style-type: none"> Four WA Herbarium records Broome Motorplex Environmental Site Investigation (GHD 2016) (exact location of survey area unknown, assumed in close proximity to the study areas) Broome Road Industrial Area Targeted Survey (GHD 2018)

Both *Jacquemontia* sp. Broome (P1) and *Polymeria* sp. Broome (P3), are herbs; seasonal in habit. Confirmation of presence for these species would have been difficult during this survey given the poor seasonal conditions (see Section 1.4). Additional survey effort during more favourable seasonal conditions and during appropriate flowering period (Mar-May) would be required to confirm these species' presence or absence.

Two other Priority Flora are recorded within 20 km of the G1 Study Area. These are:

- *Tetragonia coronata* (P3); 17 km west. Medium Likelihood; and
- *Fuirena incrassata* (P3); 18 m east, Low Likelihood, 2 records.

Suitable habitat for these Priority taxa is not present in the G1 Study Area.

4.1.2.2. Local and Regional Significance

The two Priority Flora in the vicinity of the G1 Study Area, with High Likelihood of occurrence, *Jacquemontia* sp. Broome (P1) and *Polymeria* sp. Broome (P3), are known from few records and are possibly restricted in range. Populations of these taxa hold high local and regional significance. Impact should be avoided where possible.

4.2. Vegetation

4.2.1. D2 Study Area

4.2.1.1. Vegetation Resembling TECs or PECs

Threatened Ecological Communities

No Threatened Ecological Communities were recorded from the D2 Study Area.

Priority Ecological Community; Mangarr (Minyjuru) (17327)

One Priority One Ecological Community was identified during the database searches as intersecting the north-western corner of the D2 Study Area (see Map 3.1). This P1 PEC is Mangarr (Minyjuru) (17327), a relict dune system dominated by extensive stands of Mangarr (Minyjuru) *Sersalisia* formerly (*Pouteria*) *sericea*.

The buffer included on this circular PEC polygon is 500m. It is likely that this PEC surrounds a stand of *Sersalisia sericea* previously recorded from the north-western corner of the D2 Study Area. Given the PEC polygon diameter is 1100-1200m, the population of *Sersalisia sericea* is expected to be spatially constrained. Typically, *Sersalisia sericea* occurs in dune systems closer to the coast, associated with vine thickets, beach forest and monsoon forest. The clearing required for the access tracks and drill pads (25 ha) is unlikely to impact this PEC and associated buffer.

The vegetation and habitat of the D2 Study Area is not typical of the habitat associated with *Sersalisia sericea*. No *S. sericea* was recorded from the current survey. There are 19 records of the Mangarr (Minyjuru) PEC identified within 50 km of the study areas. All of these are small in size (less than 3 km at the widest point) and occur on the peninsula of Broome township. Additional survey effort in the area of D2 within the PEC buffer zone would confirm the presence or absence of this PEC if the area is at risk of being impacted. The 25 ha access tracks and drill pad footprint will also be designed in such a way that this portion of the D2 study area will be avoided.

Communities Considered Significant as Priority Flora Habitat

Habitat for the Priority One Flora *Corymbia paractia* is recorded throughout the D2 Study Area. This species was recorded at the northern and western boundary of this study area during the Environs Kimberley (2018) targeted search for *C. paractia*. Presence of this species at the D2 Study Area and species distribution mapping, indicated that this area has high significance as potential habitat.

PECs in the Vicinity of the D2 Study Area

Conservation significant ecological communities present within 5 km south and west of the D2 Study Area (see Section 3.2) include:

- Roebuck Bay Mudflats; Vulnerable, 1 km south;
- Mangarr (Minyjuru); Priority One; Intersecting, 1.7 km south-east and 3.6 km south-west;
- Kimberley Vegetation Association 770; Priority One, 3.9 km west; and
- Kimberley Vegetation Association 73; Priority Three, 3.2 km west and 3.2 km south.

The above Ecological Communities are riparian and do not resemble the vegetation communities recorded from the D2 Study Area.

4.2.1.2. Local and Regional Significance

The D2 Study Area holds moderate to high local and regional significance for the presence of:

- PEC Mangarr (Minyjuru) (17327); and
- Habitat for the Priority One Flora *Corymbia paractia*.

The PEC Mangarr (Minyjuru) (17327) is considered to have moderate local and regional significance in the D2 Study Area. Given the:

- small size of PEC Mangarr (Minyjuru) (17327) present at the D2 Study Area;
- atypical habitat association with *S. sericea* at the D2 Study Area; and
- small size of other records of the Mangarr (Minyjuru) PEC.

Should the presence of *S. sericea* be confirmed in subsequent surveys of the D2 Study Area, the PEC Mangarr (Minyjuru) (17327) will have greater local and regional significance.

Presence of this species at the D2 Study Area and species distribution mapping, indicated that this area has high local and regional significance as providing habitat for Priority One Flora, *Corymbia paractia*.

4.2.2. G1 Study Area

4.2.2.1. Vegetation Resembling TECs or PECs

There were no vegetation types identified in the current assessment or the desktop assessments resembling PECs or TECs or considered significant due to historical impact from threatening processes, or providing a function to maintain ecological integrity of a significant ecosystem at the G1 Study Area.

The G1 Study Area is located on Pindan Plains which holds potential significance as habitat for Priority One Flora *Corymbia paractia*. Species distribution mapping from the Environs Kimberley targeted search for *C. paractia* in the Broome area (2018), indicated that the G1 Study Area has a low likelihood of providing appropriate habitat for this species to occur.

