

WARRIRDA ROAD DETAILED & TARGETED FLORA & BASIC FAUNA ASSESSMENT

PREPARED FOR: MAIN ROADS WESTERN
AUSTRALIA



Spectrum
ECOLOGY & SPATIAL



© 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:	Warrirda Road Detailed & Targeted Flora & Basic Fauna Assessment		
Prepared For:	Main Roads Western Australia		
Project ID:	2056		
Version History	Authors	Reviewer	Date of Issue
V1	Roberta Dayrell (flora) Nicola Palmer (fauna)	Melissa Hay Astrid Heidrich	09-Jul-2021
V2	Susan Murrey (Flora) Nicola Palmer (fauna)	Melissa Hay Astrid Heidrich	20-Oct-2021
V3	Melissa Hay	Melissa Hay	2-Feb-2022
V4	Melissa Hay	Melissa Hay	28-Jul-2022

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.....	3
1.1. PROJECT BACKGROUND.....	3
1.2. SCOPE OF WORK.....	3
1.3. LEGISLATION & GUIDANCE.....	3
1.4. BIOREGION & CLIMATE.....	5
1.5. DISTURBANCE HISTORY & LAND USE.....	5
1.6. GEOLOGY.....	6
1.7. LAND SYSTEMS.....	8
1.8. PRE-EUROPEAN BEARD VEGETATION MAPPING.....	10
1.9. SIGNIFICANT LANDS.....	12
1.9.1. Conservation Estate.....	12
1.9.2. Environmentally Sensitive Areas.....	12
1.9.3. Australian Wetlands Database.....	12
2. METHODS.....	14
2.1. SURVEY TIMING.....	14
2.2. PROJECT TEAM & LICENCES.....	15
2.3. FLORA NOMENCLATURE, SPECIMEN IDENTIFICATION & LODGEMENT.....	15
2.4. SIGNIFICANT FLORA, VEGETATION & FAUNA DEFINITIONS.....	15
2.5. INTRODUCED FLORA & DECLARED PLANTS.....	16
2.6. DESKTOP ASSESSMENT.....	16
2.6.1. Previously Conducted Flora & Fauna Assessments.....	16
2.6.2. Likelihood of Occurrence Assessment.....	19
2.7. FLORA & VEGETATION ASSESSMENT.....	20
2.7.1. Field Methods.....	20
2.7.2. Vegetation Mapping.....	20
2.7.3. Vegetation Condition.....	21
2.7.4. Significant Flora Targeted Searches.....	21
2.8. TERRESTRIAL FAUNA ASSESSMENT.....	23
2.8.1. Field Methods.....	23
2.8.2. Fauna Habitat Mapping.....	23
2.9. LIMITATIONS & CONSTRAINTS.....	25
3. RESULTS & DISCUSSION – FLORA & VEGETATION.....	27
3.1. DESKTOP ASSESSMENT.....	27
3.1.1. Conservation Significant Flora.....	27
3.1.2. TEC, PECs & Other Significant Vegetation.....	28
3.2. FLORA ASSESSMENT.....	30
3.2.1. General Flora.....	30
3.2.2. Species Accumulation Curve.....	30
3.2.3. Significant Flora.....	31
3.2.4. Introduced Flora.....	34
3.3. FIELD VEGETATION ASSESSMENT.....	36

3.3.1.	Vegetation Types	36
3.3.2.	Significant Vegetation	37
3.3.3.	Vegetation Condition	49
4.	RESULTS & DISCUSSION – FAUNA	58
4.1.	FAUNA DESKTOP ASSESSMENT	58
4.1.1.	Short Range Endemic Invertebrates	58
4.2.	TERRESTRIAL FAUNA ASSESSMENT	64
4.2.1.	Fauna Habitat Types	64
4.2.2.	Vertebrate Fauna	71
4.2.3.	Significant Fauna	72
4.2.4.	Mammals	82
4.2.5.	Birds	82
5.	CONCLUSION	87
5.1.	FLORA	87
5.2.	VEGETATION	87
5.3.	FAUNA	88
6.	REFERENCES	89

TABLES

Table 1.1:	Geological Units	6
Table 1.2:	Land Systems	8
Table 1.3:	Beard Vegetation Sub-Associations	10
Table 1.4:	Significant Lands within the Vicinity of the Survey Area	12
Table 2.1:	Project Team & Licences	15
Table 2.2:	Desktop Assessment Sources	16
Table 2.3:	Summary of Previous Assessments Undertaken in the Vicinity of the Survey Area	18
Table 2.4:	Likelihood of Occurrence Assessment Criteria	19
Table 2.5:	Flora & Vegetation Survey Technique	20
Table 2.6:	Vegetation & Condition Scale – Eremaean Botanical Province	21
Table 2.7:	Fauna Survey Techniques	23
Table 2.8:	Limitations & Constraints – Flora & Fauna Assessment	25
Table 3.1:	Significant Flora Recorded from Desktop Assessment	27
Table 3.4:	PECs Recorded from Desktop Assessment	28
Table 3.2:	Priority Flora Recorded at the Survey Area	32
Table 3.3:	Introduced Flora Recorded at the Survey Area	34
Table 3.5:	Local & Regional Significance of Significant Vegetation Types	37
Table 3.6:	Vegetation Types Recorded at the Survey Area	38
Table 3.7:	Vegetation Condition Recorded at the Survey Area	49
Table 4.1:	Summary of Vertebrate Fauna Species Previously Recorded	58
Table 4.2:	Potential SRE Invertebrate Species Returned in the Database Search	59
Table 4.3:	Fauna Habitat Types Recorded at the Survey Area	64
Table 4.4:	Fauna Species Recorded at the Survey Area	71
Table 4.5:	Significant Fauna Species Likely to Occur	73
Table 4.6:	Shorebirds of the East Asian-Australasian Flyway that Potentially Occur at the Survey Area	82

FIGURES

Figure 1.1: IBRA Classification of the Survey Area	5
Figure 2.1: Rainfall Data for Onslow, WA (BOM Station #5017)	14
Figure 3.1 Species Accumulation Curve	30
Figure 3.2: Dendrogram of Floristic Analysis.....	36

MAPS

Map 1.1: Survey Area Location.....	4
Map 1.2: Geological Units (1:500,000)	7
Map 1.3: Land Systems.....	9
Map 1.4: Beard Vegetation Sub-Associations	11
Map 2.1: Location of Previous Surveys	17
Map 2.2: Sampling Effort – Flora & Vegetation	22
Map 2.3: Sampling Effort – Fauna.....	24
Map 3.1: Desktop Assessment Significant Flora	29
Map 3.2: Priority Flora Recorded at the Survey Area.....	33
Map 3.3 Introduced Flora Recorded at the Survey Area	35
Map 3.4: Vegetation Types – Overview.....	41
Map 3.5: Vegetation Types – Map A	42
Map 3.6: Vegetation Types – Map B	43
Map 3.7: Vegetation Types – Map C	44
Map 3.8: Vegetation Types – Map D.....	45
Map 3.9: Vegetation Types – Map E.....	46
Map 3.10: Vegetation Types – Map F	47
Map 3.11: Vegetation Types – Map G.....	48
Map 3.12: Vegetation Condition – Overview	50
Map 3.13: Vegetation Condition – Map A	51
Map 3.14: Vegetation Condition – Map B.....	52
Map 3.15: Vegetation Condition – Map C	53
Map 3.16: Vegetation Condition – Map D	54
Map 3.17: Vegetation Condition – Map E.....	55
Map 3.18: Vegetation Condition – Map F	56
Map 3.19: Vegetation Condition – Map G	57
Map 4.1: Desktop Assessment Significant Fauna	61
Map 4.2: Desktop Assessment Migratory Birds	62
Map 4.3: Desktop Assessment Short Range Endemic Invertebrates.....	63
Map 4.4: Fauna Habitats.....	70
Map 4.5: Significant Fauna Recorded	81

APPENDICES

Appendix A: Conservation Codes.....	93
Appendix B: Flora Quadrat & Relevé Site Data.....	99
Appendix C: Significant Flora Likelihood of Occurrence	111
Appendix D: Site by Species Matrix.....	113
Appendix E: Fauna Desktop Assessment	121

EXECUTIVE SUMMARY

Mineral Resources (MRL) haul iron ore from their west Pilbara projects to the Port of Ashburton. A new private road is required for Heavy Vehicles (HV) (i.e., not road legal) for haulage to the Port from the Storage area. The new private road will be constructed adjacent to Onslow and Warrirda Roads and a fence will be erected between the private and state roads. The Survey Area is 372.2 ha and is located approximately 12 km south of Onslow in the Shire of Ashburton.

Main Roads Western Australia requires a biological survey to delineate key flora, fauna, soil, and surface water values (wetlands) and potential sensitivity to impact for the project. Spectrum Ecology has been engaged to conduct a desktop assessment, detailed flora, targeted flora & basic fauna assessment of the HV Carriageway in Warrirda Road Reserve (the Survey Area). The outcome of the survey and information supplied in the biological survey report will be used to inform the environmental assessment and approvals process. The results of the biological survey may also assist in the preparation of Environmental Impact Assessment documentation.

The assessment was undertaken from 4 to 7 May 2021 by Principal Botanist Melissa Hay and Principal Zoologist Astrid Heidrich. Autumn is considered the optimal time to conduct flora assessments in the Carnarvon region and thus this survey was undertaken at the appropriate time of year. There was higher than median rainfall at the Survey Area in the three months prior to the survey, providing optimal conditions for flora species growth.

Twelve quadrats and 13 relevés were sampled during the flora assessment along with 65 km of targeted flora traverses. The targeted flora traverses were undertaken at a spacing of approximately 20–40 m through all potential habitat for Priority Flora. A total of 23 fauna sites were surveyed throughout the Survey Area.

Flora

No Threatened flora taxa were recorded during the desktop assessment or considered likely to occur within the Survey Area.

Two Priority 3 flora species were recorded within the Survey Area during the desktop and current field assessment: *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata*.

Eremophila forrestii subsp. *viridis* was recorded widespread across the swales and footslopes of the sand dunes, with 1,073 individuals recorded, of which 123 individuals were recorded outside the Survey Area. It was assigned a low local significance as it is known from four locations in the local area and was recorded widespread across the sand dunes of the Survey Area, and a low regional significance as it is known from scattered locations across Western Australia.

Triumfetta echinata was recorded scattered along the dune crests with 103 individuals recorded, of which one was recorded outside the Survey Area. It was assigned a low local significance as it is known from six locations in the area, and a low regional significance as it has been recorded across three IBRA regions.

None of the seven additional significant flora species recorded during the desktop assessment, were considered likely to occur in the Survey Area following the survey and no range extensions or species of other significance were recorded.

Vegetation

A total of eight vegetation types were described from the Survey Area, mapped across sandy-clay plains, claypans, sand dunes, and drainage lines. Four types were derived from floristic analysis of quadrat data,

with floristic vegetation type P1 further split into two structural types (P1a and P1b), based on level of dominance of **Cenchrus ciliaris* in the understorey stratum. Four vegetation types were classified structurally, as these units were in Degraded or Completely Degraded condition, or where there was no vegetation (i.e. tidal flats).

The Survey Area was dominated by vegetation type P1, which was characterised by isolated overstorey species including *Acacia tetragonophylla* or *Acacia synchronicia*, over *Triodia epactia* hummock grassland or **Cenchrus ciliaris* tussock grassland.

No vegetation recorded at the Survey Area resembles any known TEC or PEC communities.

Based on the definitions of significant vegetation listed in section 2.4 (EPA 2016a) vegetation Type D1 is considered significant as it acts as a role as refuge (providing habitat) for the two Priority 3 flora species, *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata*, found exclusively on the dunes and this vegetation type.

Vegetation type D1 is likely to be widespread in the local area as dune landforms are common. Vegetation type D1 is mapped as 77 ha of the Survey Area. There is 20,512 ha of the Dune land system mapped in the desktop Study Area, therefore of the potential habitat for vegetation type D1 within the desktop Study Area, 0.3% is mapped within the Survey Area.

The Dune land system is mostly restricted to small patches along the coastline of the Carnarvon region. Within the Carnarvon region there is 37,448 ha or 84% of the total area (44,402 ha in Western Australia) of the Dune land system mapped within. The Onslow land system extends 100 km further east into the Pilbara region along the coastline and may provide some habitat for vegetation type D1 however as the habitats within this land system are not dominated by dune landforms, it is not likely to be widespread. Therefore vegetation type D1 is likely to be restricted regionally.

The vegetation condition within the Survey Area ranged from Very Good (49.1%) to Completely Degraded (18.7%) and varied within vegetation types based on previous disturbances and proximity to the road verge. Weeds were common, with **Cenchrus ciliaris* (Buffel Grass) recorded commonly across the Survey Area, especially along the roadside, and forming the dominant understory species in three vegetation types (P1b, P3, DL1) and **Prosopis pallida* (Mesquite) forming the dominant structural overstorey component in vegetation type P3.

Fauna

A desktop assessment identified two species of significance to have been recorded within the Survey Area in previous surveys – Oriental Pratincole and Caspian Tern. A further 25 species were assessed to have a High likelihood of occurrence at the Survey Area including one mammal and 24 birds. Eleven species were assessed to have a Medium likelihood of occurrence, and 19 species were assessed to have a Low to Very Low likelihood of occurrence.

Five fauna habitat types were recorded: Sand Plains, Sand Dunes, Tidal Mudflats and Claypans, Tecticornia Shrubland and Tall Mesquite Shrubland. There were 44 vertebrate species recorded during the field assessment including two significant fauna species – one Little Tern and two Gull-Billed Terns (both species EPBC Act and BC Act Migratory).

The Tidal Mudflats and Claypans habitat provides suitable foraging habitat for water and shorebirds including migratory species. The Sand Plains provide suitable habitat for the Northern Short-tailed Mouse.

1. INTRODUCTION

1.1. Project Background

Mineral Resources (MRL) haul iron ore from their west Pilbara projects to the Port of Ashburton. A new private road is required for Heavy Vehicles (HV) (i.e., not road legal) for haulage to the Port from the Storage area. The new private road will be constructed adjacent to Onslow and Warrirda Roads and a fence will be erected between the private and state roads. The Survey Area is 372.2 ha and is located approximately 12 km south of Onslow in the Shire of Ashburton, the desktop Study Area consists of a 40km buffer of the Survey Area (Map 1.1).

1.2. Scope of Work

Main Roads Western Australia (Main Roads) requires a biological survey to delineate key flora, fauna, soil, and surface water values (wetlands) and potential sensitivity to impact for the project. Spectrum Ecology has been engaged to conduct a desktop assessment, detailed flora, targeted flora & basic fauna assessment of the HV Carriageway in Warrirda Road Reserve Project Area.

1.3. Legislation & Guidance

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

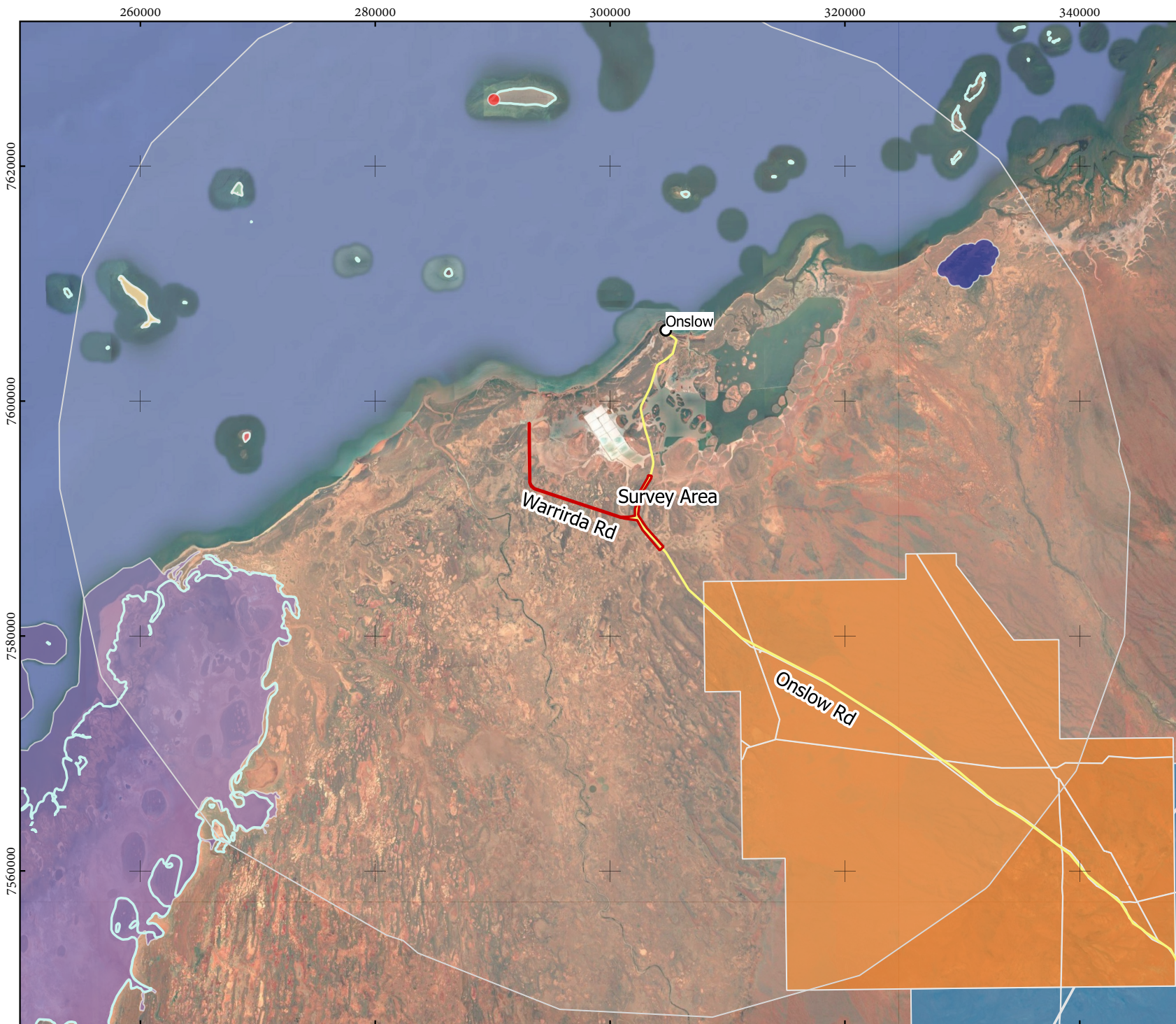
- Biodiversity Conservation Act 2016 (Western Australian Government, 2016);
- Environmental Protection Act 1986 (Western Australian Government, 1986); and
- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act);

The survey was compliant with survey guidelines, as outlined in:

- EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2016c);
- EPA Technical Guidance Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2020)
- EPA Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna (Environmental Protection Authority, 2016e).

This assessment was also consistent with the following guidelines and standards:

- EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (Environmental Protection Authority, 2002);
- EPA Environmental Factor Guideline: Flora and Vegetation (Environmental Protection Authority, 2016b);
- DBCA Threatened and Priority Flora Report Form – Field Manual (Department of Biodiversity Conservation and Attractions, 2017b);
- National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual (ESCAVI, 2003);
- EPA & DEC Technical Guide: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA and DEC, 2010);
- Main Roads Environment and Heritage Data Standards (revision 6, June 2020); and



Legend

- Survey Area
- Desktop Study Area
- Project Roads
- Environmentally Sensitive Area
- Important Wetlands in Australia
- Conservation Estates**
- WA_29011
- CWTH_N7038
- WA_33834
- WA_44665
- WA_44666
- WA_46122
- PEC**
- Peedamulla
- Coastal dune native tussock grassland



0 3 6 9 12 15 km
Scale 1:450000 @ A4

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



Author: RD

Date: 28-09-2021

Survey Area Location

HV Carriageway in Warrirda Road Reserve

Prepared for
Main Roads
Western Australia

MAP
1.1

1.4. Bioregion & Climate

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

The Survey Area is situated in the Carnarvon IBRA region which is made up of two subregions: the Cape Range and Wooramel subregions. The Survey Area is located within the Cape Range subregion (Figure 1.1). The vegetation of the Carnarvon region consists of a mosaic of saline alluvial plains with samphire and saltbush low shrublands, Bowgada low woodland on sandy ridges and plains, Snakewood scrubs on clay flats, and tree to shrub steppe over hummock grasslands on and between red sand dune fields. Limestone strata with *Acacia startii* and *Acacia bivenosa* shrublands outcrop in the north, where extensive tidal flats in sheltered embayments support Mangroves. The Cape Range subregion is characterised by limestone ranges and extensive areas of red dunefields, coastal beach dunes and mud flats. The climate is arid, semi-desert to subtropical climate, with variable summer and winter rainfall; cyclonic activity can be significant (Kendrick and Mau, 2001).



Figure 1.1: IBRA Classification of the Survey Area

1.5. Disturbance History & Land Use

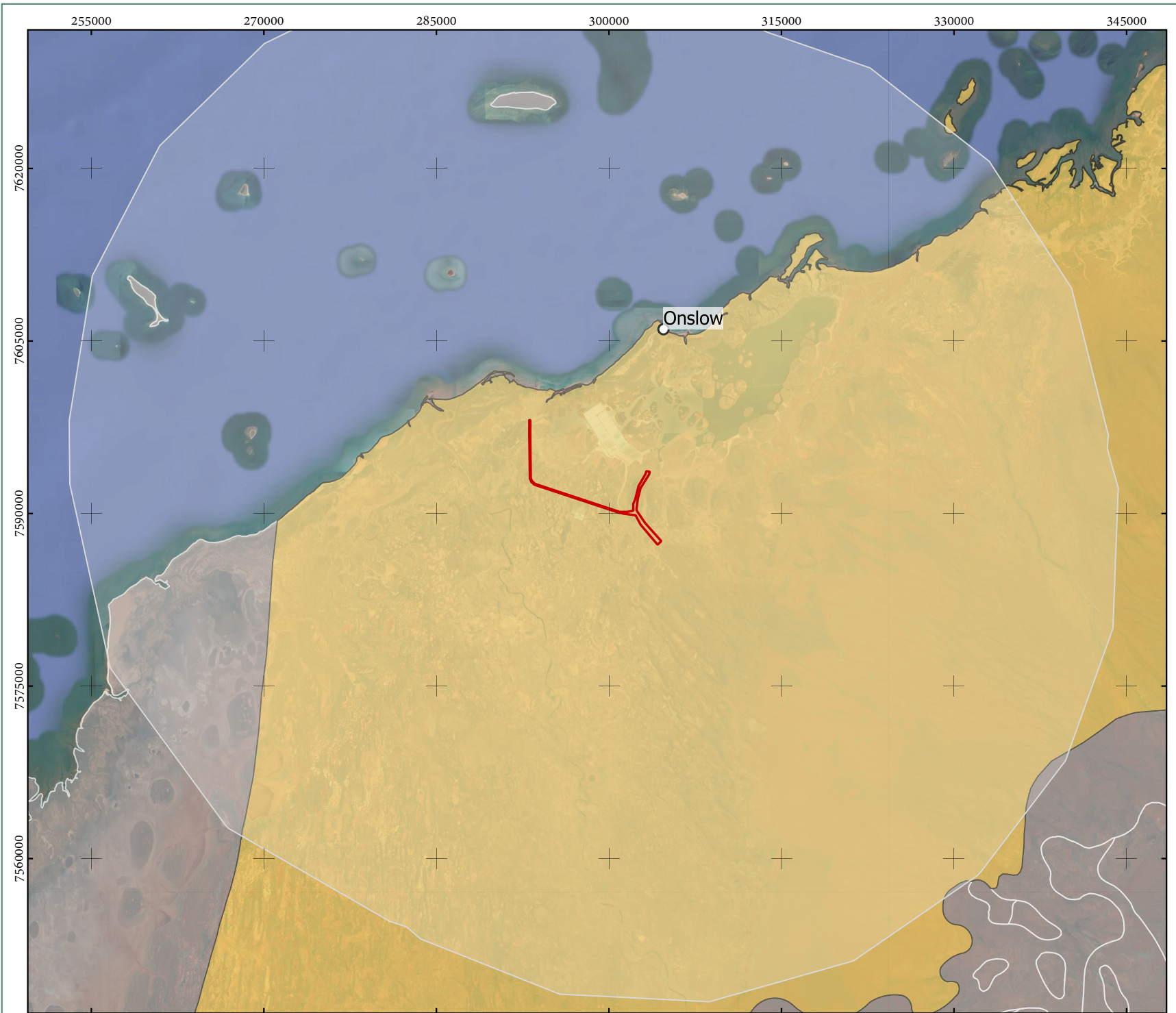
The Cape Range subregion is mainly used for grazing (native pastures), conservation, mining and urban/industrial zones, and has only 2.2% of its area in conservation reserve (IUCN I-IV) (Kendrick and Mau, 2001).

1.6. Geology

The surface geology of Western Australia has been mapped into various geological units at a scale of 1:500,000 (Department of Mines Industry Regulation and Safety, 2020). The entirety of the Survey Area falls within unit K-WN-sf (Table 1.1, Map 1.2). This unit is widespread across the Carnarvon region with 79% of its total extent occurring within the region. Less than 0.1% of its regional extent occurs within the Survey Area.

Table 1.1: Geological Units

Formation	Unit	Description	Area in Survey Area (ha)	% of Survey Area	Total WA Extent (ha)	Total Carnarvon Extent (ha)	% of Carnarvon Extent Within Survey Area
Winning Group	K-WN-sf	Shale, siltstone, marl, and basal sandstone; commonly glauconitic; radiolarian siltstone in central part.	372.2	100	2,794,083	2,194,354	<0.1



Legend

- Survey Area
- Desktop Study Area
- Geology**
- K-WN-sf

0 4 8 12 km
 Scale 1:450000 @ A4
Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter

Author: RD Date: 01-10-2021

**Geological Units
(1:500,000)**

HV Carriageway in Warrirda Road Reserve

Prepared for
Main Roads
Western Australia

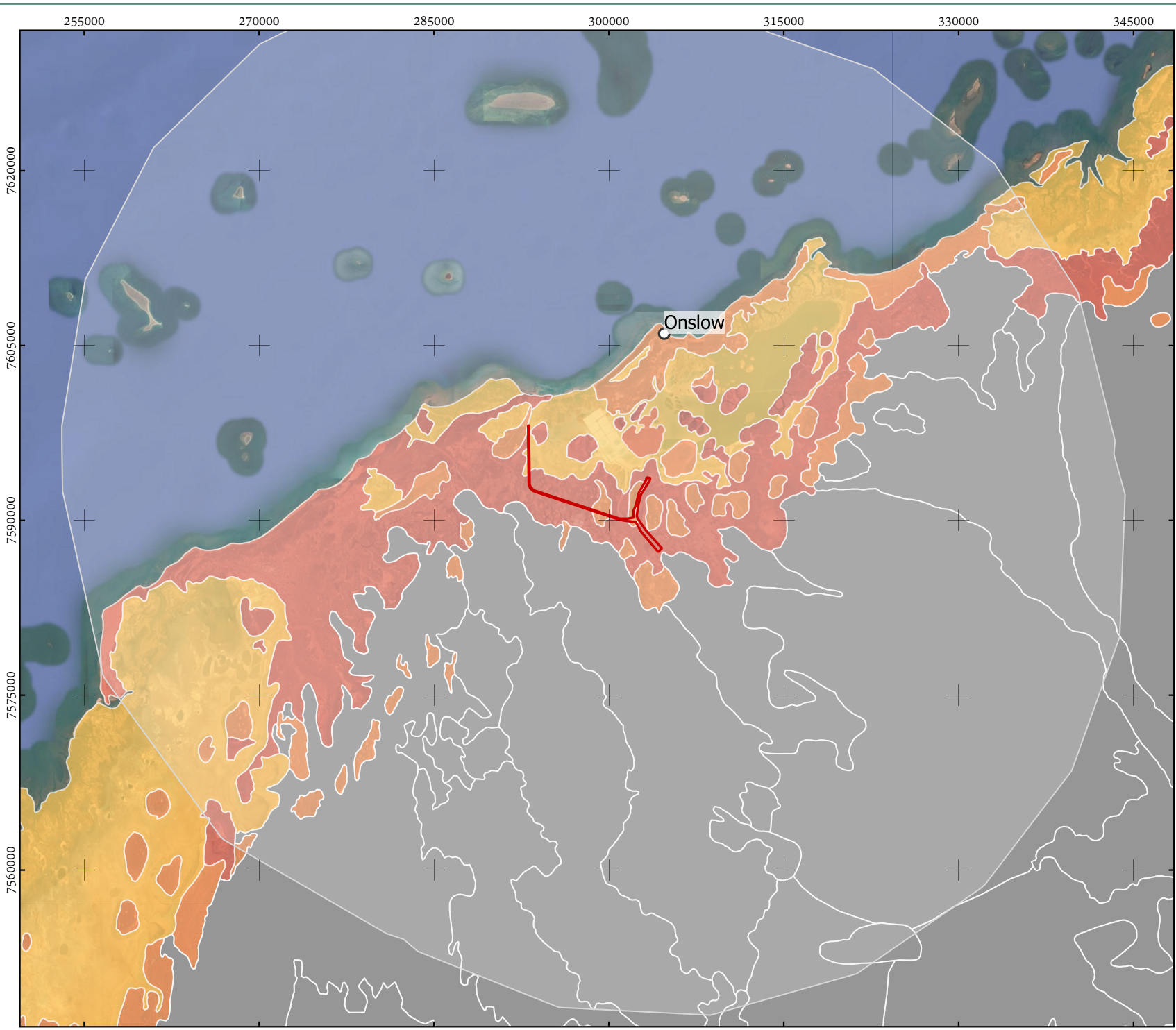
**MAP
1.2**

1.7. Land Systems

The land system of Western Australia has been mapped at a scale of 1:250,000 (Department of Agriculture and Food Western Australia, 2016). Three land systems were mapped across the Survey Area, two of which, Littoral and Onslow, are well represented in the wider region, occur across multiple bioregions, and have 0.4% or less of their Carnarvon extent occurring within the Survey Area (Table 1.2, Map 1.3). The Dune land system is less widespread, occurring as small patches along the coast, and is mostly restricted to the Carnarvon IBRA region.



Table 1.2: Land Systems

Description	Area in Survey Area (ha)	% of Survey Area	Total WA Extent (ha)	Total Carnarvon Extent (ha)	% of Carnarvon Extent in Survey Area
Dune Land System: Dune fields supporting soft spinifex and minor hard spinifex grasslands.	92.7	24.9%	44,402	37,448	0.2
Littoral Land System: Bare coastal mudflats (unvegetated), samphire flats, sandy islands, coastal dunes and beaches, supporting samphire low shrublands, sparse acacia shrublands and mangrove forests.	28.6	7.7%	394,005	156,748	<0.1
Onslow Land System: Undulating sandplains, dunes and level clay plains supporting soft spinifex grasslands and minor tussock grasslands.	250.7	67.4%	86,691	56,711	0.4



Legend

- Survey Area
- Desktop Study Area
- LandSystem_GDA94**
- 755
- 488
- 396


0 4 8 12 km
 Scale 1:450000 @ A4
Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter


Author: RD Date: 01-10-2021

Land Systems

HV Carriageway in Warrirda Road Reserve

Prepared for
Main Roads
Western Australia

MAP
1.3

1.8. Pre-European Beard Vegetation Mapping

Pre-European vegetation mapping was originally undertaken by Beard at various scales across the state and has since been updated to be consistent with NVIS descriptions at a scale of 1:500,000 (Department of Primary Industry and Regional Development, 2019). The Commonwealth of Australia stated national targets and objectives for biodiversity conservation, which recognised the retention of 30%, or more, of the pre-European extent of each community was necessary to preserve Australia's biological diversity (Environmental Protection Authority, 2000). Vegetation associations that do not meet these retention targets are considered significant (Department of Environment Regulation, 2014). The conservation status of these complexes is classified as:

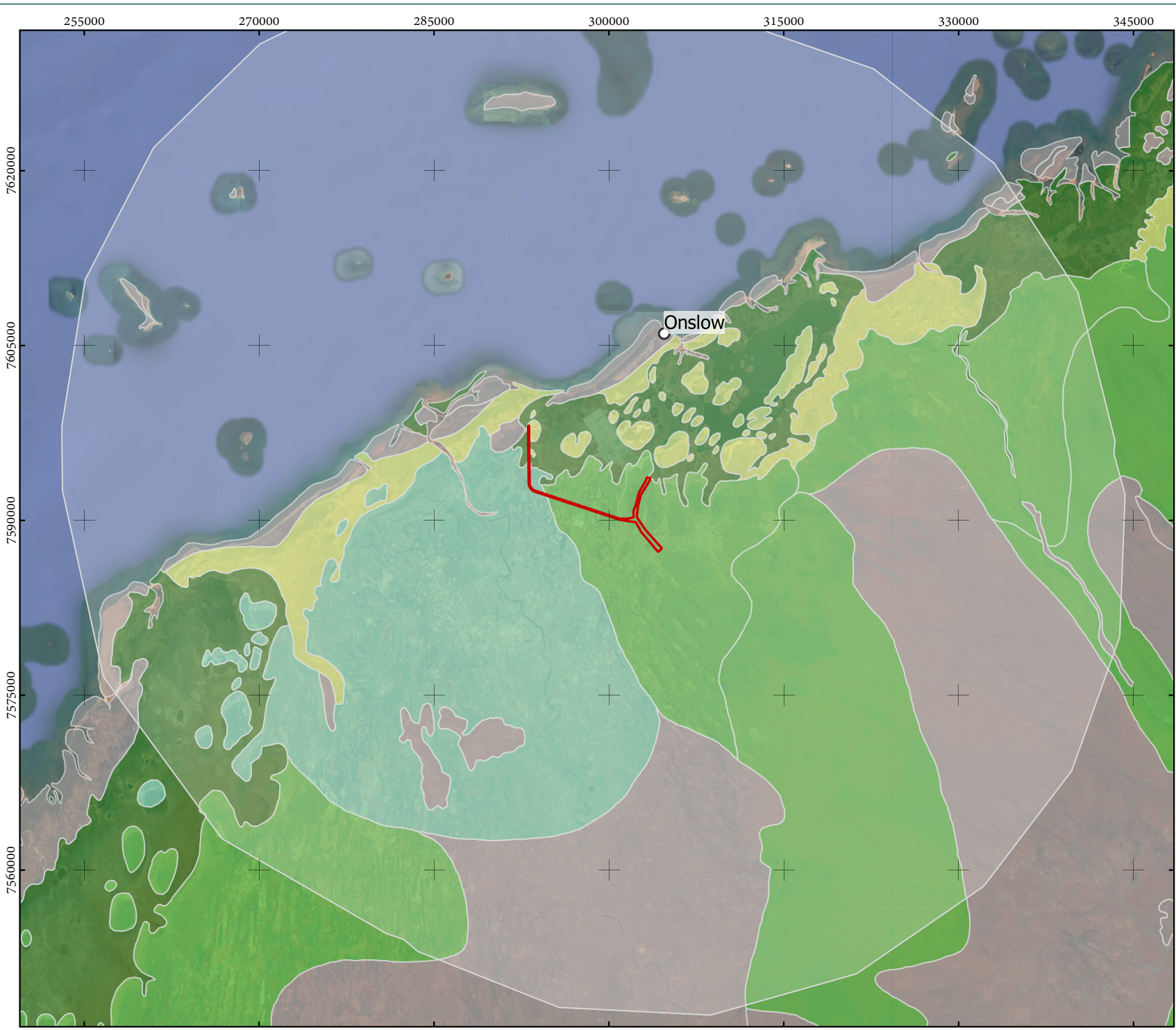
- Presumed extinct: probably no longer represented;
- Endangered*: Less than 10% of pre-European extent remains;
- Vulnerable*: 10-30% of pre-European extent remains;
- Depleted*: 30-50% of pre-European extent remains; and
- Least Concern: >50% of pre-European extent remains.

(* = or a combination of depletion, loss of quality, current threats and rarity gives a comparable status).

Four sub-associations have been mapped within the Survey Area (Table 1.3, Map 1.4). State-wide vegetation statistics are available for this unit which list pre-European extent, current extent, area in DBCA managed lands etc., and is a useful tool to determine if a vegetation community is rare or otherwise significant (Government of Western Australia, 2019). The Beard sub-associations (SA) 127.0, 589.0, 670.0 and 676.0 mapped within the Survey Area have 96-100% of their pre-European extent remaining in both regional and state levels, which is well above the 30% retention target and within the Least Concern category as listed above. Less than 0.1% of the extent of each sub-association occurs within the Survey Area and all are widespread across Western Australia.

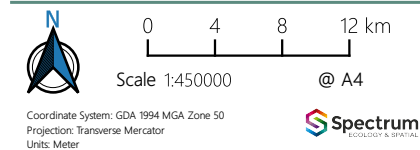
Table 1.3: Beard Vegetation Sub-Associations

SA Code	NVIS Level V Vegetation Description	Area in Survey Area (ha)	% of Survey Area	Pre-European Extent (ha)	Current Extent (ha)	% Remaining	% of Current Extent in Survey Area
127.0	Tidal mud flat: Bare areas; mud flats	16	4%	WA: 716,161	WA: 691,516	WA: 96.6	WA: <0.1
				Carnarvon: 102,781	Carnarvon: 101,490	Carnarvon: 98.7	Carnarvon: <0.1
589.0	Short bunch-grass savanna / Grass-steppe: <i>Eragrostis</i> sp. tussock grassland and <i>Triodia</i> sp. hummock grassland / <i>Triodia pungens</i> open hummock grassland	30.6	8%	WA: 806,985	WA: 802,647	WA: 99.5	WA: <0.1
				Carnarvon: 78,101	Carnarvon: 77,835	Carnarvon: 99.7	Carnarvon: <0.1
670.0	Shrub-steppe: <i>Acacia</i> sp. tall isolated shrubs over <i>Triodia basedowii</i> open hummock grassland	315	85%	WA: 147,810	WA: 147,794	WA: 100.0	WA: <0.1
				Carnarvon: 147,809	Carnarvon: 147,792	Carnarvon: 100.0	Carnarvon: <0.1
676.0	Samphire: <i>Tecticornia</i> sp. low open samphire shrubland	10.6	3%	WA: 438,799	WA: 435,592	WA: 99.3	WA: <0.1
				Carnarvon: 33,230	Carnarvon: 32,486	Carnarvon: 97.8	Carnarvon: <0.1



Legend

- Survey Area
- Desktop Study Area
- Beard Vegetation Units**
- Samphire
- Short bunch-grass savanna / Grass-steppe
- Shrub-steppe
- Tidal mud flat



Author: RD Date: 01-10-2021

Beard Vegetation Sub-Associations

HV Carriageway in Warrirda Road Reserve

1.9. Significant Lands

1.9.1. Conservation Estate

The Western Australian conservation estate includes land and waters vested in the Conservation and Parks Commission under the Conservation and Land Management Act (1984). The conservation estate is generally managed by the Parks and Wildlife Service of the Department of Biodiversity, Conservation and Attractions (DBCA) to protect Western Australia's biodiversity, and includes National Parks, Nature Reserves, Conservation Reserves and other areas managed primarily for biodiversity conservation (Department of Agriculture Water and the Environment, 2021a).