There are three conservation significant ecological communities present within 10 km south of the G1 Study Area (see Section 3.2). They are:

- Roebuck Bay Mudflats; Vulnerable, 8 km south-west;
- Kimberley Vegetation Association 73; Priority Three, 2.4 km south-east; and
- Roebuck Landsystem; Priority Three, 2.8 km south-east.

All of these Ecological Communities are riparian and do not resemble the vegetation communities recorded from the G1 Study Area.

4.2.2.2. Local and Regional Significance

There were no vegetation types considered to have high local or regional significance in the G1 Study Area.

4.3. Fauna

4.3.1. Fauna Habitats

The fauna habitat types and vertebrate fauna assemblage that was both identified during the literature review and was recorded from the Survey Areas is typical of the wider Dampier Peninsular region and are not considered unique or significant. Extensive areas of similar habitat occur to the north east and further to the south indicating that any vertebrate fauna disturbed by the clearing activities will be able to move away from the site. The proximity to the town of Broome, associated road infrastructure and the presence of feral predator species indicates a moderate level of disturbance that would impact the vertebrate fauna present at the site.

The purpose of the assessment is to determine impacts from clearing of native vegetation to complete preliminary ground disturbance works. The areas to be cleared are considered very small and are relatively widely spaced. The proposed clearing activities are not expected to significantly impact any of the identified conservation significant fauna species that are expected to utilise habitats within the survey area.

4.3.2. Conservation Significant Fauna

The Greater Bilby (*Macrotis lagotis*) is currently listed as Vulnerable under both the *EPBC Act* and the *BC Act*, following the IUCN common assessment method. Although once widespread across arid and semi-arid Australia, the Greater Bilby is now primarily restricted to sandy inland deserts in the north-west of the continent. It can be found in a range of habitats with moderately open ground-level vegetation, from cracking clays to desert sandplains and dune fields with spinifex hummock grasslands and *Acacia* shrubland (Burbidge and Johnson, 2008). On the Dampier Peninsula, it usually prefers open woodland or forest pindan habitat, with less preference for pindan shrubland and other vegetation communities (Southgate, 2012). The Greater Bilby also prefers mixed shrublands dominated by *Acacia* and *Grevillea* along paleo-drainage systems (Southgate and Carthew, 2006). These habitat preferences align closely with the habitat found throughout the study area.

The presence of Greater Bilby was not confirmed during the field survey, however approximately 160 previous records have also been recorded from within 40 km of the Study Areas, and several recent surveys on the Dampier Peninsula have identified signs of Greater Bilby presence. The apparent lack of any burrows or significant foraging activity can only indicate that Greater Bilby were not present at the time of the field survey. Individuals could utilise habitats in either of the Study Areas in the future as home ranges are usually temporary and may suddenly shift when food availability changes (Burbidge and Johnson, 2008). Due to the temporary nature of Greater Bilby presence, a visual check of the area to be cleared should be completed immediately prior to any clearing activity to ensure no active burrows have been created since the field survey. If active burrows are located, a suitable buffer around the burrow should be avoided to limit impacts to any individuals inside the burrow.

The Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*) has been recorded from *Acacia eriopoda* shrubland over *Chrysopogon fallax* grassland habitat during recent surveys conducted near the D2 Study Area. It is likely that the species occurs in this area on an infrequent basis when conditions are suitable due to the limited number of records. The movements patterns and occurrence of the species within the Broome region is not fully understood at the moment but it is likely that the species is a resident in the local area. Due to the large home range of the species, it is unknown how frequent the Spectacled Hare-wallaby would visit either study area; however, the habitat provides suitable conditions and

additional regional records have been made from within 25 km south-east of the Study Area during a previous survey in 2017 (Ecoscape, 2017). Due to the highly mobile nature of Spectacled Hare-wallaby and the high noise and vibrations associated with clearing activity any individuals present within the clearance area are expected to flee the area immediately prior to clearing.

The Northern Brushtail Possum (*Trichosurus vulpecula arnhemensis*) is often recorded from The Broome townsite and is rarely recorded outside of the developed areas. This species prefers habitats that support large hollow bearing trees as they provide shelter with the surrounding habitats used for foraging. No individuals have been recorded from either of the Study Areas however due to its proximity to the Broome townsite, the D2 Study Area would be considered more likely to support this species. No suitably large trees were recorded from the D2 Study Area so this area would only support foraging. Suitable trees were recorded from the G1 Study Area however the likelihood of possums occurring in the areas is slightly lower. Unlike the Spectacled Hare-wallaby, the high noise and vibrations associated with clearing activity would cause any individuals to remain in any shelters such as tree hollows or hollow logs. These habitat structures should be avoided where possible during clearing activities.

Little is known about the ecology of the Dampierland Goanna (*Varanus sparnus*) however it is expected to be very similar to *Varanus brevicauda*, which utilises sandy spinifex dominated habitats. The Dampierland Goanna is thought to utilise the Pindan Shrubland habitats that cover most of the Damper Peninsula and is expected to utilise habitats within both Study Areas. Any individuals present within the clearance area are expected to flee the area immediately prior to clearing due to the high noise and vibrations associated with clearing activities.

The Study Areas do not constitute significant habitat for the six conservation significant bird species considered to have a medium likelihood of occurrence (Gouldian Finch (*Erythrura gouldiae*), Oriental Cuckoo (*Cuculus optatus*), Barn Swallow (*Hirundo rustica*), Fork-tailed Swift (*Apus pacificus*), Grey Falcon (*Falco hypoleucos*) and Peregrine Falcon (*Falco peregrinus*). Any individuals present within the clearance area are expected to flee the area immediately prior to clearing due to the high noise and vibrations associated with clearing activities.