Several conservation estates occur within the desktop Study Area, identified from the Collaborative Australian Protected Area Database (CAPAD). The closest known conservation estate is Cane River (Mount Minnie and Nanutarra), located 5 km southeast of the Survey Area (Map 1.1; Table 1.4).

1.9.2. Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESA) that are associated with flora and vegetation are areas that are defined by the Department of Water and Environmental Regulation (Department of Water and Environmental Regulation, 2019) as:

- A defined wetland and the area within 50 m of a wetland;
- The area covered by vegetation within 50 m of Threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the Threatened flora is located;
- The area covered by a Threatened Ecological Community (TEC);
- A Bush Forever site;
- Areas covered by the Gngangara Mound Crown Land Policy and Western Swamp Tortoise Policy; and
- Areas covered by lakes, wetlands, and fringing vegetation of the Swan Coastal Plain Lakes Policy, including South West Agricultural Zone Wetlands Policy and Swan and Canning Rivers Policy.

Several unnamed ESA occur within the desktop Study Area (Map 1.1; Table 1.4).

1.9.3. Australian Wetlands Database

The Australian Wetlands Database includes nationally significant wetlands (as listed in the directory of important wetlands), wetlands listed under the Ramsar convention, wetlands that are representative, rare or unique, or wetlands that are considered of international importance (Department of the Environment and Energy, 2019). Exmouth Gulf East is the only significant wetlands occurring the desktop Study Area, located 22 km west of the Survey Area (Map 1.1; Table 1.4).

Table 1.4: Significant Lands within the Vicinity of the Survey Area

Name	Database	ID	Distance	Jurisdiction / Size
Nature Reserve				
Bessieres Island	CAPAD, ESA	WA_44666	32 km northwest (island)	Western Australia, 56 ha
Cane River (Mount Minnie and Nanutarra)	CAPAD	CWTH_N7038	5 km southeast	Western Australia, 180,995 ha
Locker Island	CAPAD, ESA	WA_29011	24 km west (island)	Western Australia, 29 ha
Serrurier Island	CAPAD, ESA	WA_33834	34 km northwest (island)	Western Australia, 291 ha
Unnamed	CAPAD	WA_44665	32 km northwest (island)	Western Australia, 0.04 ha

Name	Database	ID	Distance	Jurisdiction / Size
ESA				
Unnamed	ESA	-	35 km southwest	Western Australia, 28 ha
Unnamed	ESA	-	22 km west	Western Australia, 114,229 ha
Unnamed	ESA	-	40 km southwest	Western Australia, 58 ha
Unnamed	ESA	-	39 km southwest	Western Australia, 15 ha
Unnamed	ESA	-	39 km southwest	Western Australia, 147 ha
Unnamed	ESA	-	39 km southwest	Western Australia, 8 ha
Unnamed	ESA	-	31 km northwest (island)	Western Australia, 2 ha
Unnamed	ESA	-	37 km northeast (island)	Western Australia, 30 ha
Unnamed	ESA	-	20 km northwest (island)	Western Australia, 5 ha
Unnamed	ESA	-	29 km northwest (island)	Western Australia, 0.5 ha
Unnamed	ESA	-	24 km northeast (island)	Western Australia, 23 ha
Unnamed	ESA	-	28 km northeast (island)	Western Australia, 3 ha
Unnamed	ESA	-	29 km northeast (island)	Western Australia, 6 ha
Unnamed	ESA	-	14 km north (island)	Western Australia, 30 ha
Unnamed	ESA	-	39 km northeast (island)	Western Australia, 121 ha
Unnamed	ESA	-	27 km north (island)	Western Australia, 608 ha
Important Wetlands in Australia				
Exmouth Gulf East	Directory of Important Wetlands in Australia	-	22 km west	Western Australia, 160,096 ha

2. METHODS

2.1. Survey Timing

The assessment was undertaken from 4 to 7 May 2021. Autumn is considered the optimal time to conduct flora assessments in the Carnarvon region and thus this survey was undertaken at the appropriate time of year (Environmental Protection Authority, 2016c, 2020). The survey timing was appropriate for bird and mammal assemblages in the Eremaean climatic region, and just outside the optimal season for reptiles (September-April), however basic fauna assessments are not timing dependant (Environmental Protection Authority, 2020). Rainfall preceding a field survey influences the number and type of flora species recorded. To characterise these prevailing conditions, monthly rainfall data was sourced from the nearest Bureau of Meteorology (BOM) station (Onslow Airport BOM station #5017, located 14 km north-west of the Survey Area), for the 12 and three months prior to the survey and compared to the sum of the long term (1940-2021) median rainfall for the area (Bureau of Meteorology, 2021), this is displayed in Figure 2.1.

The survey was conducted following a dryer than usual year, as indicated by climate data retrieved from BOM (Figure 2.1). Rainfall for the twelve months preceding the field survey (May 2020 – April 2021) was 207 millimetres (mm), 100 mm lower than the long-term median rainfall of 307 mm, however the three months preceding the field survey (February – April 2021) was 166 mm, 26 mm higher than the long-term median rainfall of 140 mm (for the same 3 month period). The field survey therefore occurred in optimal conditions for the region.

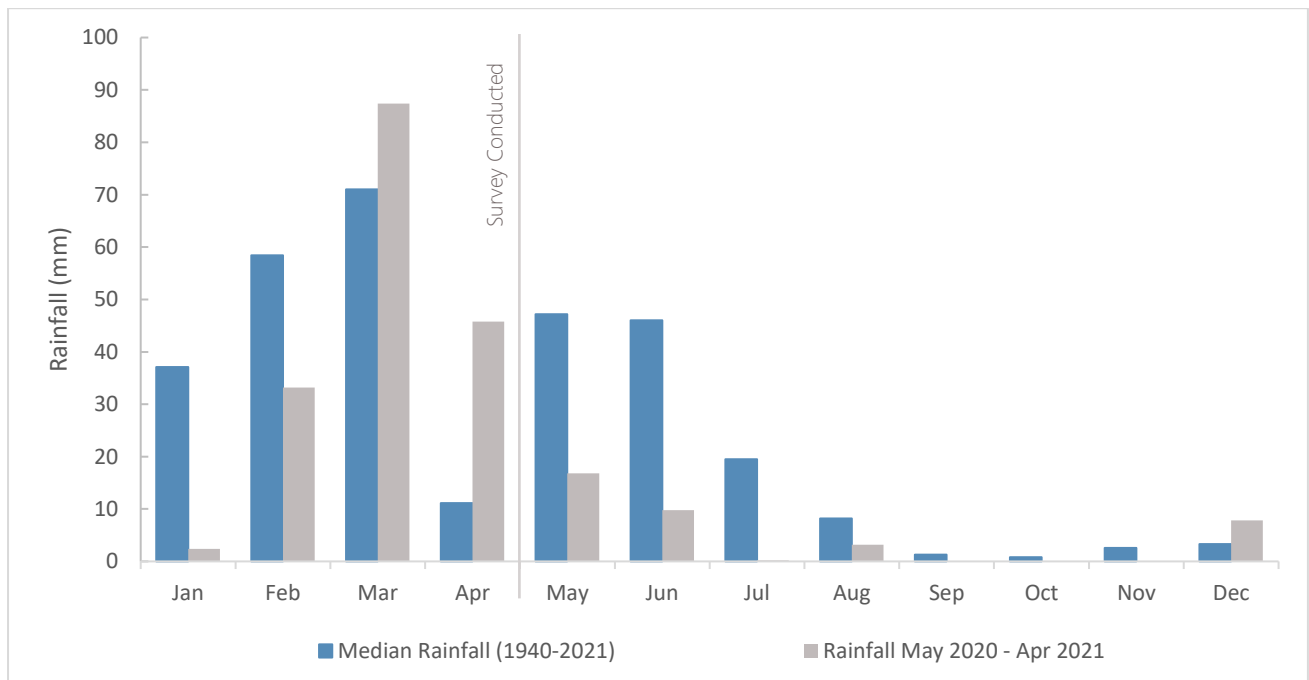


Figure 2.1: Rainfall Data for Onslow, WA (BOM Station #5017)

2.2. Project Team & Licences

Spectrum Ecology staff involved in this assessment are listed in Table 2.1, along with their role in the project, years of experience, and flora collection licence numbers.

Table 2.1: Project Team & Licences

Staff	Project Tasks	Experience	Flora Collection Licence	Fauna Licence
Flora & Vegetation				
Melissa Hay	Field survey, project management, reporting	15 years	FB62000006-2	-
Roberta Dayrell	Reporting	8 years	-	-
Fauna				
Astrid Heidrich	Field survey, reporting	13 years	-	BA27000414
Nicola Palmer	Reporting	6 years	-	-

2.3. Flora Nomenclature, Specimen Identification & Lodgement

Flora nomenclature used in this report is consistent with the Western Australian Herbarium's plant census, provided on FloraBase (Western Australian Herbarium, 2020) and is current at the time of report preparation.

Flora specimens were collected to confirm species recorded during the assessment or to investigate suspected conservation significance. Specimens were identified using the appropriate taxonomic keys and where required, relevant taxonomic experts at the Western Australian Herbarium were consulted.

Specimens were 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.

2.4. Significant Flora, Vegetation & Fauna Definitions

Significant flora can include (Environmental Protection Authority, 2016b):

- Being identified as Threatened: Critically Endangered, Endangered or Vulnerable (state listed BC Act and/or nationally listed EPBC Act);
- Being identified as Priority flora species: Priority 1 to 4 (Department of Biodiversity Conservation and Attractions, 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; or
- Relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

Significant vegetation can include (Environmental Protection Authority, 2016b):

- Threatened Ecological Community (TEC): Critically Endangered, Endangered or Vulnerable (state listed BC Act and/or nationally listed EPBC Act);
- Priority Ecological Community (PEC): Priority 1 to 5 (Department of Biodiversity Conservation and Attractions, 2017a);
- Restricted distribution;
- Degree of historical impact from threatening processes;

- A role as a refuge; or
- Providing an important function required to maintain ecological integrity of a significant ecosystem.

Significant fauna can include (Environmental Protection Authority, 2016a):

- Being identified as a Threatened or Priority species;
- Species with restricted distribution;
- Degree of historical impact from threatening processes; or
- Providing an important function required to maintain the ecological integrity of a significant ecosystem.

2.5. Introduced Flora & Declared Plants

Introduced flora or weeds can pose a threat to native vegetation and biodiversity. The Department of Primary Industries and Regional Development (DPIRD) keeps a database of Declared Plants in Western Australia which are considered environmentally significant weeds. This database is regulated under the Biosecurity and Agricultural Management Act (Government of Western Australia, 2007). Legal status and control requirements for these declared plants are defined in Appendix A.

2.6. Desktop Assessment

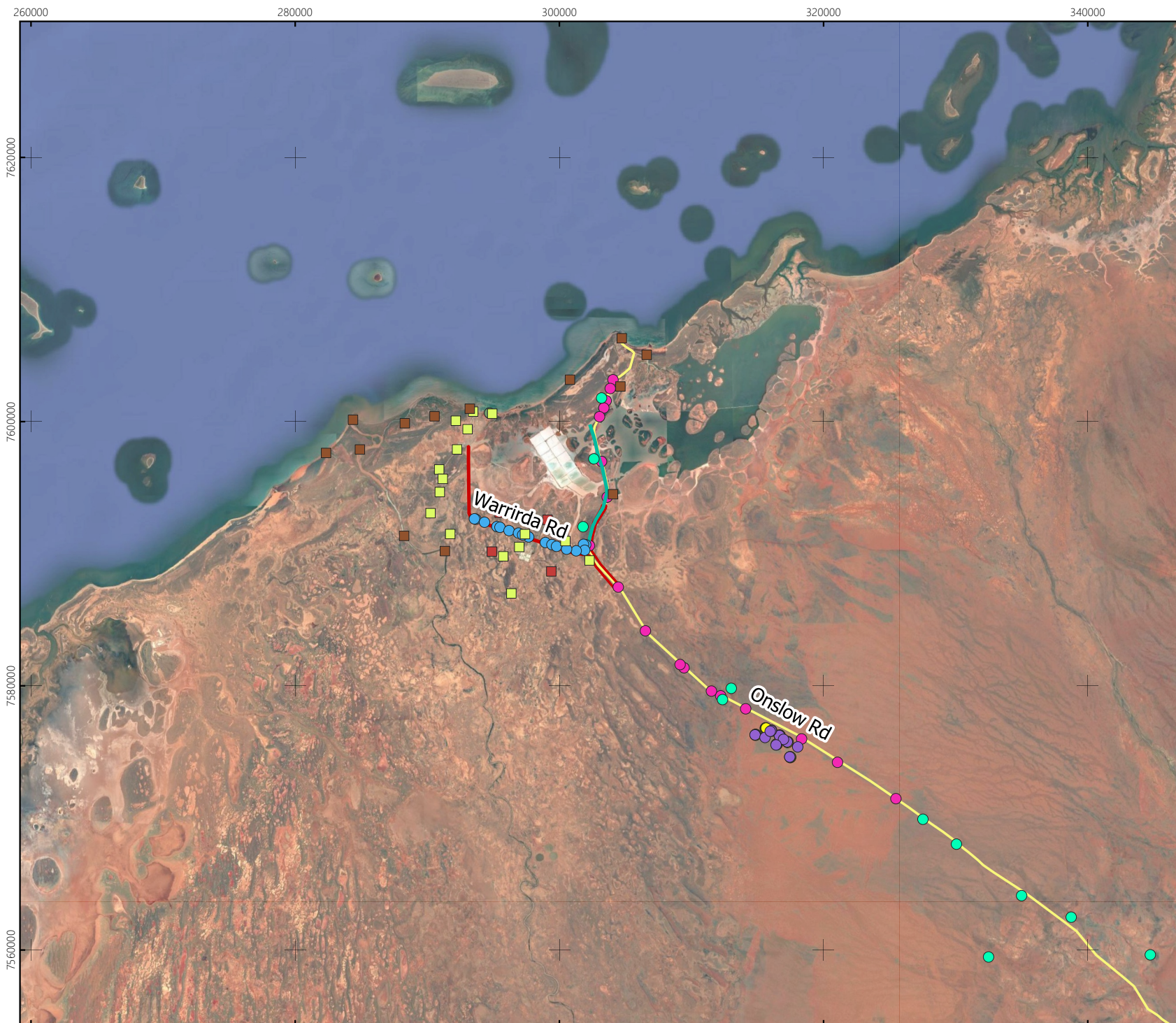
A review of all relevant and available flora, vegetation, and fauna data sources was undertaken prior to the field survey and incorporated into the desktop assessment (Table 2.2).

Table 2.2: Desktop Assessment Sources

Data Source	Custodian	Details
Atlas of Living Australia	CSIRO	Date 9/9/2021 Buffer: 40 km around centre point
Commonwealth Protected Matters Search Tool (PMST)	Department of Agriculture, Water and the Environment (DAWE)	Date: 08/04/21 Buffer: 40 km around centre point
NatureMap	Department of Biodiversity Conservation and Attractions (DBCA)/ Western Australian Museum (WAM)	Date: 07/04/21 Buffer: 40 km around centre point
DBCA Threatened Fauna Database	Main Roads	Date: 17/03/21 Buffer: 40 km around Survey Area polygon
Threatened and Priority Flora database (TPFL/ WA Herbarium)	Main Roads	Date: 17/03/21 Buffer: 30 km around Survey Area polygon
Communities database (TEC/PEC)	Main Roads	Date: 17/03/21 Buffer: 40 km around Survey Area polygon
Invertebrate Fauna Databases	WAM	Arachnids & Myriapods: 12/04/2021 Mollusca & Crustacea: 8/04/2021 Buffer: 40 km square around the Survey Area
Index of Biodiversity Surveys of Assessments (IBSA) database	Department of Water and Environmental Regulation (DWER)	Date: 08/04/21 Buffer: 40 km around centre point

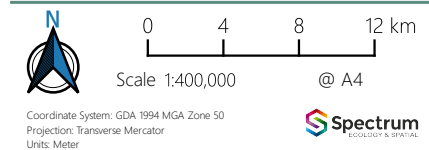
2.6.1. Previously Conducted Flora & Fauna Assessments

Numerous surveys have previously been conducted in the vicinity of the Survey Area, these were reviewed for significant flora, vegetation, and fauna. Reports were incorporated if they were provided by the client or if they were publicly available. The reports incorporated into the desktop assessment are listed in Table 2.3 and the approximate location of the survey, where available, is shown in Map 2.1.



Legend

- Survey Area
- Project Roads
- Previous Surveys
- BCE (2009)
- Biota (2010)
- GHD (2011)
- Mattiske Consulting (2014)
- GHD (2017)
- Phoenix Environmental Sciences (2017)
- BCE (2018)
- Phoenix Environmental Sciences (2018)
- Main Roads (2018)
- Vicki Long & Associates (2020)



Author: RD Date: 09-07-2021

Location of Previous Surveys

HV Carriageway in Warrirda Road Reserve

Prepared for
Main Roads
Western Australia

MAP
2.1

Table 2.3: Summary of Previous Assessments Undertaken in the Vicinity of the Survey Area

Report	Reference	Location from Current Project	Survey Summary
Flora & Vegetation Reports			
Onslow Material Pits Environmental Impact Assessment and Environmental Management Plan	GHD (2011)	Several Survey Areas along Onslow Road – one is adjacent to this Survey Area, another six are within 50 km from this Survey Area.	Priority 3 species <i>Triumfetta echinata</i> was recorded less than 300 m from Survey Area. Priority 3 species <i>Eremophila forrestii</i> subsp. <i>viridis</i> was recorded approximately 49 km from Survey Area.
Level 1 flora and vegetation survey of the Ashburton North Gas Pipeline (ANGP) project area	Mattiske Consulting (2014)	Less than 100 m from current Survey Area.	Two Priority 3 species, <i>Eremophila forrestii</i> subsp. <i>viridis</i> and <i>Triumfetta echinata</i> , were recorded.
Targeted Flora Survey - Onslow Utilities Infrastructure Upgrade Project	GHD (2017)	Partially overlaps current Survey Area.	Two Priority 3 species, <i>Eremophila forrestii</i> subsp. <i>viridis</i> and <i>Triumfetta echinata</i> , were recorded.
Flora and vegetation survey and terrestrial fauna survey for the proposed Pilbara Regional Waste Management Facility. Prepared for Talis Consultants.	Phoenix Environmental Sciences (2017)	Approximately 15 km southeast.	Two Priority 3 species, <i>Abutilon</i> sp. <i>Pritzelianum</i> (S. van Leeuwen 5095) and <i>Triumfetta echinata</i> , were recorded.
Detailed flora and vegetation survey for the Pilbara Regional Waste Management Facility. Prepared for Talis Consultants.	Phoenix Environmental Sciences (2018)	Approximately 15 km southeast.	Unconfirmed records of Priority 3 <i>Abutilon</i> sp. <i>Pritzelianum</i> (S. van Leeuwen 5095). Definitive confirmation of plant identity was not possible and inferred from previous survey.
Onslow Road Phase 2 Reconnaissance Survey	Main Roads (2018)	Partially overlaps current Survey Area.	Site inspection targeted significant species. 5903 individuals of <i>Abutilon</i> sp. Onslow (F. Smith s.n. 10/9/61) were recorded 4 km from the Survey Area.
Pilbara Ports Authority - Port of Ashburton - Eastern Port Precinct - Additional Clearing Areas Flora Survey	Vicki Long & Associates (2020)	Approximately 3 km north.	Priority 3 species <i>Abutilon</i> sp. <i>Pritzelianum</i> (S. van Leeuwen 5095) was recorded.
Fauna Reports			
Survey for Migratory Waterbirds in the Wheatstone LNG Project Area November 2008 and March 2009	Bamford Consulting Ecologists (2009)	Several sites within 5 km of the Survey Area.	Targeted survey for migratory waterbirds. Twenty species of significance recorded.
Wheatstone Project Terrestrial Fauna Survey	Biota Environmental Sciences (2010)	Overlaps current Survey Area.	Single phase level 2 survey of the Wheatstone Project. Three currently listed significant species were recorded – Northern Freetail-bat, Western Pebble-mound Mouse and Fork-tailed Swift.
Onslow Material Pits Environmental Impact Assessment and	GHD (GHD, 2011)	Several Survey Areas along Onslow Road – one is adjacent to this Survey Area, six are	Level 1 fauna assessment. Two species of significance were recorded (Grey Falcon and Australian Bustard).

Report	Reference	Location from Current Project	Survey Summary
Environmental Management Plan		within 40 km and four greater than 40 km from this Survey Area.	
A Level 1 Vertebrate Fauna Assessment of the Proposed Turbidge to Wheatstone Gas Pipeline, Western Australia	Ninox Wildlife Consulting (Ninox 2013)	The northern extent is less than 1 km from this Survey Area; study extended approximately 110 km south.	Level 1 reconnaissance survey. No species of current significance were recorded.
ANSIA Stage 2 Fauna Assessment	Bamford Consulting Ecologists (2018)	This study encompassed four zones that lie adjacent to the north and south of the haul road.	Level 1 fauna assessment. No significant species were recorded however three species (<i>Lerista planiventralis maryani</i> , Flock Bronzewing and Short-tailed Mouse) were assessed to be resident to the area, with another three species (Pilbara Olive Python, Barn Swallow and Brush-tailed Mulgara) assessed to be regular visitors.

2.6.2. Likelihood of Occurrence Assessment

The following information was collated for each significant flora/fauna taxon or TEC/PEC identified during the desktop assessment:

- Conservation status (EPBC Act, BC Act, DBCA listing);
- Description of species and flowering period (flora only);
- Description of habitat requirements and presence within the Survey Area; and
- Distance of record to the Project.

A likelihood of occurrence assessment was then conducted using the criteria listed in Table 2.4. This included assessing the distance of the record from the Project (historical database records considered not accurate were excluded if required), presence of appropriate habitats within the Survey Area (using geology, vegetation mapping, and/or aerial imagery), and the age of the record (fauna only).

Table 2.4: Likelihood of Occurrence Assessment Criteria

Likelihood	Flora & Vegetation	Fauna
Recorded	Species or vegetation community accurately recorded within the Survey Area during the literature review (includes TEC/PEC buffers that intersect).	Species recorded within the Survey Area within the previous ten years.
High	Species or vegetation community recorded near the Survey Area, and suitable habitat does, or is likely, to occur.	Species recorded within or near the Survey Area within the previous 20 years. Suitable habitat occurs in the Survey Area.
Medium	Species or vegetation community recorded outside the Survey Area but within 20 km and suitable habitat may occur.	Species recorded within or in proximity to the Survey Area more than 20 years ago. Species recorded outside the Survey Area but within 40 km. Suitable habitat occurs in the Survey Area.
Low	Species or vegetation community rarely or not recorded within 20 km of the Survey Area and suitable habitat is not likely to occur within the Survey Area.	Species rarely or not recorded within 40 km of the Survey Area. Suitable habitat does not occur within or in proximity to the Survey Area.

Likelihood	Flora & Vegetation	Fauna
Very Low	n/a	Species not recorded within 40 km despite multiple recent surveys. Suitable habitat does not occur within the Survey Area. Species considered locally extinct.

2.7. Flora & Vegetation Assessment

2.7.1. Field Methods

A combination of quadrats, relevés, traverses, and opportunistic sampling is appropriate for a detailed level survey as stipulated in the guidance statement (Environmental Protection Authority, 2016c). These survey techniques are described in Table 2.5 and comprehensive site data is included in Appendix B. Twelve quadrats and 13 relevés were sampled during the assessment along with 65 km of targeted flora traverses. The targeted flora traverses were undertaken at a spacing of approximately 20-40 m through all potential habitat for Priority Flora (Map 2.2; Table 2.5). All Declared Plants and WoNS were recorded as encountered.

Table 2.5: Flora & Vegetation Survey Technique

Survey Technique	Description
Quadrats	<p>Quadrats are comprehensive survey technique for gathering information for detailed flora and vegetation survey. Each vegetation unit must be represented by a minimum of three quadrats where possible and have at least one corner permanently marked. Quadrats are not installed if the vegetation is not in a good or better condition. Information collected at each quadrat include:</p> <ul style="list-style-type: none"> • Site code, date; GPS coordinates; botanist; • Size and shape of quadrat; • Photograph from north-west corner; • Landform, including; slope, aspect, soil description and rock type; • Vegetation description (NVIS Level V); • Comprehensive species list, canopy cover (%) and height (m); • Time since fire; • Vegetation condition; and • Description of disturbance types.
Relevés	<p>Relevés are a low intensity survey technique for gathering information where vegetation is in 'Degraded' or 'Completely Degraded' vegetation condition, recently burnt areas, or where it is too unsafe to survey using a quadrat. Information collected at each relevé includes:</p> <ul style="list-style-type: none"> • Site code, date, GPS coordinates, botanist; • A photograph; • Vegetation condition and disturbances (including fire); • Landform including; slope, soil, rock type, aspect; • Vegetation description (NVIS Level V); • Dominant species list, significant flora, weeds, canopy cover (%) and height (m).
Traverses	<p>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. 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	<p>Flora and vegetation not recorded through other sampling methods was opportunistically sampled as encountered in the Survey Area.</p>

2.7.2. Vegetation Mapping

The data collected from quadrats, relevés, and traverses, as well as general field notes, observations and aerial photography were used to map the vegetation across the Survey Area. The vegetation was described

to NVIS Level V – association (referred to as a ‘vegetation types’ 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).

The vegetation types were defined floristically, where the 12 quadrats were statistically classified according to similarities in species composition. The statistical analysis was performed in R Core Team (2021) using the “stats” and “vegan” (Jari Oksanen, F. Guillaume Blanchet, Michael Friendly, Roeland Kindt, Pierre Legendre, Dan McGlinn, Peter R. Minchin, R. B. O’Hara and Simpson, Peter Solymos, M. Henry H. Stevens, 2019) packages. Dissimilarity indices were calculated using the `vegdist` function with the jaccard index on a binary species matrix. Hierarchical clustering was performed using the `hclust` function using the ‘average’ or unweighted pair group with arithmetic mean (UPGMA) method. Figures of the hierarchical clustering were produced using the “dendextend” package (Galili, 2015).

Only taxa resolved to at least species were included in the floristic analysis, subspecies and varieties were combined where they were unable to be identified in the field, and annuals were excluded from the analysis as they can obscure vegetation patterning. The site by species matrix used for this analysis has been provided electronically with the report.

2.7.3. Vegetation Condition

Vegetation condition was recorded at quadrats, relevés and where areas of different vegetation condition were observed. The vegetation condition was mapped at the same scale as the vegetation mapping. Vegetation condition ratings follow the scale recommended for the Eremaean Botanical Province (Environmental Protection Authority, 2016b adapted from Trudgen, 1988), summarised in Table 2.6.

Table 2.6: Vegetation & Condition Scale – Eremaean Botanical Province

Condition	Disturbance Criteria
Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	Still retains basic vegetation structure or ability to regenerate it after obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with multiple weed species present including very aggressive species.
Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation, i.e. areas that are cleared or “parkland cleared” with their flora comprising weed or crop species with isolated native trees or shrubs.

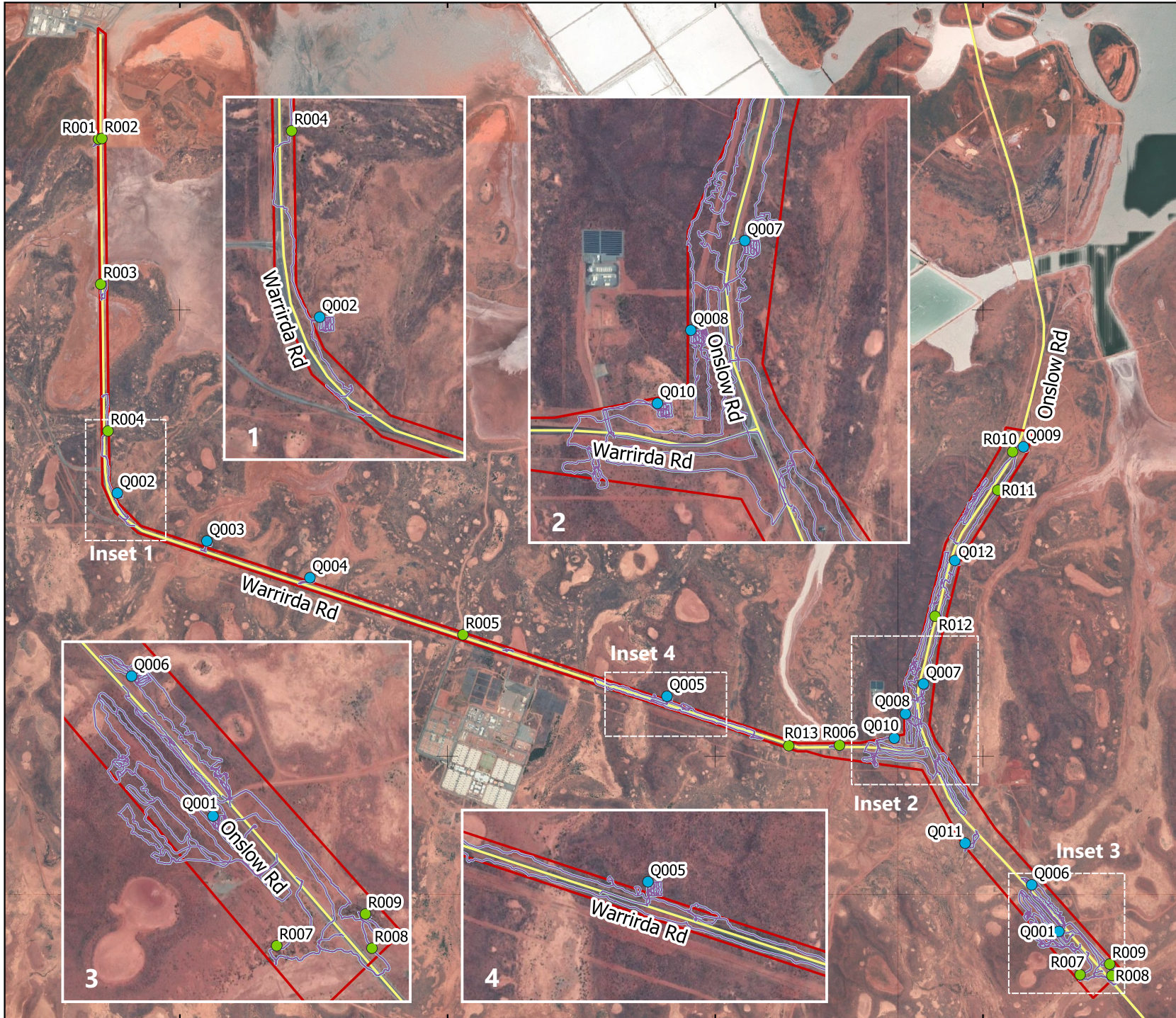
2.7.4. Significant Flora Targeted Searches

Areas likely to support significant flora or vegetation were targeted during the survey which included the sand dunes and swales across the Survey Area. Some areas were traverses adjacent to the Survey Area where the population extended outside, and there was time available to do so. The entire population boundaries were not walked outside the Survey Area. Areas were selected based on existing records from database searches and vegetation mapping. Where significant flora were encountered during the survey, sufficient information was recorded to complete a Threatened and Priority Flora Report Form (TPRF).

294000 297000 300000 303000

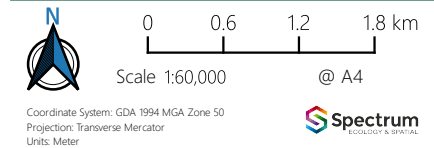
7595000

7590000



Legend

- Survey Area
- Project Roads
- Flora traverses
- Flora Survey Sites**
- Quadrat
- Releve



Author: RD Date: 09-07-2021

Sampling Effort – Flora & Vegetation

HV Carriageway in Warrirda Road Reserve

MAP

2.2

Prepared for
Main Roads
Western Australia

2.8. Terrestrial Fauna Assessment

2.8.1. Field Methods

The terrestrial vertebrate fauna survey was consistent with Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2020) and Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna (Environmental Protection Authority, 2016e). The guidance suggests selective low-intensity sampling of the fauna and fauna habitats to verify the accuracy of the desktop assessment. The approach of the survey was to describe and map the vertebrate fauna habitats across the Survey Area and complete active searches to describe the vertebrate fauna assemblages, particularly any significant fauna identified as likely to be present. A total of 23 fauna sites were surveyed within the Survey Area (Map 2.3). At each survey site, a variety of survey techniques were used for fauna as outlined in Table 2.7.

Table 2.7: Fauna Survey Techniques

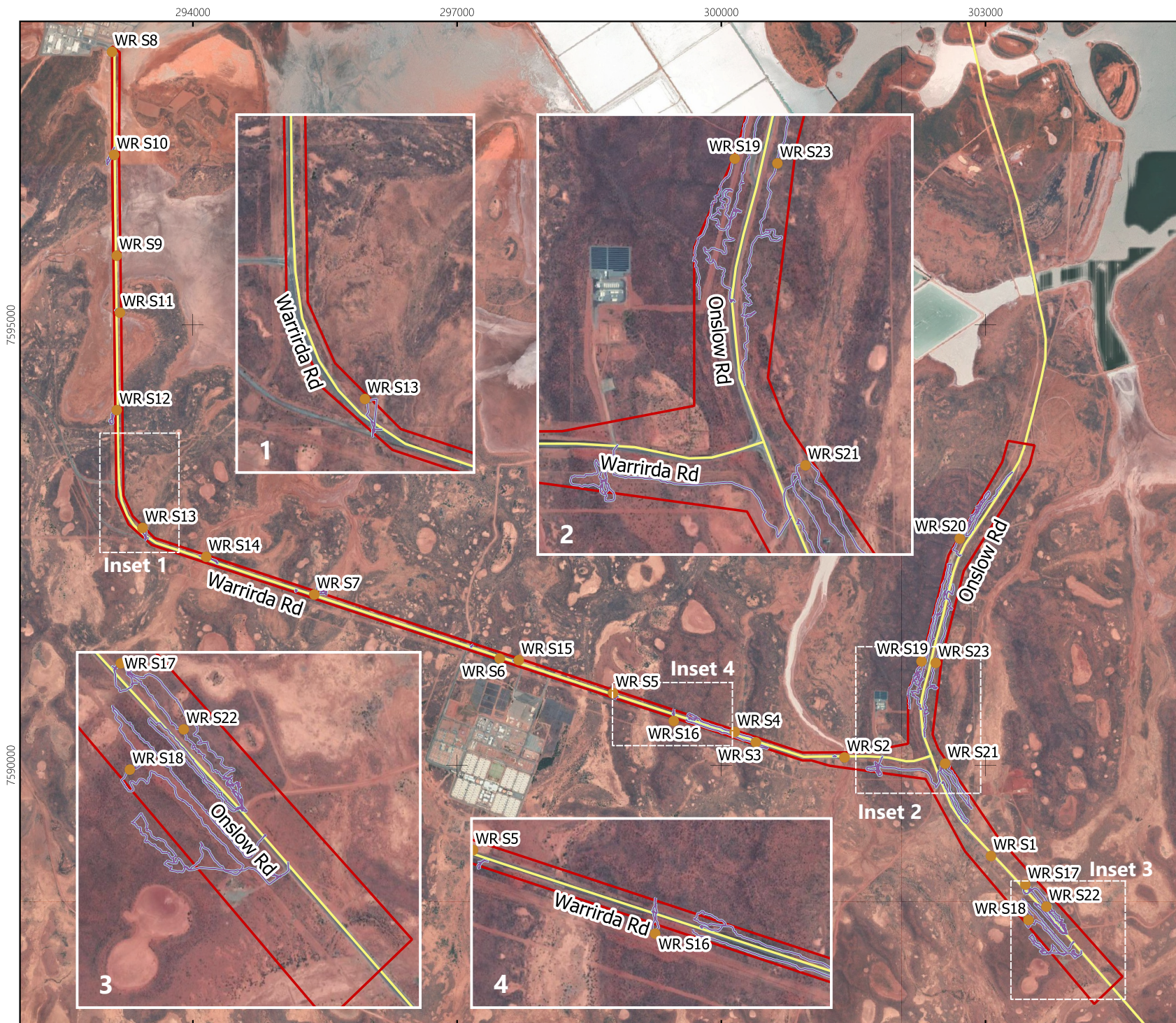
Fauna	Survey Technique
Mammals	Direct sightings and indirect evidence such as tracks, scats and diggings were recorded across the Survey Area.
Birds	Direct sightings and calls, as well as indirect evidence such as feathers, pellets and nests were recorded across the Survey Area.
Reptiles & Amphibians	Direct sightings and indirect evidence such as calls, tracks, diggings, skins, and latrines were recorded across the Survey Area and targeted searches were undertaken in areas with suitable habitat.

2.8.2. 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 mapped based on the following information:

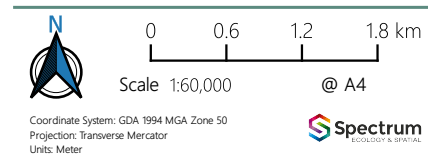
- General vegetation type (Shepherd, Beeston and Hopkins, 2001)
- Vegetation Types mapped within the Survey Area
- Vegetation structure
- Landforms
- Geological units
- Soil substrate
- Aerial imagery
- Fauna assemblage
- Field observations.

The fauna habitat was recorded at each fauna site and opportunistically while traversing the Survey Area. Fauna habitat types are descriptive and specific to the Survey Area.



Legend

- Survey Area
- Project Roads
- Traverse
- Fauna Sites



Author: NP Date: 02-02-2022

Sampling Effort – Fauna

HV Carriageway in Warrirda Road Reserve

2.9. Limitations & Constraints

Survey specific limitations and constraints for the detailed flora and vegetation assessment and basic fauna assessment are discussed in Table 2.8.