4.3.3. Invertebrate SRE Fauna

Short Range Endemic invertebrates are defined by their dispersal limiting life history strategies. SRE taxa are associated with relictual micro habitats that typically have a higher humidity or moisture availability than the surrounding habitats. Impacts to SRE taxa are of greater concern due to the high potential to impact a large proportion of the total population due to their poor dispersal abilities and the relictual nature of their preferred habitats.

Of the SRE taxa identified from the WAM database searches, only four taxa (*Urodacus* 'fossor?', *Urodacus* 'kraepelini', *Quistrachia leptogramma* and *Rhagada bulgana*) have a high likelihood of occurrence and eight are considered to have a medium likelihood of occurrence (*Aname* 'MYG284', *Aname* 'MYG388', *Kwonkan* 'MYG285' and *Lychas* 'JPP', *Conothele* 'MYG613', *Conothele* 'MYG615', *Conothele* 'MYG616', *Conothele* 'MYG617'). No habitat data is available for the four *Conothele* taxa identified above however a fifth taxa was recorded from remnant rainforest habitat which could form suitable habitat for all the taxa in this genus. Table 3.5 lists the likelihood of occurrence and potential impact to the taxa from the proposed clearing activities. Clearing activity conducted in either Study Area is not expected to have a significant impact.

5. CONCLUSIONS

5.1. Flora

The desktop assessment and literature review revealed five conservation significant flora species with a high likelihood of occurrence at the D2 study area and two species at the G1 study area. The field survey was able to adequately assess the presence or absence of long-lived, perennial species; however, due to poor seasonal conditions, herbaceous species such as *Jacquemontia* sp. Broome (P1), *Glycine pindanica* (P3) and *Polymeria* sp. Broome (P3) were less likely to be present and detectable during the reconnaissance survey. A survey conducted after sufficient rainfall in the period of March to May when these species are flowering would enable confirmation of the presence or absence of these species.

The Priority One tree species, *Corymbia paractia*, is known to occur on the boundary of the D2 Study Area, with previously undertaken distribution modelling (Environs Kimberley, 2018) indicating favourable habitat exists within the D2 Study Area. Despite the reconnaissance survey being undertaken in this species' peak flowering period (November – December), poor seasonal conditions meant that no flowering specimens were observed and therefore the species could not be identified with confidence. This means that this species cannot be said to be absent from the D2 study area and avoidance of impact to Eucalypt/Corymbia species should be minimised.

No introduced flora was recorded from either of the D2 and G1 Study areas.

The D2 Study Area is associated with more Priority Flora records than the G1 Study Area. Thus indicating G1 holds less local and regional conservation significance than the D2 Study Area.

5.2. Vegetation

The vegetation across both D2 and G1 Study Areas was assessed to be in excellent condition, with only minor grazing disturbances. Fire age varied between the Study Areas, with 80% of the G1 Study Area burnt within the last year, the remainder of the areas across D2 and G1 were burnt over five years ago.

Two TECs and four PECs were recorded from within 5 km of either the D2 and G1 Study Areas. However, the habitat assessed within the Study Areas did not resemble any TEC or PECs.

Despite the buffer zone for the P1 PEC, Mangarr (Minyjuru) (17327), being present within the north-western corner of the D2 Study Area, the habitat observed within the D2 Study Area is not typical of the habitat associated with the characteristic species, *Sersalisia sericea*. No *S. sericea* was recorded from the current survey. Additional survey effort in the area of D2 within the PEC buffer zone will confirm the presence or absence of this PEC. The 30 ha infrastructure footprint will also be designed in such a way that this portion of the D2 study area will be avoided.

The habitat within the D2 Study Area is considered significant as it provides suitable habitat for the priority flora species *Corymbia paractia* (P1) and lies within the modelled distribution of the species (Environs Kimberley, 2018).

Vegetation in the G1 Study Area is of lower conservation significance than the D2 Study Area.

5.3. Terrestrial Fauna

Clearing of either Study Area is not expected to significantly impact any terrestrial fauna species identified during this study. Preclearing searches for evidence of active Greater Bilby burrows should be completed immediately prior to any clearing activities.

Both Study Areas contain similar Pindan Shrubland habitats however the D2 Study Area is located closer to coastal habitats which may make it more suitable for some threatened fauna such as the Northern Brushtail Possum and several SRE invertebrate taxa identified from Broome and the James Price Point region.

6. RECOMMENDATIONS

Clearing of the proposed access tracks for site investigation at each of the D2 and G1 Study Areas is considered low impact. The DWER will assess the proposal and provide feedback on the level of further survey requirements; therefore, it is recommended to seek advice from DWER based on the findings and limitations of the reconnaissance survey. DWER will provide additional advice and impose any necessary conditions on the works. The following recommendations based on the results of the reconnaissance survey are made in order to minimise the impact on the environment and maximise the amount of environmental information recorded at the Study Areas to inform future decision making and approvals.

6.1. Flora

- Further survey effort in optimal seasonal conditions and at an appropriate time to detect the high likelihood of occurrence, herbaceous species (*Jacquemontia* sp. Broome (P1), *Polymeria* sp. Broome (P3), and to a lesser degree *Glycine pindanica* (P3)) would be beneficial in confirming their presence or absence within the Study Areas. Information available on the DBCAs database, FloraBase, suggests the optimal time for these herb species to be present and flowering lies between the months of March and May
- Due to the urgency of the project, submitting a clearing permit prior to the March to May period for the installation of temporary access tracks, boreholes and pits is recommended. The permit application could include the following disturbance mitigation measures:
 - Clearing at D2 to avoid Eucalypt/Corymbia species which have the potential to represent the Priority One species, *Corymbia paractia*
 - Clearing at D2 to avoid the north west corner which includes the buffer zone for the Priority One PEC, Mangarr (Minyjuru)
 - Clearing for access tracks and bore sites to be undertaken using a 'Front End Loader' (Wheel Loader) to remove vegetation, while limiting disturbance to the soil surface
 - It is possible that a trained Ecologist, familiar with the conservation significant species, could perform a clearance survey role in front of the machinery whilst clearing is taking place and inform operators to avoid conservation significant species. This will be possible in March when the herbaceous species are most detectable.
 - An experienced Ecologist could provide training to project personnel in the identification of conservation significant species to aid in future avoidance.

6.2. Fauna

- Immediately prior to clearing, a suitable qualified zoologist or country manager should walk along the clearing path to ensure no new active Greater Bilby burrows have been constructed post fauna survey. Clearance areas should be altered to avoid damaging active burrow systems. This activity can be completed in conjunction with cultural monitoring activities.

7. NATIVE VEGETATION CLEARING PRINCIPLES

An assessment on how the proposed vegetation clearing applies to the native vegetation clearing principles is present below in Table 7.1.

Table 7.1: Native Vegetation Clearing Principles

Principle number	Principle	Comment	Outcome
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.	<p>There were three Vegetation Types identified from the study areas derived from flat Pindan Plains. There were 45 taxa from 18 families and 34 genera recorded from five relevé sites. Proportion of flora collected was consistent with expectations for this type of survey and survey timing in the context of other surveys of a similar level and seasonality.</p> <p>Both study areas fall in the 750.1 Pre-European Vegetation mapping classification (see Section 1.6). This vegetation unit covers more than 1.2 million hectares, of which, approximately 99% is undisturbed.</p> <p>Given the species count, vegetation types, literature review and the Pre-European vegetation units, the vegetation at the study areas is not considered to have a high level of biological diversity.</p>	Proposal at the study areas is not at variance with the 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	Pindan Shrubland habitats identified within both Study Areas occur extensively across the Dampier Peninsula and is not considered a significant habitat type. The small area that is proposed to be cleared the Study Areas also limits any potential impacts to terrestrial fauna taxa	Proposal at the study areas is not at variance with the principle.

Principle number	Principle	Comment	Outcome
(c)	Native vegetation should not be cleared if it includes, or is necessary for, the continued existence of rare flora.	<p>No rare or threatened flora were recorded from the study areas. One Threatened flora species <i>Seringia exastia</i> was identified in the database searches. This species is considered to have a medium likelihood of occurrence within the study areas. Suitable habitat for Threatened Flora <i>Seringia exastia</i> is not present at either of the study areas.</p> <p>One Priority One Flora <i>Corymbia paractia</i>, was recorded at the D2 Study Area in the desktop study. The presence of this Priority Flora was unconfirmed in the current survey, though given better seasonal conditions is highly likely to occur throughout.</p> <p>Of the 23 priority flora species returned in the database searches, five were considered to have Highly Likelihood of occurrence in the study areas. All of these Priority Flora have a High Likelihood of occurrence in the D2 Study Area. The D2 Study Area has suitable habitat for each of these taxa. They are:</p> <ul style="list-style-type: none"> • <i>Jacquemontia</i> sp. Broome (P1); • <i>Glycine pindanica</i> (P3); • <i>Polymeria</i> sp. Broome (P3); • <i>Seringia katatona</i> (P3); and • <i>Terminalia kumpaja</i> (P3). <p>Although the D2 Study Area includes conservation significant flora and has appropriate habitat for conservation significant flora, clearing of the D2 Study Area is unlikely to threaten the continued existence of the Priority One Flora, <i>Corymbia paractia</i>, and other Priority Flora with High Likelihood of occurrence. Vegetation at the D2 Study Area is not necessary for the continued existence of this conservation significant flora.</p> <p>No Priority flora were recorded at the G1 Study Area.</p> <p>Of the Five with High Likelihood of occurrence in the study areas, two have suitable habitat in the G1 Study Area. They are:</p> <ul style="list-style-type: none"> • <i>Jacquemontia</i> sp. Broome (P1); and • <i>Polymeria</i> sp. Broome (P3); <p>Although the G1 Study Area has appropriate habitat for conservation significant flora, clearing of the G1 Study Area is unlikely to threaten the continued existence of these priority Flora.</p>	<p>Proposal at the D2 Study Area is somewhat at variance with the principle.</p> <p>The Proposal at the G1 Study Area is not at variance with the principle.</p>