Table 2.8: Limitations & Constraints – Flora & Fauna Assessment

Limitation	Constraint	Comment
Availability of the contextual information at a regional and local scale.	No	Beard vegetation, geology and land system mapping were used to determine regional significance of vegetation types. Database searches provided detailed information, adequate to guide field survey design and effort for the flora and fauna survey. There were multiple assessments conducted within and in the vicinity of the Survey Area and have been included in the desktop assessment.
Competency/experience of the consultant carrying out the survey including experience in bioregion surveyed.	No	Principal Botanist Melissa Hay and Principal Zoologist Astrid Heidrich have suitable knowledge and experience conducting botanical and fauna surveys, respectively, in the Carnarvon and Pilbara region of Western Australia.
Timing/weather/season/cycle.	No	The field survey timing was considered appropriate for a flora and vegetation survey conducted in the Carnarvon region, where the appropriate timing is Autumn (March to May). There was higher than median rainfall at the Survey Area in the three months prior to the survey, providing optimal conditions for flora species growth. A basic level fauna survey is not timing dependent.
Disturbances (e.g., fire, flood, accidental human intervention) which affected results of survey.	No	No disturbances were recorded at the Survey Area that have affected the results of the flora and fauna assessment. As the survey was undertaken along a linear corridor, quadrats were sometimes installed slightly outside of the Survey Area in order to target vegetation in good condition.
Remoteness and/or access problems.	No	There were no access restrictions at the Survey Area.
Flora Specific		
Survey effort and extent.	No	The 12 quadrats and 13 relevés recorded from the Survey Area were sufficient to map and classify the vegetation for a detailed level survey. All vegetation types in Good or better condition that were used in the floristic analysis had more than three quadrats installed, except vegetation that was not widespread (P2) which had two installed. The targeted flora assessment was conducted along 65 km of traverses at a spacing of approximately 20-40 m through all identified potential habitat for Priority Flora.
Proportion of flora recorded and/or collected, any identification issues.	No	At least one specimen of every flora species encountered was collected for confirmation. SAC analysis suggested that 75% of the taxa expected to be present were recorded within quadrats and additional 45 taxa were recorded in relevés and opportunistic sampling. Plants were identified by the Senior Botanist Raimond Orifici who has botanical and taxonomic experience throughout Western Australia and is particularly experienced around the Onslow area. <i>Tecticornia</i> specimens were identified by Dr. Kelly Shepherd at the Western Australian Herbarium. Three specimens were unable to be conclusively identified attributed to insufficient material and plants being sterile.

Limitation	Constraint	Comment
Fauna Specific		
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	Sampling techniques were adequate for a basic terrestrial fauna survey. All fauna groups were sampled, and no survey constraints were experienced.
Proportion of fauna identified, recorded, and/or collected.	No	All vertebrate fauna species encountered were identified in the field. Basic survey methods do not require the identification of all fauna species present within the project.
The proportion of the task achieved and further work which might be needed.	No	All components of a basic fauna assessment were completed.
Resources (degree of expertise available in animal identification to taxon level).	No	Fauna resources available were adequate and did not compromise the outcome of the survey.
Intensity (in retrospect, was the intensity adequate).	No	A basic assessment was adequate to identify faunal assemblages and fauna habitat present within the Survey Area. Targeted searches for significant fauna species were completed within areas of suitable habitat.
Completeness (was the relevant area fully surveyed).	No	All major fauna habitat types were sampled and defined. Habitat types that may host significant fauna species were surveyed.

3. RESULTS & DISCUSSION – FLORA & VEGETATION

3.1. Desktop Assessment

3.1.1. Conservation Significant Flora

Database searches undertaken of the desktop Study Area identified nine Priority flora taxa as potentially occurring within the Survey Area. Two of the nine species, *Eremophila forrestii* subsp. *viridis* (P3), and *Triumfetta echinata* (P3) have previously been recorded within the Survey Area. An additional four of the nine species were considered to have a high pre-survey likelihood of occurrence due to previous records close to the Survey Area and the presence of suitable habitat. A full list of likelihood of occurrence is provided in Appendix C and the locations are presented on Map 3.1. No Threatened flora were identified as potentially occurring within the Survey Area.

Table 3.1: Significant Flora Recorded from Desktop Assessment

Pre-survey Likelihood	Post-survey Likelihood	Status	Species	Habitat
Recorded	Recorded	Priority 3	<i>Eremophila forrestii</i> subsp. <i>viridis</i> ,	Red sand dunes.
			<i>Triumfetta echinata</i>	Red sandy soils. Sand dunes.
High	Low	Priority 1	<i>Abutilon</i> sp. Onslow (F. Smith s.n. 10/9/61)	Sandplain with orange-brown sandy loam. Roadsides.
	Low	Priority 3	<i>Abutilon</i> sp. Pritzelianum (S. van Leeuwen 5095)	Red clay over granite, open clay flats. Claypans.
			<i>Eleocharis papillosa</i>	Skeletal soils. Sandstone hills.
			<i>Stackhousia clementii</i>	Flat, stony plain. Roadsides.
Low	Low	Priority 1	<i>Isotropis forrestii</i>	Coarse white sand, dune tops, and disturbed areas
	Low	Priority 3	<i>Myriocephalus scalpellus</i>	Stony clay loam and sandy alluvium. Along drainage lines.
			<i>Carpobrotus</i> sp. Thevenard Island (M. White 050)	Clay and depressions on flood plain.

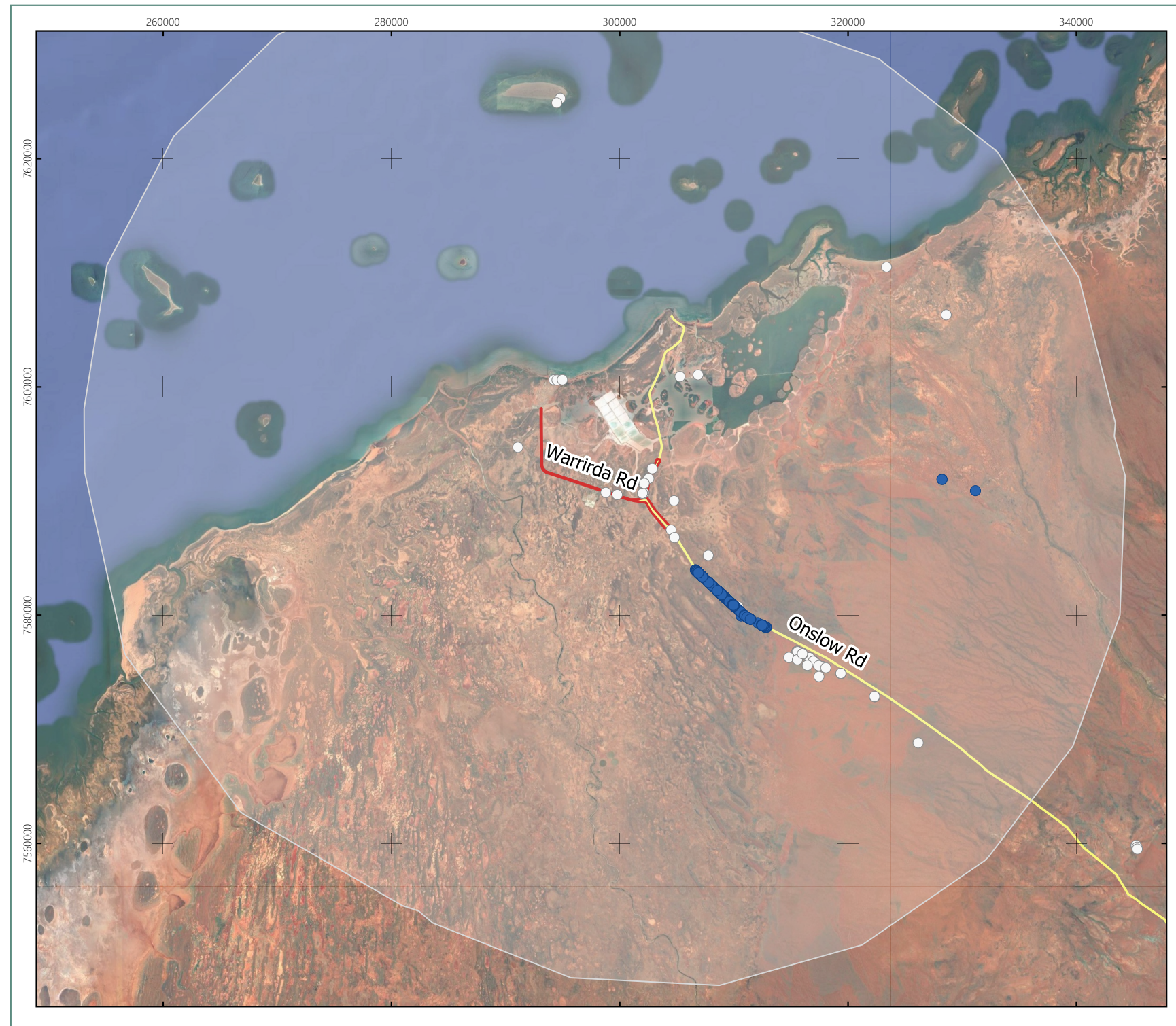
3.1.2. TEC, PECs & Other Significant Vegetation

Two PECs were identified in the desktop review for the Project – Peedamulla Marsh vegetation complex (Priority 1) and Coastal dune native tussock grassland dominated by *Whiteochloa airoides* (Priority 3). Known occurrences of both PECs are more than 20 km from the Survey Area, and neither are related to land systems or vegetation associations occurring within the Survey Area. Therefore, the PECs were assigned a Low likelihood of occurrence (Table 3.2; Map 1.1).

Table 3.2: PECs Recorded from Desktop Assessment

Pre-survey Likelihood	Status	Name	Description	Distance from Survey Area & Area Within (ha)
Low	PEC: Priority 1	Peedamulla Marsh vegetation complex	Peedamulla (Cane River) Swamp Cyperaceae community, near mouth of Cane River.	30 km east
Low	PEC: Priority 3	Coastal dune native tussock grassland dominated by <i>Whiteochloa airoides</i>	Coastal dune tussock grassland dominated by <i>Whiteochloa airoides</i>	27 km north (Thevis island)

No other significant vegetation was identified during previously conducted flora surveys in the vicinity of the Survey Area.



Legend

- Survey Area
- Desktop Study Area
- Project Roads
- Significant Flora**
- Priority 1
- Priority 3

0 4 8 12 km
 Scale 1:450000 @ A4
Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter

Author: RD Approved: XX Date: 01-10-2021

Desktop Assessment Significant Flora

HV Carriageway in Warrirda Road Reserve

Prepared for
Main Roads
Western Australia

MAP
3.1

3.2. Flora Assessment

3.2.1. General Flora

A total of 145 taxa from 36 families and 97 genera were recorded within the Survey Area and are listed in Appendix D. The most species rich family was Fabaceae, with 32 species from 12 genera, followed by Poaceae with 26 species from 20 genera. The most species rich genera were *Acacia* with ten species, followed by *Indigofera* with five species. Of the 145 taxa recorded, nine were introduced flora species and two were significant flora species.

3.2.2. Species Accumulation Curve

Species accumulation curves (SAC) show the relationship between sampling effort and the number of species recorded and can therefore be used to discuss sampling adequacy. As sampling effort (quadrats) increases, the rate at which new species are recorded is reduced, and this is used to predict the number of species that are likely to be present within the Survey Area.

A SAC is presented in Figure 3.1, which was plotted using the *specaccum* function in the *vegan* package in R v.4 (R Core Team, 2021). The improved Chao 2 non-parametric species richness estimator (Chiu *et al.*, 2014) was determined at 133 (95% CI [122, 149]), suggesting that 75% of flora species were recorded during the survey, based on the 100 taxa recorded within quadrats. Should the additional 45 taxa recorded during opportunistic collections and relevés be included in the total, the results suggest that sampling effort was adequate to record species within the survey area.

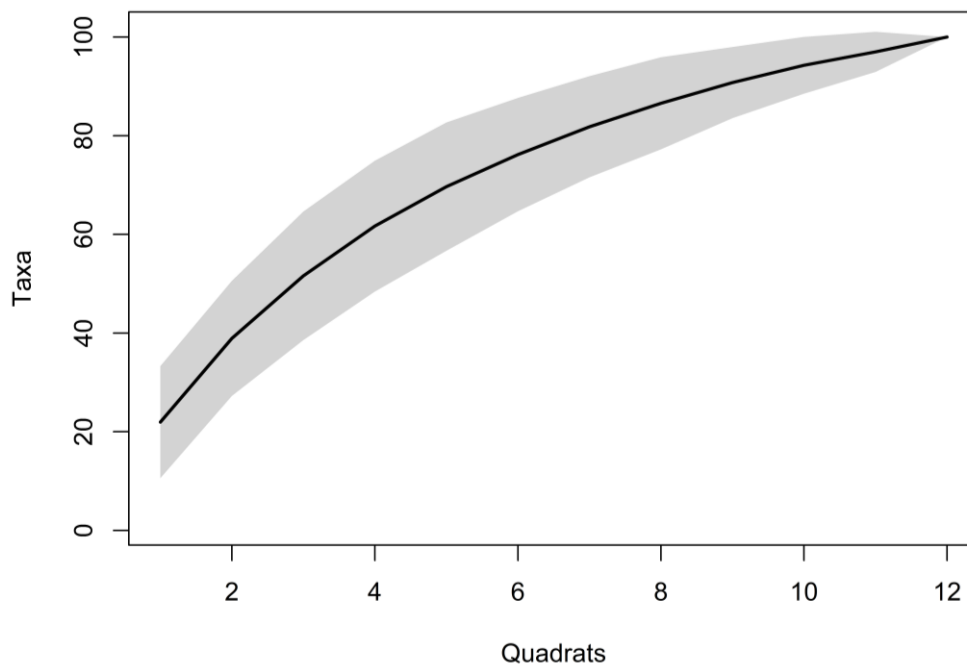


Figure 3.1 Species Accumulation Curve

3.2.3. Significant Flora

No Threatened flora taxa were recorded during the desktop or current assessment or is considered likely to occur in the Survey Area.

Two Priority 3 flora species were recorded within the Survey Area: *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata* (Table 3.3, Map 3.2). The same two Priority taxa were identified as recorded during the desktop assessment, confirming the accuracy of the search results. Both Priority taxa occurred exclusively on red sand dunes, mainly along Onslow Road.

Eremophila forrestii subsp. *viridis* was recorded widespread across the swales and footslopes of the red sand dunes, with 1,073 individuals recorded during the assessment. Of these, 950 individuals were recorded within, and 123 individuals were recorded outside of the Survey Area (Table 3.3; Map 3.2).

Eremophila forrestii subsp. *viridis* is previously known from two previous locations in the vicinity of the Survey Area at approximately 2.5 km (no abundance or habitat details) and 9 km (6-20 plants on red sand dune). There were four other previously known locations recorded within, or very close to, the Survey Area. It is likely to be widespread across the sand dune and sandy areas in vicinity of the Survey Area. *Eremophila forrestii* subsp. *viridis* is known from multiple locations across Western Australia, and has been recorded on sandy and rocky habitats across six IBRA regions (Carnarvon, Pilbara, Little Sandy Desert, Great Sandy Desert, Great Victoria Desert, Central Ranges) and is therefore not regionally restricted (Chinnock, 2007).



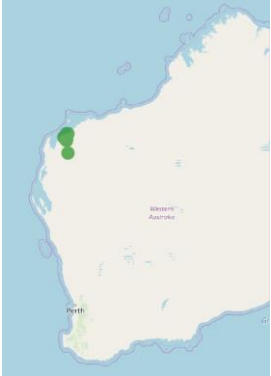

Triumfetta echinata was recorded scattered along the dune crests with 103 individuals recorded. Of these, one individual was recorded outside of the Survey Area (Table 3.3; Map 3.2).

Triumfetta echinata is previously known from six locations in the vicinity of the Survey Area at approximately 0.6 km (no abundance or habitat details), 3.9 km (on red sand dune, no abundance details), 17 km (no abundance or habitat details), 28 km (on red sand, no abundance details), 26 km (on red sand dune, common abundance), and 28 km (on red sand dune, no abundance details). There were two other previously known locations recorded within, or very close to, the Survey Area. These records were all found on red sand dunes. It is likely to be widespread across the sand dune and sandy areas in vicinity of the Survey Area. *Triumfetta echinata* is known from multiple locations across Western Australia, and has been recorded on red sand and sand dune habitats across three IBRA regions (Carnarvon, Gascoyne, and Pilbara) and is therefore not regionally restricted (Western Australian Herbarium, 2020).

Coordinates of all significant flora taxa have been provided electronically with this report.

No other significant flora taxa (as listed in section 2.4) were recorded at the Survey Area during the field assessment. The four significant flora taxa assigned High or Medium likelihood of occurrence prior to the survey, namely *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095), *Eleocharis papillosa*, *Stackhousia clementii*, and *Abutilon* sp. Onslow (F. Smith s.n. 10/9/61), were assigned a Low likelihood of occurrence post survey, as the survey effort was sufficient and there were no limitations and constraints for the detailed flora and vegetation assessment (Appendix C).

Table 3.3: Priority Flora Recorded at the Survey Area

Description	Landform	# of individuals	Map	Photograph	Local Distribution	Regional Distribution
<i>Eremophila forrestii</i> subsp. <i>viridis</i>						
Much-branched shrub, approximately 1 m high, with pink-cream flowers recorded.	Recorded on the swales and footslopes of red sand dunes within the Survey Area.	Survey: Within Survey Area - 950 Outside Survey Area - 123 Total - 1,073			Known from six locations in the local area.	Known from many scattered locations throughout Western Australia: Carnarvon, Pilbara, Little Sandy Desert, Great Sandy Desert, Great Victoria Desert, Central Ranges.
<i>Triumfetta echinata</i>						
Prostrate shrub, to 0.3 m high, with yellow flowers and spiky, round fruits recorded.	Recorded on crests of red sand dunes within the Survey Area	Survey: Within Survey Area - 102 Outside Survey Area - 1 Total - 103			Known from eight locations in the local area.	Known from Carnarvon, Gascoyne, and Pilbara IBRA regions.

294000

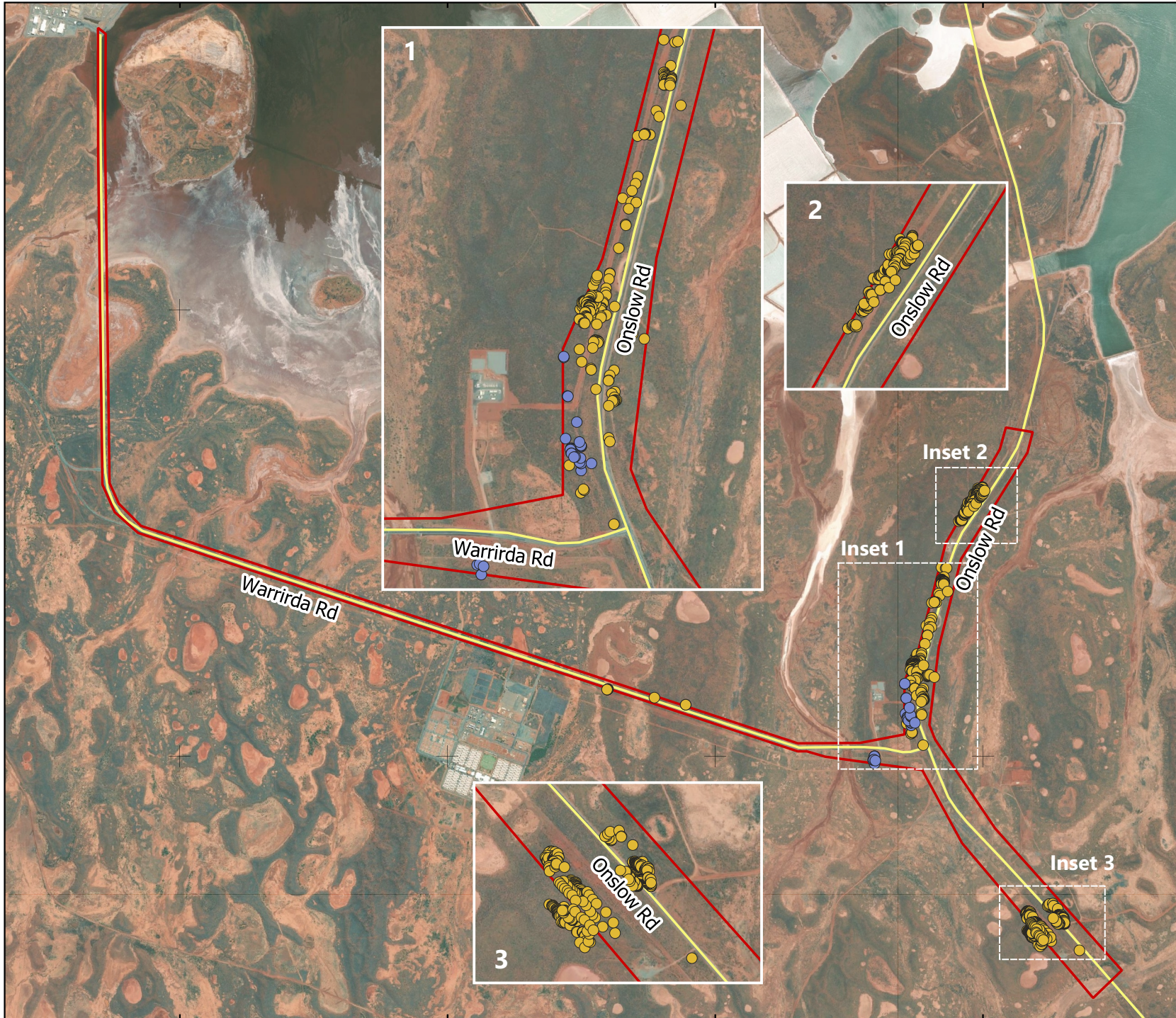
297000

300000

303000

7595000

7590000



Legend

Survey Area

Project Roads

Priority taxa

● *Triumfetta echinata*

● *Eremophila forrestii* subsp. *viridis*



0 0.5 1 1.5 km

Scale 1:60,000 @ A4

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



Author: RD

Date: 09-07-2021

Priority Flora recorded at the Survey Area

HV Carriageway in Warrirda Road Reserve

Prepared for
Main Roads
Western Australia

MAP
3.2

3.2.4. Introduced Flora

Nine introduced flora species were recorded at the Survey Area of which two are Declared Pests and one was a Weed of National Significance (WoNS). Among the Declared Pests, **Prosopis pallida* (Mesquite) is classified as Prohibited - s12, and should be eradicated from Western Australia, and **Tamarix aphylla* (Athel Pine) is exempt from restricted keeping categories and has not been assigned required control measures. **Tamarix aphylla* is also a WoNS.

Of the introduced flora species recorded, **Cenchrus ciliaris* was the most prevalent across the Survey Area, especially along the roadside, and formed the dominant understory species in three vegetation types (P1b, P3, DL1). Vegetation type P3 was dominated by weeds with **Prosopis pallida* forming the dominant structural component. Vegetation type DL1 was also dominated by weeds with **Vachellia farnesiana* forming a dominant structural component.

All introduced flora species are listed in Table 3.4. Locations have been provided on Map 3.3 and electronically with the report.

Table 3.4: Introduced Flora Recorded at the Survey Area

Family	Species	Location	Environmental Significance
Amaranthaceae	<i>*Aerva javanica</i>	Opportunistic collections, Q006, Q010, R001, R006	Permitted - s11
Asteraceae	<i>*Flaveria trinervia</i>	Q002, Q004, Q009	Permitted - s11
Fabaceae	<i>*Prosopis pallida</i>	Q010, R005, occurrence at the Survey Area was mapped as vegetation type P3	Declared Pest, Prohibited - s12 (C2 Prohibited)
	<i>*Stylosanthes hamata</i>	Opportunistic collection	Permitted - s11
	<i>*Vachellia farnesiana</i>	Opportunistic collection, Q010, Q011, R009	Permitted - s11
Malvaceae	<i>*Malvastrum americanum</i>	R005	Permitted - s11
Poaceae	<i>*Cenchrus ciliaris</i>	Opportunistic collection, Q001, Q002, Q003, Q004, Q006, Q007, Q008, Q009, Q010, Q011, Q012, R001, R003, R004, R005, R006, R008, R009, R010, R013	Permitted - s11
	<i>*Cenchrus setiger</i>	Opportunistic collection, R005	Permitted - s11
Tamaricaceae	<i>*Tamarix aphylla</i>	Opportunistic collection – only one location recorded during the survey. Not seen elsewhere during any traverses.	Weed of National Significance (WoNS), Declared Pest - s22(2) (Exempt)



Legend

- Survey Area
- ◆ *Aerva javanica
- ◆ *Cenchrus ciliaris
- ◆ *Cenchrus setiger
- ◆ *Flaveria trinervia
- ◆ *Malvastrum americanum
- ◆ *Prosopis pallida
- ◆ *Stylosanthes hamata
- ◆ *Tamarix aphylla
- ◆ *Vachellia farnesiana
- Prosopis pallida polygon



0 0.5 1 1.5 km
 Scale 1:60000 @ A4

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



Author: RD Date: 20-10-2021

Introduced Flora recorded at the Survey Area

HV Carriageway in Warrirda Road Reserve

Prepared for
 Main Roads
 Western Australia

MAP
3.3

3.3. Field Vegetation Assessment

3.3.1. Vegetation Types

A total of eight vegetation types were described from the Survey Area, including four derived from floristic analysis of quadrat data (Figure 3.2), and four additional structural groups using the relevé data (Table 3.6; Map 3.4 to Map 3.11). Vegetation was described structurally for four vegetation types, as these units were in Degraded or Completely Degraded condition, or where there was no vegetation (i.e. tidal flats). Floristic vegetation type P1 was further split into two structural types (P1a and P1b), based on level of dominance of **Cenchrus ciliaris* in the understorey stratum.

The claypans were grouped into one floristic group (C1) and one structural group consisting of bare clay pans and tidal mud flats (C2). These were characterised by *Tecticornia auriculata* or *Tecticornia indica* subsp. *leiostachya* with or without *Eragrostis pergracilis* and/or **Cenchrus ciliaris* low sparse tussock grassland.

The dunes and low sandy rises were grouped into one floristic group (D1). They were characterised by *Scaevola sericophylla* and *Acacia stellaticeps* mid sparse shrubland over *Triodia epactia* open hummock grassland, with or without *Grevillea stenobotrya* tall sparse shrubland. The two Priority taxa, *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata*, were exclusively associated with this vegetation type.

The plains were grouped into two floristic groups (P1a, P2) and two structural groups characterised by the dominance of weeds (P1b, P3). The floristic groups (P1a, P2) were characterised by differing overstorey species, including *Acacia tetragonophylla*, *Acacia synchronicia* isolated tall shrubs, over *Triodia epactia* hummock grassland or tussock grassland. The structural groups were characterised by **Cenchrus ciliaris* low open tussock grassland with or without **Prosopis pallida* overstorey.

The drainage lines were grouped into one structural group (DL1). They were characterised by +/- *Eucalyptus camaldulensis* subsp. *refulgens* isolated low trees, over *Acacia tetragonophylla* and **Vachellia farnesiana* tall open shrubland over **Cenchrus ciliaris* sparse tussock grassland.

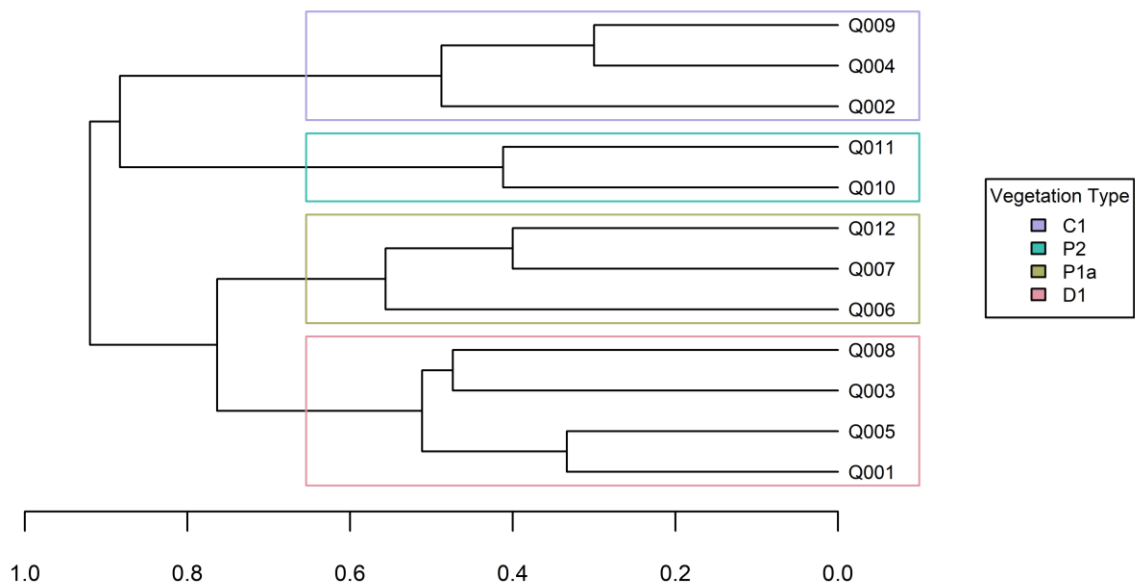


Figure 3.2: Dendrogram of Floristic Analysis

3.3.2. Significant Vegetation

No vegetation recorded within the Survey Area resembles any known TEC or PEC communities.

Based on the definitions of significant vegetation listed in section 2.4 (EPA 2016a) vegetation Type D1 is considered significant as it acts as a role as refuge (providing habitat) for the two Priority 3 flora species, *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata*, found exclusively on the dunes and this vegetation type.

The majority of vegetation type D1 was recorded on sand dunes and swales that are mapped and associated with the Dune land system. Some areas were also mapped on sand dunes associated within the Onslow land system. Dunes account for approximately 5% of the total area of the Onslow land system with the majority of landforms described as clay plains, saline flats, drainage floors, and sand plains (Van Vreeswyk *et al.*, 2004) which are not suitable habitat for vegetation type D1.




Vegetation type D1 is likely to be widespread in the local area as dune landforms are common. Vegetation type D1 is mapped as 77 ha of the Survey Area. There is 20,512 ha of the Dune land system mapped in the desktop Study Area, therefore of the potential habitat for vegetation type D1 within the desktop Study Area, 0.3% is mapped within the Survey Area.




The Dune land system is mostly restricted to small patches along the coastline of the Carnarvon region. Within the Carnarvon region there is 37,448 ha or 84% of the total area (44,402 ha in Western Australia) of the Dune land system mapped within. The Onslow land system extends 100 km further east into the Pilbara region along the coastline and may provide some habitat for vegetation type D1 however as the habitats within this land system are not dominated by dune landforms, it is not likely to be widespread. Therefore vegetation type D1 is likely to be restricted regionally (Table 3.5).



Table 3.5: Local & Regional Significance of Significant Vegetation Types

Vegetation Type	Significance	Condition	Local Discussion	Regional Discussion
Type D1: +/- <i>Grevillea stenobotrya</i> tall sparse shrubland over <i>Scaevola sericophylla</i> , +/- <i>Acacia stellaticeps</i> mid sparse shrubland over <i>Triodia epactia</i> open hummock grassland.	Role as refuge	Good to Very Good	Mapped commonly throughout Survey Area and sand dune landforms are common in the local vicinity.	Not comparable to any Beard vegetation sub-associations. Dune land system is restricted to small areas along the coastline mostly within the Carnarvon region (84% of total mapped area). Almost 50% of the total area (44,402 ha) is within the desktop Study Area (22,512 ha).

Table 3.6: Vegetation Types Recorded at the Survey Area

Code	Vegetation Description (NVIS)	Associated Species	Landform, Condition	Sites	Area & %	Representative Photo
Claypans						
C1	<i>Tecticornia auriculata</i> or <i>Tecticornia indica</i> subsp. <i>leiostachya</i> low open shrubland over <i>Eragrostis pergracilis</i> and/or * <i>Cenchrus ciliaris</i> low sparse tussock grassland.	<i>Cullen cinereum</i> <i>Cyperus bulbosus</i> <i>Lawrenca viridigrisea</i> <i>Nicotiana occidentalis</i> subsp. ? <i>occidentalis</i> <i>Portulaca oleracea</i> <i>Swainsona pterostylis</i>	Drainage plain, salt pans on clay soils.	Q002 Q004 Q009 R008 R010	15.4 ha 4.1%	
C2	+/- <i>Tecticornia auriculata</i> low isolated shrubs.	-	Bare clay pans, tidal mud flats.	R002	26.5 ha 7.1%	
Dunes						
D1	+/- <i>Grevillea stenobotrya</i> tall sparse shrubland over <i>Scaevola sericophylla</i> , +/- <i>Acacia stellaticeps</i> mid sparse shrubland over <i>Triodia epactia</i> open hummock grassland.	<i>Abutilon</i> sp. Dioicum (A.A. Mitchell PRP 1618) * <i>Cenchrus ciliaris</i> <i>Eremophila forrestii</i> subsp. <i>viridis</i> (P3) <i>Hakea stenophylla</i> subsp. <i>stenophylla</i> <i>Indigofera colutea</i> <i>Triumfetta echinata</i> (P3) <i>Yakirra australiensis</i> var. <i>australiensis</i>	Sand dunes, swales, low rises.	Q001 Q003 Q005 Q008 R012	77.1 ha 20.7%	

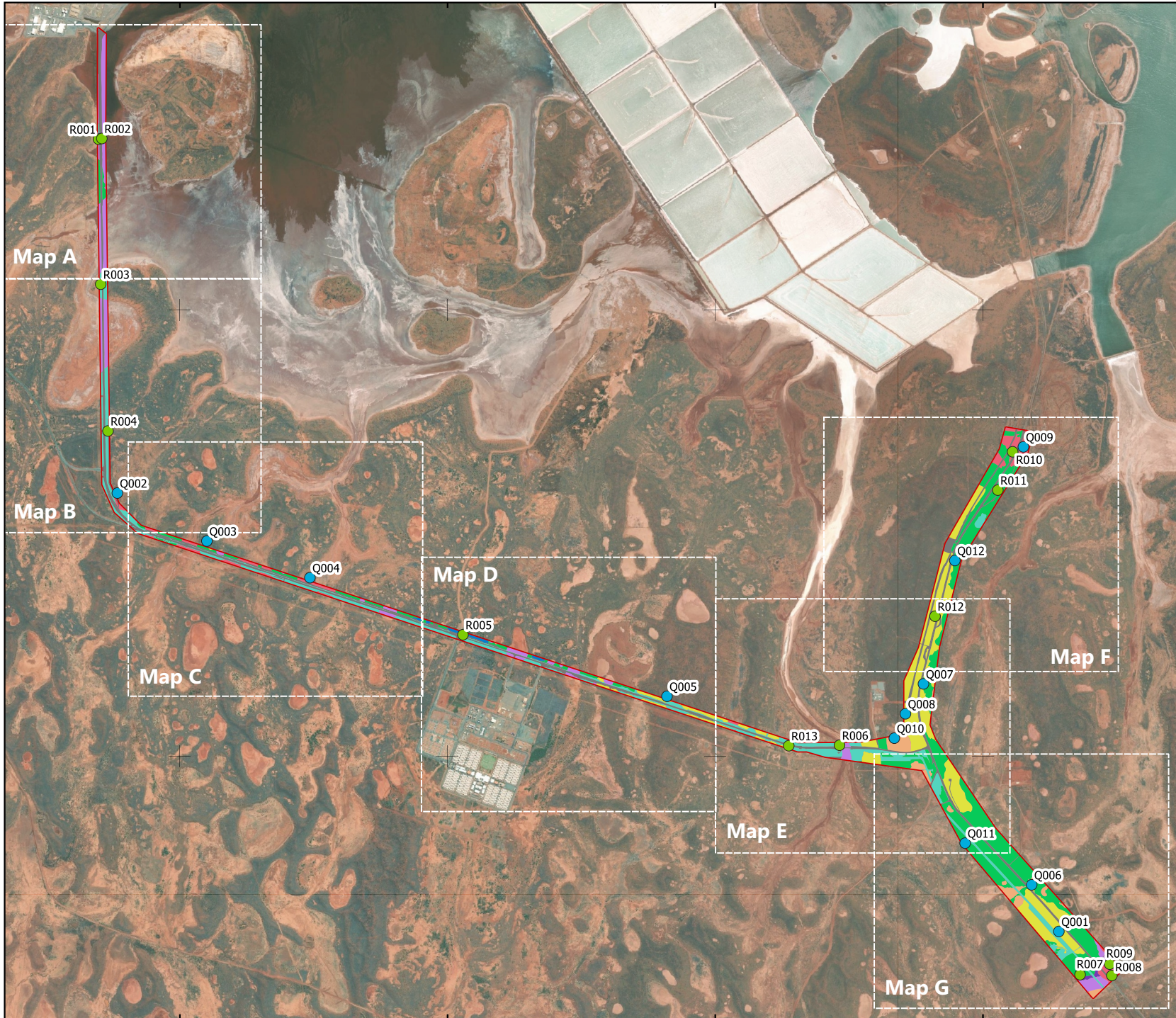
Code	Vegetation Description (NVIS)	Associated Species	Landform, Condition	Sites	Area & %	Representative Photo
Drainage Line						
DL1	+/- <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> low isolated trees over <i>Acacia tetragonophylla</i> and * <i>Vachellia farnesiana</i> tall open shrubland over * <i>Cenchrus ciliaris</i> sparse tussock grassland.	<i>Acacia synchronicia</i> <i>Ipomoea muelleri</i>	Drainage line. Degraded condition. Mostly no native species present.	R009	2.1 ha 0.6%	
Plains						
P1a	+/- <i>Acacia tetragonophylla</i> tall isolated shrubs over <i>Triodia epactia</i> open hummock grassland.	<i>Abutilon</i> sp. Dioicum (A.A. Mitchell PRP 1618) <i>Acacia stellaticeps</i> <i>Acacia synchronicia</i> <i>Enchylaena tomentosa</i> <i>Indigofera colutea</i> <i>Indigofera linifolia</i> <i>Rhagodia eremaea</i> <i>Senna glutinosa</i> subsp. <i>xluerssenii</i> <i>Yakirra australiensis</i> var. <i>australiensis</i>	Flat plains on sand/sandy clay/ clay soils.	Q006 Q007 Q012 R007 R011	108.3 ha 29.1%	
P1b	* <i>Cenchrus ciliaris</i> low open tussock grassland, with +/- <i>Triodia epactia</i> sparse hummock grassland.	<i>Acacia synchronicia</i> <i>Aerva javanica</i> <i>Neobassia astrocarpa</i>	Flat plains / Floodplains on sandy clay soils. Structurally separated from P1a due to dominance of * <i>Cenchrus ciliaris</i> .	R001 R003 R004 R006 R013	58.0 ha 15.6%	