Principle number	Principle	Comment	Outcome
(d)	Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a threatened ecological community.	<p>One federally listed TEC (State listed Vulnerable) was identified from the database searches, Vine Thickets. An additional State listed, Vulnerable Ecological Community, Roebuck Bay mudflats was identified from the database searches. These ecological communities are associated with riparian vegetation and do not resemble any vegetation communities of the study areas.</p> <p>No TECs were recorded within the D2 Study Area. The D2 Study Area does not comprise the whole or part of, or is necessary for the maintenance of a TEC.</p> <p>One P1 PEC was identified as intersecting the north-west corner of the D2 Study Area; Mangarr (Minyjuru) (17327), a relict dune system dominated by extensive stands of Mangarr (Minyjuru) <i>Sersalisia</i> formerly (<i>Pouteria</i>) <i>sericea</i>.</p> <p>No <i>S. sericea</i> was recorded from the current survey. Typically, <i>Sersalisia sericea</i> occurs in dune systems closer to the coast, associated with vine thickets, beach forest and monsoon forest. The vegetation and habitat of the D2 Study Area is not typical of the habitat associated with <i>Sersalisia sericea</i>. Further clarification is needed to confirm presence/absence of the Mangarr (Minyjuru) PEC.</p> <p>There are four PECs within 5 km to the south of the D2 Study Area. Each of these PECs are associated with riparian communities and do not occur at the D2 Study Area.</p> <p>No PECs or TECs were recorded from the G1 Study area. Three PECs are within 10 km to the south of the G1 Study Area. Each of these PECs are associated with riparian communities and do not occur at the G1 Study Area.</p> <p>Native vegetation at the G1 Study Area does not comprise the whole or part of, or is necessary for the maintenance of a TEC.</p>	<p>Proposal at the D2 Study Area may be at variance with the principle.</p> <p>The Proposal at the G1 Study Area is not at variance with the principle.</p>
(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>The Study Area is mapped as 100% 750.1; <i>Acacia tumida</i> shrubland with grey box and cabbage gum medium woodland over ribbon grass & curly spinifex, as defined by Beard (DBCA, 2009).</p> <p>The Pre-European Vegetation Mapping lists this vegetation unit to have cleared is less than 1% of the original extent of this vegetation unit. No vegetation at the Study Areas is significant as a remnant of native vegetation in an area that has been extensively cleared.</p>	<p>Proposal at the study areas is not at variance with the principle.</p>

Principle number	Principle	Comment	Outcome
(f)	Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	<p>There are no water courses, related wetlands or riparian vegetation in the study areas.</p> <p>One Ecological Community associated with a water course and state listed as Vulnerable occurs within 1 kilometre south of the study areas. This is Roebuck bay Mudflats; Species-rich faunal community of the intertidal mudflats of Roebuck Bay.</p> <p>Given the close proximity it is likely that water-flow through the study areas during times of heavy rainfall is associated with the Roebuck bay Mudflats.</p>	Clearing at the study areas is unlikely to be at variance with the principle.
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	<p>The total area to be cleared at the D2 Study Area is 30 ha. The Total area to be cleared at the G1 Study Area is 25 ha.</p> <p>Considering the small area proposed to be cleared, the history of minimal land clearing in the area and existing vegetation condition of the study area, it is unlikely that the proposed clearing will cause appreciable land degradation.</p>	Proposal at the study areas is not at variance with the 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>One Conservation area, Yawuru Birragun Conservation Park (WA_52354) is adjacent, directly to the west of the D2 Study Area.</p> <p>Clearing of approximately 30 ha to establish temporary tracks, bore holes and trial pits at the D2 study area is unlikely to impact the environmental values of the directly adjacent conservation park, Yawuru Birragun.</p> <p>No conservation areas are within the vicinity of the G1 Study Area as defined by the Land Management Act (1984) as National Parks, Nature Reserves, Conservation Reserve or other areas managed for biodiversity conservation.</p> <p>The clearing of vegetation (25 ha) in the G1 Study Area is not considered to impact on the environmental values of any adjacent or nearby conservation area.</p>	<p>Proposal at the D2 Study Area is not at variance with the principle.</p> <p>Proposal at the G1 Study Area is not at variance with the principle.</p>
(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>The proposed clearing of native vegetation at D2 (30 ha) and G1 (25 ha) to establish temporary tracks, bore holes and trial pits at the D2 study area is not expected to cause deterioration in the quality of surface or underground water. However, the study areas are within 1 km of a water course (State listed Vulnerable ecological community, Roebuck bay Mudflats).</p> <p>Further site investigation works including hydrological surveys will provide more information as the project matures.</p>	Proposal at the Study Areas is unlikely to be at variance with the principle.

Principle number	Principle	Comment	Outcome
(j)	Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	The remnant vegetation proposed to be cleared at the D2 and G1 study areas is 30 ha and 25 ha, respectively. These areas are small and are not expected to cause or exacerbate the instance of flooding.	Proposal at the study areas is not at variance with the principle.

8. REFERENCES

- AECOM (2017) *Flora, Vegetation and Fauna Assessment – Broome Asparagus Farm. Unpublished Report for Kimberley Asparagus Pty Ltd.*
- Astron (2017a) *Broome Landfill Flora, Vegetation and Fauna Survey. Unpublished report for the Shire of Broome.*
- Astron (2017b) *Proposed Broome Landfill - Targeted Greater Bilby Survey. Unpublished report for the Shire of Broome.*
- Burbidge, A. A. and Johnson, P. (2008) 'Spectacled Hare-wallaby *Lagorchestes conspicillatus*', in van Dyck, S. and Strahan, R. (eds) *The Mammals of Australia*. 3rd Editio. Sydney, NSW: Reed New Holland, pp. 314–316.
- Bureau of Meteorology (2019) 'Climate Data Online'. Available at: <http://www.bom.gov.au/climate/data/>.
- Department of Biodiversity Conservation and Attractions (2017) 'Priority Ecological Communities for Western Australia Version 27'. Species and Communities Branch, Department of Biodiversity, Conservation and Attractions.
- Department of Biodiversity Conservation and Attractions (2019) 'Conservation Codes for Western Australian Flora and Fauna'. Department of Parks and Wildlife.
- Department of Primary Industry and Regional Development (2019) 'Pre-European Vegetation - Western Australia (NVIS Compliant Version 20110715)'.
- Department of Sustainability Environment Water Population and Communities (2011) 'Survey Guidelines for Australia's Threatened Mammals. Guidelines for detecting mammals listed as threatened under the EPBC Act'.
- Ecoscope (2017) *Nyamba Buru Yawuru Flora and Fauna Survey (Roebuck Station). Unpublished report for Nyamba Buru Yawuru.*
- Environmental Protection Authority (2002) 'EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection'. Environmental Protection Authority.
- Environmental Protection Authority (2004) 'EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia'. Environmental Protection Authority.
- Environmental Protection Authority (2016a) 'EPA Environmental Factor Guideline: Flora and Vegetation'. Environmental Protection Authority.
- Environmental Protection Authority (2016b) 'EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment'. Environmental Protection Authority.
- Environmental Protection Authority (2016c) 'EPA Technical Guidance: Terrestrial Fauna Surveys'. Environmental Protection Authority.
- Environmental Protection Authority (2016d) *Technical Guidance - Sampling methods for terrestrial vertebrate fauna*. Perth, Western Australia.
- Environs Kimberley (2018) *Distribution, ecology and cultural importance of Gunurru or Cable Beach Ghost Gum *Corymbia paractia* in the Broome area, Western Australia*. Broome.
- EPA and DEC (2010) 'EPA & DEC Technical Guide: Terrestrial Vertebrate Fauna Surveys for Environmental