Code	Vegetation Description (NVIS)	Associated Species	Landform, Condition	Sites	Area & %	Representative Photo
P2	<i>Acacia synchronicia</i> , <i>Acacia tetragonophylla</i> and <i>*Vachellia farnesiana</i> tall sparse shrubland over <i>Scaevola spinescens</i> and <i>Sesbania cannabina</i> mid sparse shrubland over <i>Diplachne fusca</i> subsp. <i>fusca</i> , <i>Eulalia aurea</i> , and <i>*Cenchrus ciliaris</i> sparse tussock grassland.	<i>Cullen cinereum</i> <i>Cyperus iria</i> <i>Cyperus rigidellus</i> <i>Enchylaena tomentosa</i> <i>Marsilea exarata</i> <i>Rhagodia eremaea</i> <i>Streptoglossa decurrens</i>	Minor depressions on clay to sandy clay soils.	Q010 Q011	13.2 ha 3.5%	
P3	<i>*Prosopis pallida</i> tall closed shrubland over <i>*Cenchrus ciliaris</i> open tussock grassland.	<i>*Vachellia farnesiana</i>	Unnatural depression on sandy clay soils. Degraded condition. Mostly no native species present.	R005	1.9 ha 0.5%	
Other						
-	Cleared (no vegetation)	N/A	N/A	-	69.6 ha 18.7%	-