Impact Assessment'. Environmental Protection Authority.

ESCAVI (2003) 'Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0'. Canberra: Executive Steering Committee for Australian Vegetation information. Department of Environment and Heritage.

GHD (2009) *Broome North - Northern Portion (Area B). Preliminary Environmental Impact Assessment and Biological Survey. Unpublished report for Landcorp.*

GHD (2016) *Broome Motorplex: Environmental Site Investigation. Unpublished report for LandCorp.* Perth, WA.

GHD (2018) *Broome Road Industrial Area Targeted Survey. Unpublished report for LandCorp.* Perth, WA.

GHD (2019) *Mamabulanjin Orchard Flora and Fauna Survey. Unpublished report for the Water Corporation.* Perth, WA.

Government of Western Australia (2019) '2018 Statewide Vegetation Statistics Incorporating the CAR Reserve Analysis (Full Report). Current as of December 2018'. Perth: WA Department of Biodiversity, Conservation and Attractions. Available at: <https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics>.

Graham, G. (2002) 'Dampierland 2 (DL2 - Pindanland subregion)', in *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Department of Conservation and Land Management, pp. 179–187.

Schoknecht, N. R. and Payne, A. L. (2011) *Land systems of the Kimberley region, Western Australia*. Department of Agriculture and Food.

Shepherd, D. P., Beeston, G. R. and Hopkins, A. J. M. (2001) *Native vegetation in Western Australia: Extent, type and status. Technical Report 249.*

Southgate, R. (2012) *Peer review of the Browse Bilby Review, a report detailing the consolidated information relating to the occurrence of the Bilby Macrotis lagotis near the proposed Browse LNG Precinct (close to James Price Point) and more broadly on the Dampier Peninsula.*

Southgate, R. *et al.* (2018) 'Verifying bilby presence and the systematic sampling of wild populations using sign-based protocols - with notes on aerial and ground survey techniques and asserting absence', *Australian Mammalogy*.

Southgate, R. and Carthew, S. M. (2006) 'Diet of the Bilby (Macrotis lagotis) in relation to substrate, fire and rainfall characteristics in the Tanami Desert', *Wildlife Research*, 33(6), pp. 507–519.

Thackway, R. and Cresswell, I. D. (1995) 'An Interim Biogeographic Regionalisation for Australia (IBRA)'.

Western Australian Government (2016) *Biodiversity Conservation Act*. Western Australia: Government of Western Australia.

Western Australian Herbarium (2019) 'FloraBase—the Western Australian Flora. Department of Biodiversity, Conservation and Attractions', p. <https://florabase.dpaw.wa.gov.au/>.

Appendix A: Likelihood of Occurrence of Significant Flora



Likelihood	Status	Family	Species	Key to Likelihood	Habitat	Source		
						TPFL	WA Herb	Literature Review
Recorded	1	MYRTACEAE	<i>Corymbia paractia</i>	≈ <5	Flats. Red Pindan sand dunes		•	•
High	1	CONVOLVULACEAE	<i>Jacquemontia sp. Broome (A.A. Mitchell 3028)</i>	≈ ♦	Brown orange sand on plain.		•	•
High	3	FABACEAE	<i>Glycine pindanica</i>	≈ <5	In disturbed pindan soil of roadside edges.	•	•	
High	3	CONVOLVULACEAE	<i>Polymeria sp. Broome (K.F. Kenneally 9759)</i>	≈ <5	Near-coastal plain. And; In red pindan soil on road verge and in drain.		•	•
High	3	MALVACEAE	<i>Seringia katatona</i>	≈ ♦	Red sand. Pindan vegetation. Scattered in open Eucalyptus woodland	•	•	
High	3	COMBRETACEAE	<i>Terminalia kumpaja</i>	≈ ♦	Pindan, sandy.		•	•
Medium	T	MALVACEAE	<i>Seringia exastia</i>	≠	Relict desert dune. Red sand. Peninsula. Red-orange sand.	•	•	
Medium	1	CONVOLVULACEAE	<i>Ipomoea tolmerana subsp. occidentalis</i>	≈	Margin of road in pindan plain. Eucalypt savannah woodland.	•	•	
Medium	3	FABACEAE	<i>Aphyllodium glossocarpum</i>	≈ <5	Margin of track in a pindan plain. Swampy margins of lagoon.		•	
Medium	3	CONVOLVULACEAE	<i>Bonamia oblongifolia</i>	≠	Pindan sandplain. Low-lying, semi-swampy area verging on pindan.		•	
Medium	3	GOODENIACEAE	<i>Goodenia byrnesii</i>	≈	Orange brown silty sand. Open Corymbia woodland.	•	•	
Medium	3	CONVOLVULACEAE	<i>Polymeria sp. Broome (K.F. Kenneally 9759)</i>	≈	Near-coastal plain. And; In red pindan soil on road verge and in drain.		•	
Medium	3	STYLIDIACEAE	<i>Stylidium pindanicum</i>	≠	In damp sand surrounding claypan		•	
Medium	3	FABACEAE	<i>Tephrosia pedleyi</i>	≈	Pindan Sandplain. Deep red sands on gently undulating sandplain. Yeeda Land System.		•	
Medium	3	AIZOACEAE	<i>Tetragonia coronata</i>	≠ <5	Cultivated pindan plain. Market garden.		•	
Low	1	ASTERACEAE	<i>Thespidium basiflorum</i>	≠	black soil with white sand. Melaleuca forest.		•	
Low	1	FABACEAE	<i>Aphyllodium parvifolium</i>	≠ ♦	In greyish pindan soil immediately adjacent to creek.		•	•
Low	2	AMARANTHACEAE	<i>Gomphrena pusilla</i>	≠	Coastal dune slope. Calcareous sand, sandstone. Sandy area between vine thickets.	•	•	
Low	3	CYPERACEAE	<i>Fuirena incrassata</i>	≠ ♦	On ironstone in grey sandy clay by quarry.	•	•	
Low	3	FABACEAE	<i>Acacia monticola x tumida var. kulparn</i>	≠	Exposed coastal cliff top site.		•	
Low	3	MYRTACEAE	<i>Lophostemon grandiflorus subsp. grandiflorus</i>	≠	Drainage basin. Salmon coloured sandy loam; grey		•	

Likelihood	Status	Family	Species	Key to Likelihood	Habitat	Source		
						TPFL	WA Herb	Literature Review
					brown sand			
Low	3	MENYANTHACEAE	<i>Nymphoides beaglensis</i>	≠ ♦	Grey/brown mud on the edge of a shallow pool. Floating aquatic herb.	•	•	
Low	3	STYLIDIACEAE	<i>Stylidium costulatum</i>	≠	In soakage area; Riparian woodland, Melaleuca viridiflora,		•	
Low	4	PITTOSPORACEAE	<i>Pittosporum moluccanum</i>	≠ ♦	Coastal sand dune crest and swales. Calcareous pale orange sand; Vine thicket in coastal dune pocket (leeward side of dune).	•	•	

Key to Likelihood: ≠ Habitat not present, ≈ Suitable habitat present, 5> recorded within 5 km of the Study Area, ♦ recorded more than 5 km but within 40 km of the study areas.

Appendix B: Relevé Site Data Collection Sheet





Details included in Relevé Sampling


- Site code, date; location;
- Botanist;
- Photograph;
- Vegetation condition (as defined in Table 2.2);
- Disturbances (grazing, weeds, tracks, mounds, litter, erosion, clearing etc.);
- Time since fire (<1 year, 1-2 years, 2-5 years, >5 years); and
- Landform, geology and soils, consistent with the Australian soils and land survey field handbook (National Committee on Soil and Terrain, 2009), including:
 - Flat: plain
 - Flat: valley floor
 - Flat: tidal
 - Slope: lower, mid, upper
 - Slope: cliff
 - Slope: simple
 - Slope: simple dune
 - Hillock
 - Crest: hill
 - Crest: dune
 - Crest: mesa
 - Ridge: hill
 - Ridge: dune
 - Open depression: drainage line
 - Open depression: creek/river
 - Open depression: floodplain
 - Closed depression: Lake edge
 - Closed depression: Swamp edge
 - Drainage line on slope: lower, mid, upper
- Slope: Level <1°, Very gentle 1°, Gentle 3°, Moderate 10°, Steep 23°, Very steep 37°, Precipitous 60° and Cliff 80°;
- Aspect: North, South, East, West;
- Soil: Sand, Clay, Loam, Sandy-clay, Hard-clay, Cracking-clay and Saline;
- Soil Colour: Dark, Light, Red, Orange, White, Grey, Brown, Black and Yellow;
- Rock Type: BIF, Calcrete, Creek stones, Dolerite, Granite, Ironstone, Shale, Quartz and Other;
- Rock Abundance: No rocks, Very few (<2%), Few (2-10%), Common (10-20%), Many (20-50%), Abundant (50-90%) and Continuous (>90%); and
- Rock Size: Fine gravel (<6 mm), Medium gravel (6-20 mm), Coarse gravel (20-60 mm), Cobbles (60-200 mm), Stones (200-600 mm) and Boulders (>600 mm).
- Dominant species – Crown cover (%) and Height (m); and
- Vegetation structure - NVIS Level V: three dominant species in three strata: upper, middle and ground (ESCAVI, 2003).


Appendix C: Relevé Site Data




Study area:	G1	
Landform:	Flat, Plain	
Slope, aspect:	1° - Very Gentle	
Soil:	Orange Sand; Clay;	
Rocks:	-	
Abundance:	No rocks	
Size:	-	
Fire:	1 - 2 years	
Condition:	Excellent, Grazing (Low)	
Notes:	-	
Veg Unit:	2	
Location:	POINT (122.5190795 -17.835792)	
Vegetation description		
<i>Bauhinia cunninghamii</i> open woodland over <i>Acacia eriopoda</i> and <i>A. platycarpa</i> sparse shrubland over <i>Grewia rustifolia</i> and <i>Pterocaulon intermedium</i> isolated clumps of heath shrubs over <i>Chrysopogon fallax</i> isolated clumps of tussock grasses. .		

Study area:	G1	
Landform:	Flat, Plain	
Slope, aspect:	1° - Very Gentle	
Soil:	Orange Sand; Clay;	
Rocks:	-	
Abundance:	No rocks	
Size:	-	
Fire:	<1 year	
Condition:	Excellent	
Notes:	-	
Veg Unit:	3	
Location:	POINT (122.5249032 -17.8313439)	
Vegetation description		
<i>Brachychiton diversifolius</i> ssp. <i>diversifolius</i> , <i>Corymbia flavescens</i> , <i>C. greeniana</i> and <i>Eucalyptus tectifica</i> open woodland over <i>Acacia eriopoda</i> sparse shrubland over <i>Corchorus sidoides</i> isolated clumps of heath shrubs over <i>Chrysopogon fallax</i> and <i>Sorghum plumosum</i> isolated clumps of tussock grasses.		

Study area:	G1	
Landform:	Flat, Plain	
Slope, aspect:	1° - Very Gentle	
Soil:	Orange Sand; Clay;	
Rocks:	-	
Abundance:	No rocks	
Size:	-	
Fire:	2 - 5 years	
Condition:	Excellent	
Notes:	-	
Veg Unit:	3	
Location:	POINT (122.5258259 -17.8347282)	
Vegetation description		
<i>Bauhinia cunninghamii</i> , <i>Corymbia flavescens</i> and <i>C. greeniana</i> open woodland over <i>Acacia eriopoda</i> sparse shrubland over <i>Sorghum plumosum</i> sparse tussock grassland over <i>Triodia ?caelestialis</i> isolated clumps of hummock grasses		

Study area:	D2	
Landform:	Flat, Plain	
Slope, aspect:	1° - Very Gentle	
Soil:	Red Orange Sand; Clay;; Clay;	
Rocks:	-	
Abundance:	No rocks	
Size:	-	
Fire:	>5 years	
Condition:	Excellent	
Notes:	-	
Veg Unit:	1	
Location:	POINT (122.2707153 -17.8704444)	
Vegetation description		
<i>Corymbia greeniana</i> isolated clumps of trees over <i>Acacia eriopoda</i> open shrubland over <i>Acacia adoxa</i> var. <i>subglabra</i> isolated clumps of heath shrubs over <i>Chrysopogon fallax</i> , <i>Aristida inaequiglumis</i> isolated clumps of tussock grasses.		

Study area:	D2	
Landform:	Flat, Plain	
Slope, aspect:	1° - Very Gentle	
Soil:	Orange Sand; Clay;	
Rocks:	-	
Abundance:	No rocks	
Size:	-	
Fire:	>5 years	
Condition:	Excellent	
Notes:	-	
Veg Unit:	1	
Location:	POINT (122.2718877 -17.8613389)	
Vegetation description		
<i>Acacia eriopoda</i> , <i>A. colei</i> , <i>Ficus aculeata</i> sparse shrubland over <i>Chrysopogon fallax</i> and <i>Sorghum plumosum</i> isolated clumps of tussock grasses over <i>Triodia ?caelestialis</i> sparse hummock grassland.		

Appendix D: Species List – Flora



Family	Species
APOCYNACEAE	<i>Carissa lanceolata</i>
ASTERACEAE	<i>Pterocaulon intermedium</i>
COMBRETACEAE	<i>Terminalia canescens</i>
	<i>Terminalia ferdinandiana</i>
BORAGINACEAE	<i>Ehretia saligna</i> var. <i>saligna</i>
	<i>Trichodesma zeylanicum</i>
FABACEAE	<i>Acacia adoxa</i> var. <i>subglabera</i>
	<i>Acacia coleii</i>
	<i>Acacia eriopoda</i>
	<i>Acacia platycarpa</i>
	<i>Bauhinia cunninghamii</i>
	<i>Crotalaria medicaginea</i>
	<i>Cullen corallum</i>
	<i>Galactia tenuiflora</i>
	<i>Senna notabilis</i>
GYROSTEMONACEAE	<i>Codonocarpus cotinifolius</i>
MALVACEAE	?MALVACEAE
	<i>Brachychiton diversifolius</i> ssp. <i>diversifolius</i>
	<i>Corchorus sidoides</i>
	<i>Grewia brevifolia</i>
	<i>Grewia pindanica</i>
MOLLUGINACEAE	<i>Trigastrotheca molluginea</i>
MORACEAE	<i>Ficus aculeata</i>
MYRTACEAE	<i>Corymbia flavescens</i>
	<i>Corymbia greeniana</i>
	<i>Corymbia zygophylla</i>
	<i>Eucalyptus tectifera</i>
PHYLLANTHACEAE	? <i>Phyllanthus</i> sp.
PLANTAGINACEAE	<i>Stemodia lathraia</i>
POACEAE	<i>Aristida ?inaequiglumis</i>
	<i>Aristida holathera</i>
	<i>Chrysopogon fallax</i>
	POACEAE sp.
	<i>Sorghum plumosum</i>
	<i>Triodia ?caelestialis</i>
	<i>Triodia</i> sp.
PROTEACEAE	<i>Grevillea pyramidalis</i>
	<i>Hakea macrocarpa</i>
	<i>Persoonia falcata</i>
RHAMNACEAE	<i>Ventilago viminalis</i>
RUBIACEAE	<i>Dentella misera</i>
	<i>Gardenia pyriformis</i> ssp. <i>keartlandii</i>
	<i>Spermacoce occidentalis</i>
SANTALACEAE	<i>Santalum lanceolatum</i>
SAPINDACEAE	<i>Atalaya hemiglauca</i>