294000 297000 300000 303000

7595000

7590000



Legend

Survey Area

Flora Survey Sites

● Quadrat

● Releve

Vegetation Mapping Code

■ C1

■ C2

■ DL1

■ D1

■ P1a

■ P1b

■ P2

■ P3

■ Cleared



0 0.5 1 1.5 km

Scale 1:60,000 @ A4

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



Author: RD

Date: 09-07-2021

Vegetation Types – Overview

HV Carriageway in Warrirda Road Reserve

Prepared for
Main Roads
Western Australia

MAP

3.4

292000

293000

294000

7598000

7597000

7596000



Legend

Survey Area

Flora Survey Sites

Quadrat

Releve

Vegetation Mapping Code

C1

C2

DL1

D1

P1a

P1b

P2

P3

Cleared



0 0.25 0.5 km

Scale 1:15,000 @ A4

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



Author: RD

Date: 09-07-2021

Vegetation Types – Map A

HV Carriageway in Warrirda Road
Reserve

Prepared for
Main Roads
Western Australia

MAP
3.5

292000

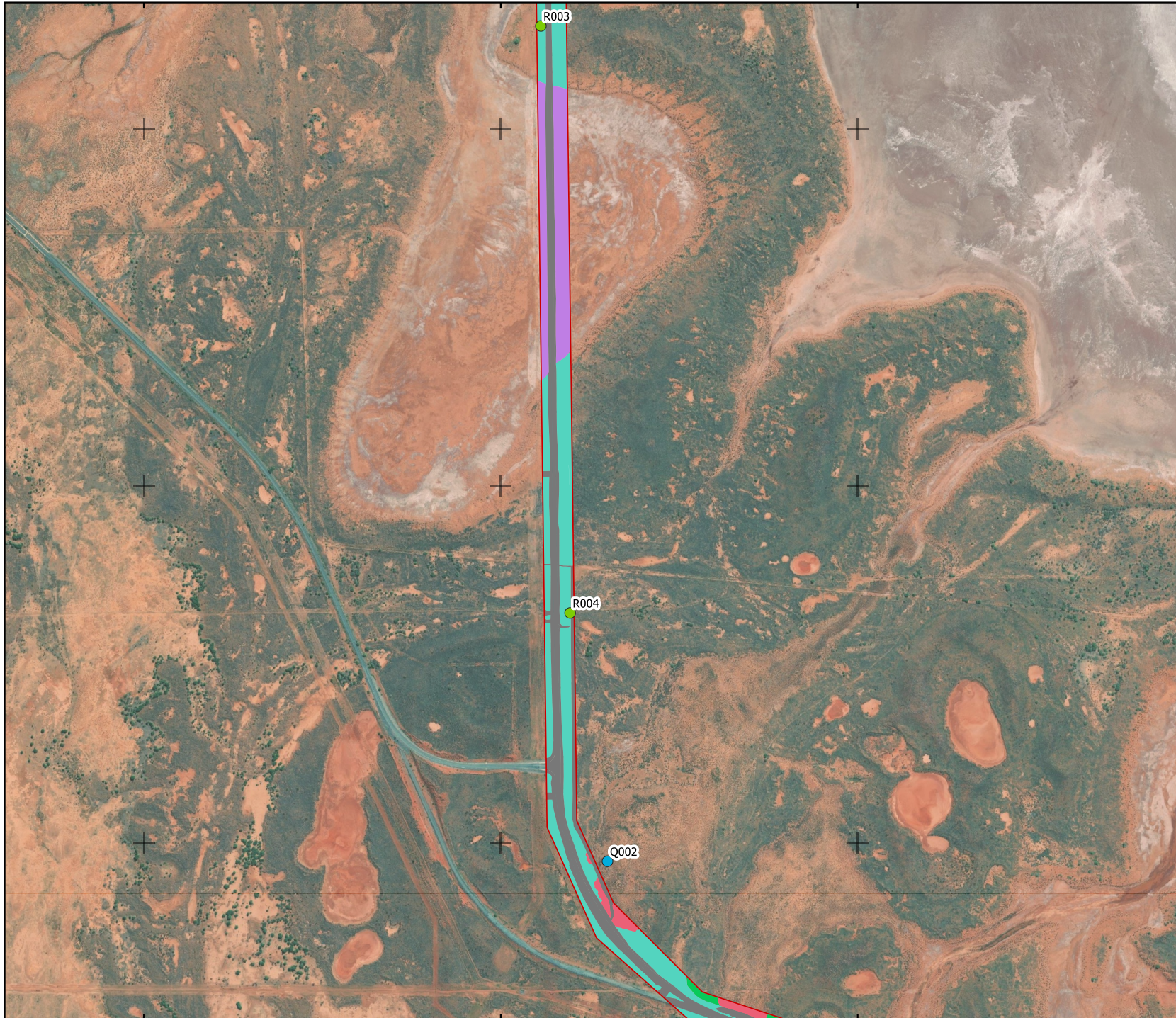
293000

294000

7595000

7594000

7593000



Legend

Survey Area

Flora Survey Sites

Quadrat

Releve

Vegetation Mapping Code

C1

C2

DL1

D1

P1a

P1b

P2

P3

Cleared



0 0.25 0.5 km

Scale 1:15,000 @ A4

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



Author: RD

Date: 09-07-2021

Vegetation Types – Map B

HV Carriageway in Warrirda Road
Reserve

Prepared for
Main Roads
Western Australia

MAP
3.6

294000

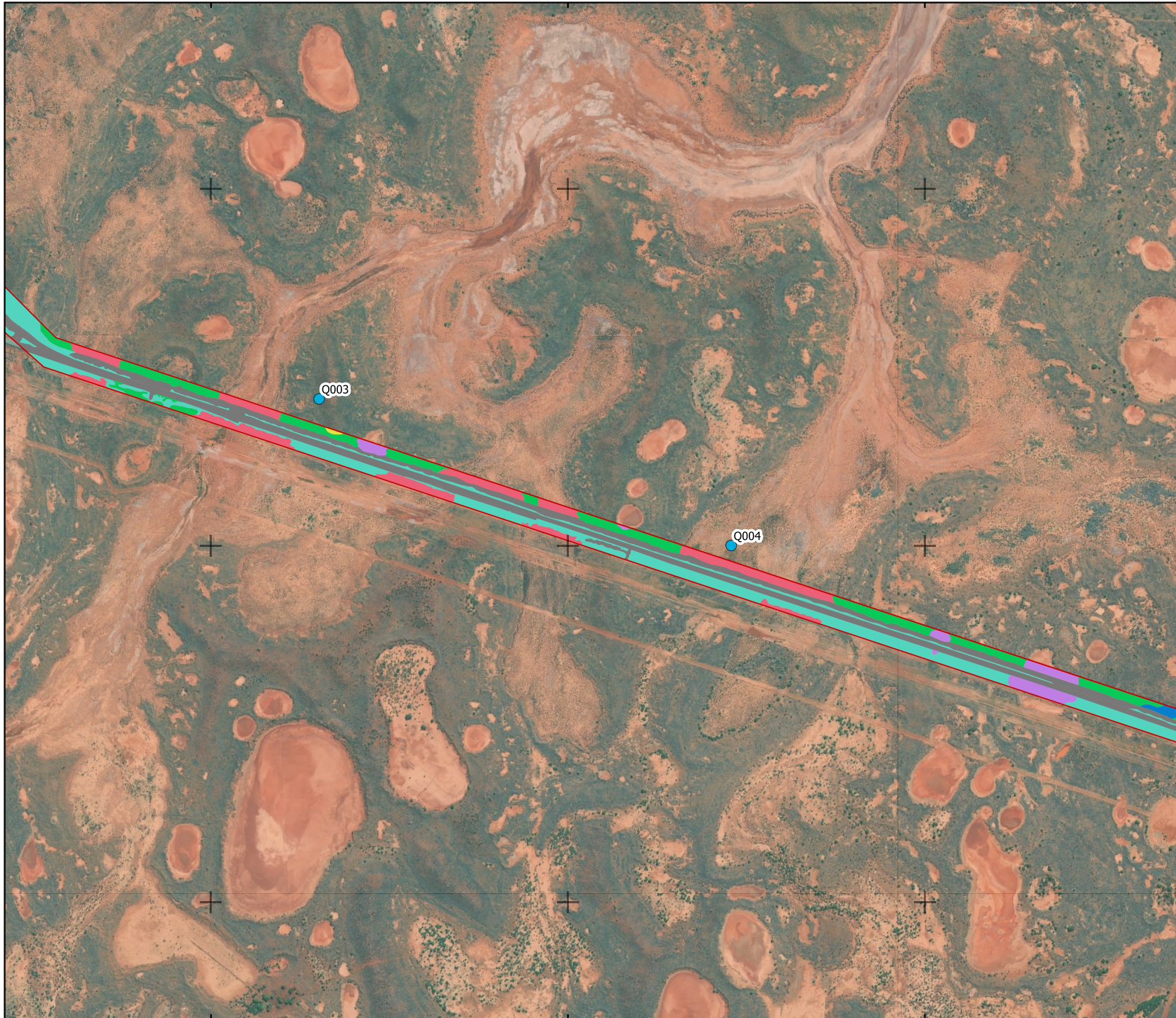
295000

296000

7593000

7592000

7591000



Legend

Survey Area

Flora Survey Sites

Quadrat

Releve

Vegetation Mapping Code

C1

C2

DL1

D1

P1a

P1b

P2

P3

Cleared



0 0.25 0.5 km

Scale 1:15,000 @ A4

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



Author: RD

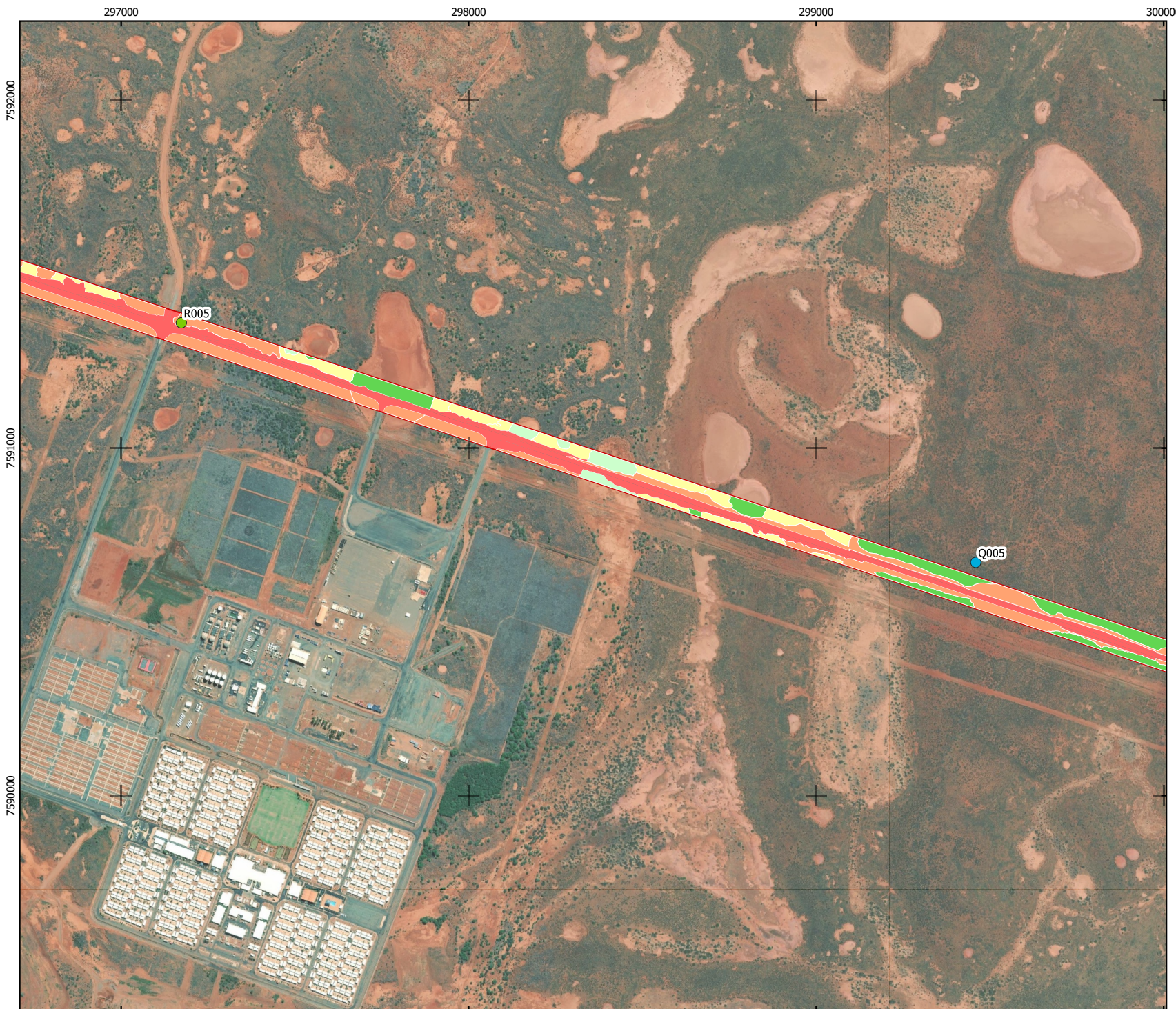
Date: 09-07-2021

Vegetation Types – Map C

HV Carriageway in Warrirda Road
Reserve

Prepared for
Main Roads
Western Australia

MAP
3.7



Legend

Survey Area

Flora Survey Sites

Quadrat

Releve

Vegetation Mapping Code

C1

C2

DL1

D1


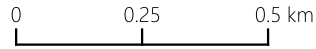
P1a

P1b

P2


P3

Cleared

 Scale 1:15,000 @ A4

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



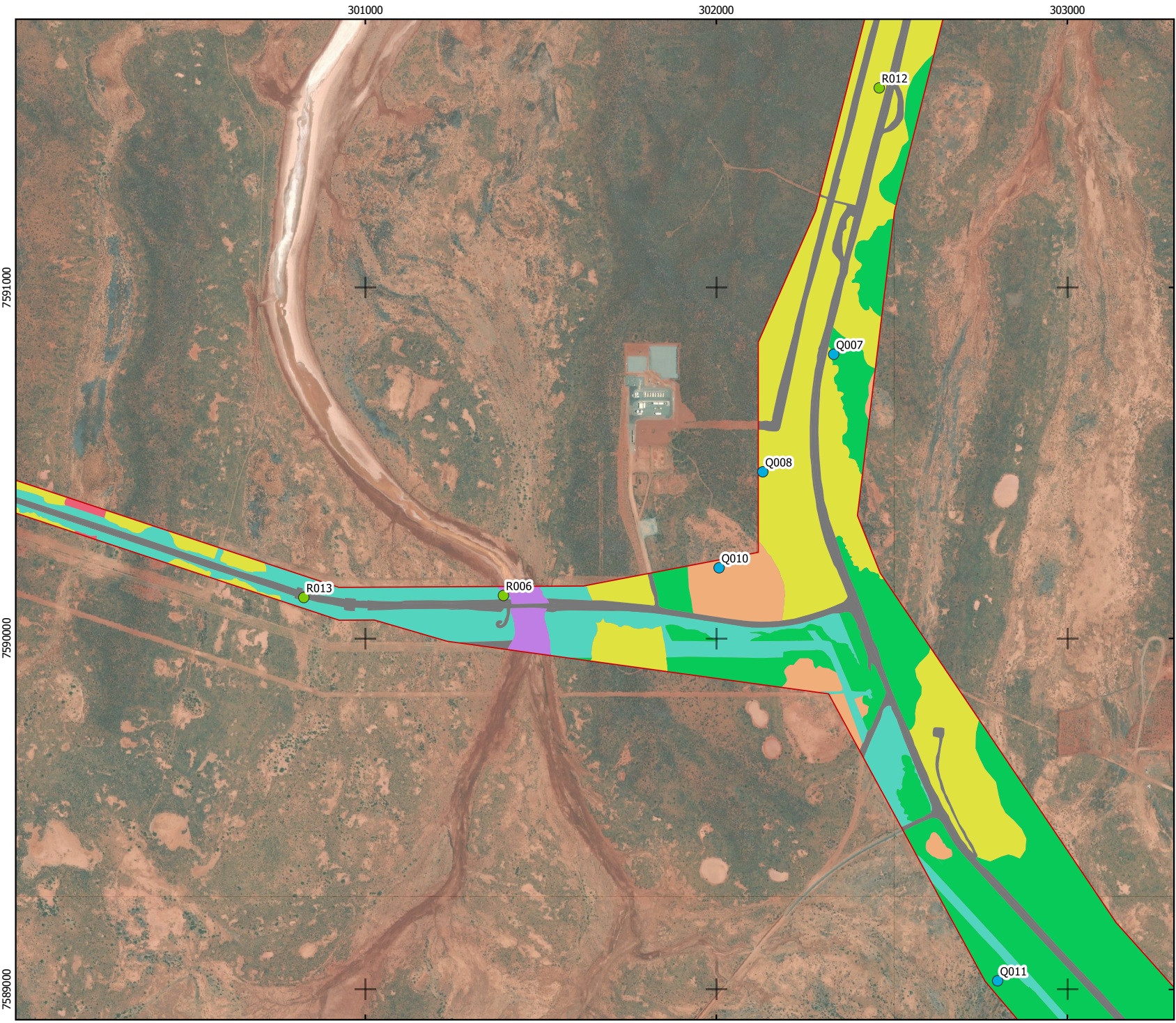
Author: RD Date: 09-07-2021

**Vegetation Types –
Map D**

HV Carriageway in Warrirda Road Reserve

Prepared for
Main Roads
Western Australia

**MAP
3.8**



Legend

Survey Area

Flora Survey Sites

Quadrat

Releve

Vegetation Mapping Code

C1

C2

DL1

D1

P1a

P1b

P2

P3

Cleared



0 0.25 0.5 km

Scale 1:15,000 @ A4

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



Author: RD

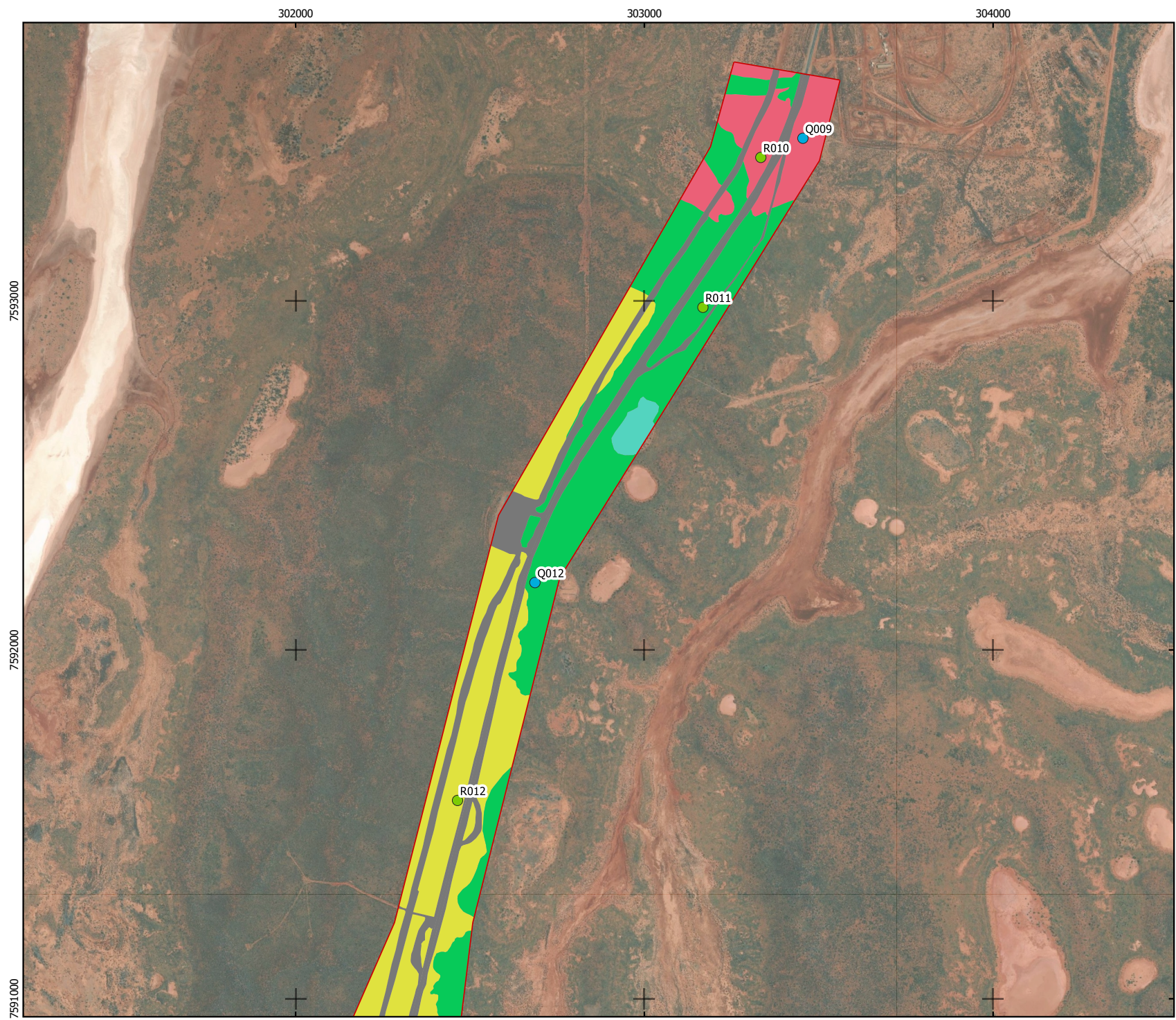
Date: 09-07-2021

Vegetation Types – Map E

HV Carriageway in Warrirda Road
Reserve

Prepared for
Main Roads
Western Australia

MAP
3.9



Legend

Survey Area

Flora Survey Sites

Quadrat

Releve

Vegetation Mapping Code

C1

C2

DL1

D1

P1a

P1b

P2

P3

Cleared

Scale 1:15,000 @ A4

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

SPECTRUM
 ECOLOGY & SPATIAL

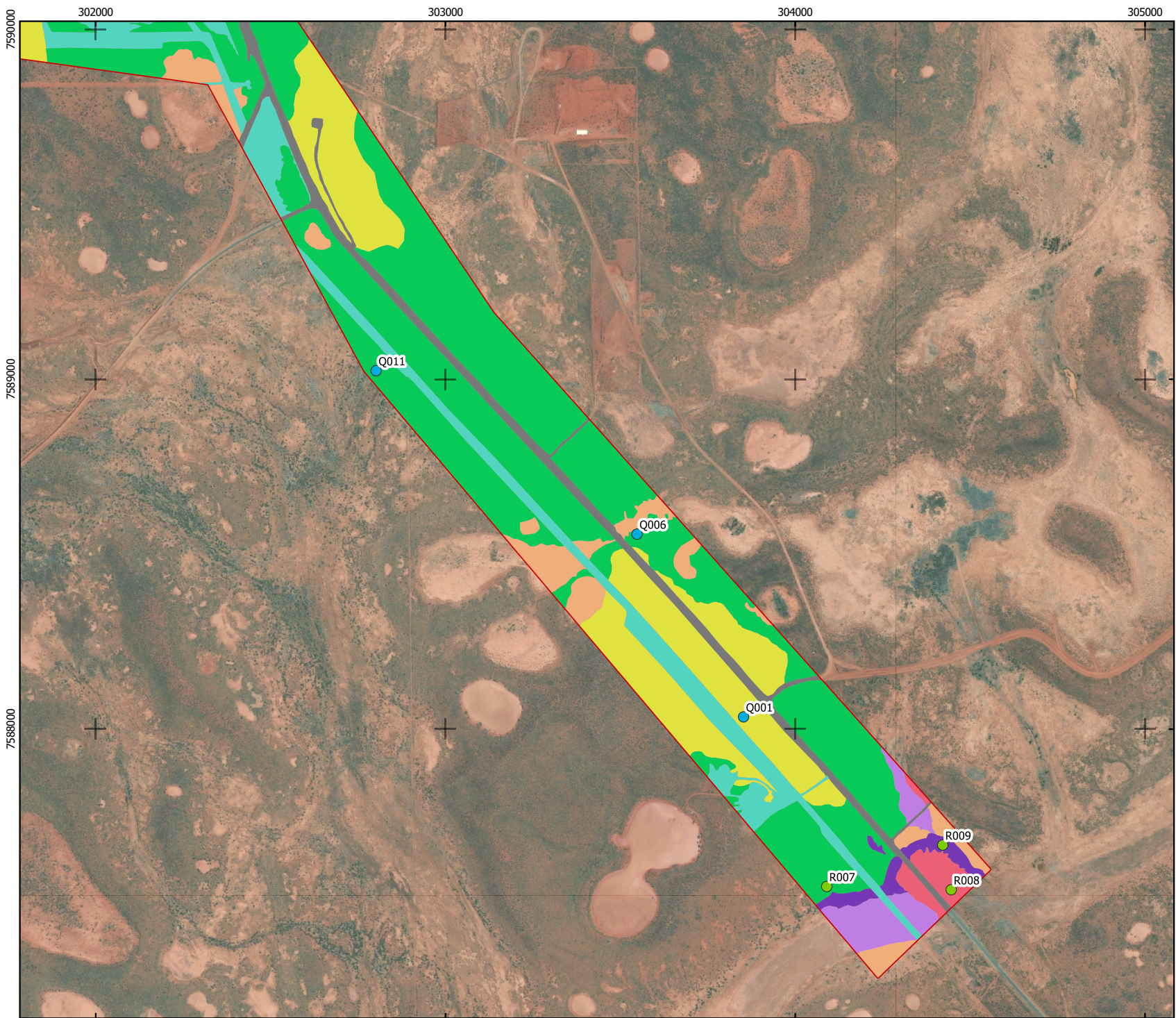
Author: RD Date: 09-07-2021

**Vegetation Types –
Map F**

HV Carriageway in Warrirda Road Reserve

Prepared for
 Main Roads
 Western Australia

MAP
3.10



Legend

Survey Area

Flora Survey Sites

● Quadrat

● Releve

Vegetation Mapping Code

- C1
- C2
- DL1
- D1
- P1a
- P1b
- P2
- P3
- Cleared



0 0.25 0.5 km

Scale 1:15,000 @ A4

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



Author: RD

Date: 09-07-2021

Vegetation Types – Map G

HV Carriageway in Warrirda Road
Reserve

MAP

Prepared for
Main Roads
Western Australia

3.11

3.3.3. Vegetation Condition

The vegetation condition within the Survey Area ranged from Very Good (49.1%) to Completely Degraded (18.7%). Vegetation condition varied within vegetation types based on previous disturbances and proximity to the road verge. Vegetation condition of the Survey Area is presented in Table 3.7 and mapped in Map 3.12 to Map 3.19.

Weeds were common, with **Cenchrus ciliaris* recorded commonly across the Survey Area, especially along the roadside, and forming the dominant understory species in three vegetation types (P1b, P3, DL1). Vegetation type P3 was dominated by weeds with **Prosopis pallida* forming the dominant structural overstorey component, and **Cenchrus ciliaris* the dominant understory. Vegetation type DL1 was also dominated by weeds with **Vachellia farnesiana* forming a dominant overstorey component and **Cenchrus ciliaris* the dominant understory.

Table 3.7: Vegetation Condition Recorded at the Survey Area

Condition	Area (ha) & % of Survey Area	Disturbance Detail in Survey Area
Excellent	-	-
Very Good	182.5 ha 49.1%	Scattered weeds, low levels of grazing within areas of undisturbed native vegetation.
Good	47.7 ha 12.8%	Moderate weed cover within undisturbed native vegetation.
Poor	65.3 ha 17.6%	Vegetation along roadside or larger areas that may have been cleared, dominated by weeds, but maintains some natural vegetation structural components.
Degraded	6.9 ha 1.8%	Previously cleared areas that have regenerated with very few native species along roadsides and areas dominated by weeds with no native species present.
Completely Degraded	69.6 ha 18.7%	Includes the parkland cleared and developed areas, including roads and roadsides with no vegetation present. Mapped as 'Cleared' in vegetation mapping and vegetation condition for this project.



Legend

- Survey Area
- Project Roads
- Flora Survey Sites**
 - Quadrat
 - Releve
- Vegetation Condition**
 - Very Good
 - Good
 - Poor
 - Degraded
 - Completely Degraded (Cleared)

0 0.5 1 1.5 km
 Scale 1:60,000 @ A4
Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter

Author: RD Date: 02-02-2022

Vegetation Condition – Overview

HV Carriageway in Warrirda Road Reserve

292000

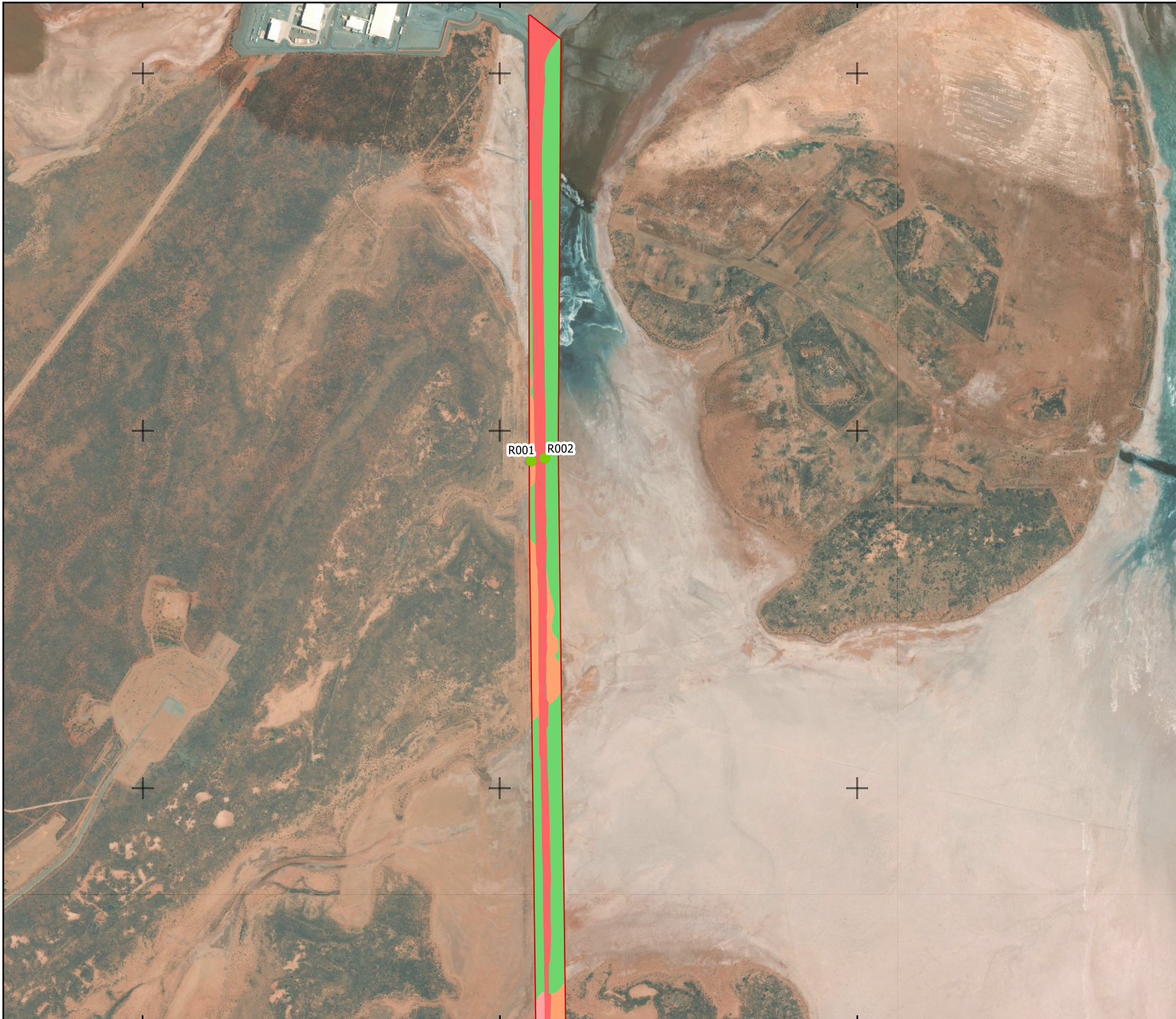
293000

294000

7598000

7597000

7596000



Legend

Survey Area

Flora Survey Sites

Quadrat

Releve

Vegetation Condition

Very Good

Good

Poor

Degraded

Completely Degraded (Cleared)



0 0.25 0.5 km

Scale 1:15,000 @ A4

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



Author: RD

Date: 02-02-2022

Vegetation Condition – Map A

HV Carriageway in Warrirda Road
Reserve

Prepared for
Main Roads
Western Australia

MAP

3.13

292000

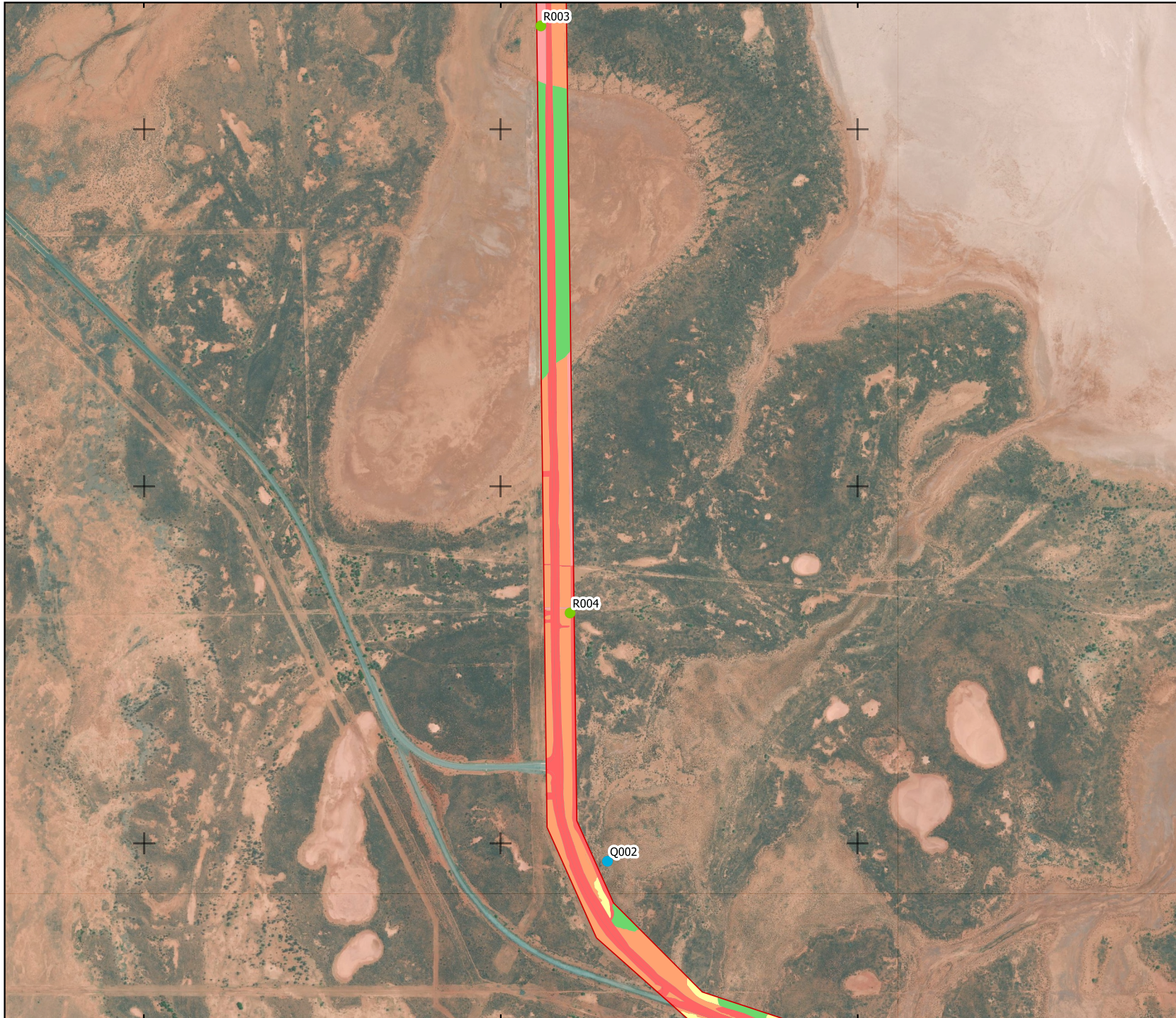
293000

294000

7595000

7594000

7593000



Legend

Survey Area

Flora Survey Sites

Quadrat

Releve

Vegetation Condition

Very Good

Good

Poor

Degraded

Completed Degraded (Cleared)



0 0.25 0.5 km

Scale 1:15,000 @ A4

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



Author: RD

Date: 02-02-2022

Vegetation Condition – Map B

HV Carriageway in Warrirda Road
Reserve

Prepared for
Main Roads
Western Australia

MAP

3.14

294000

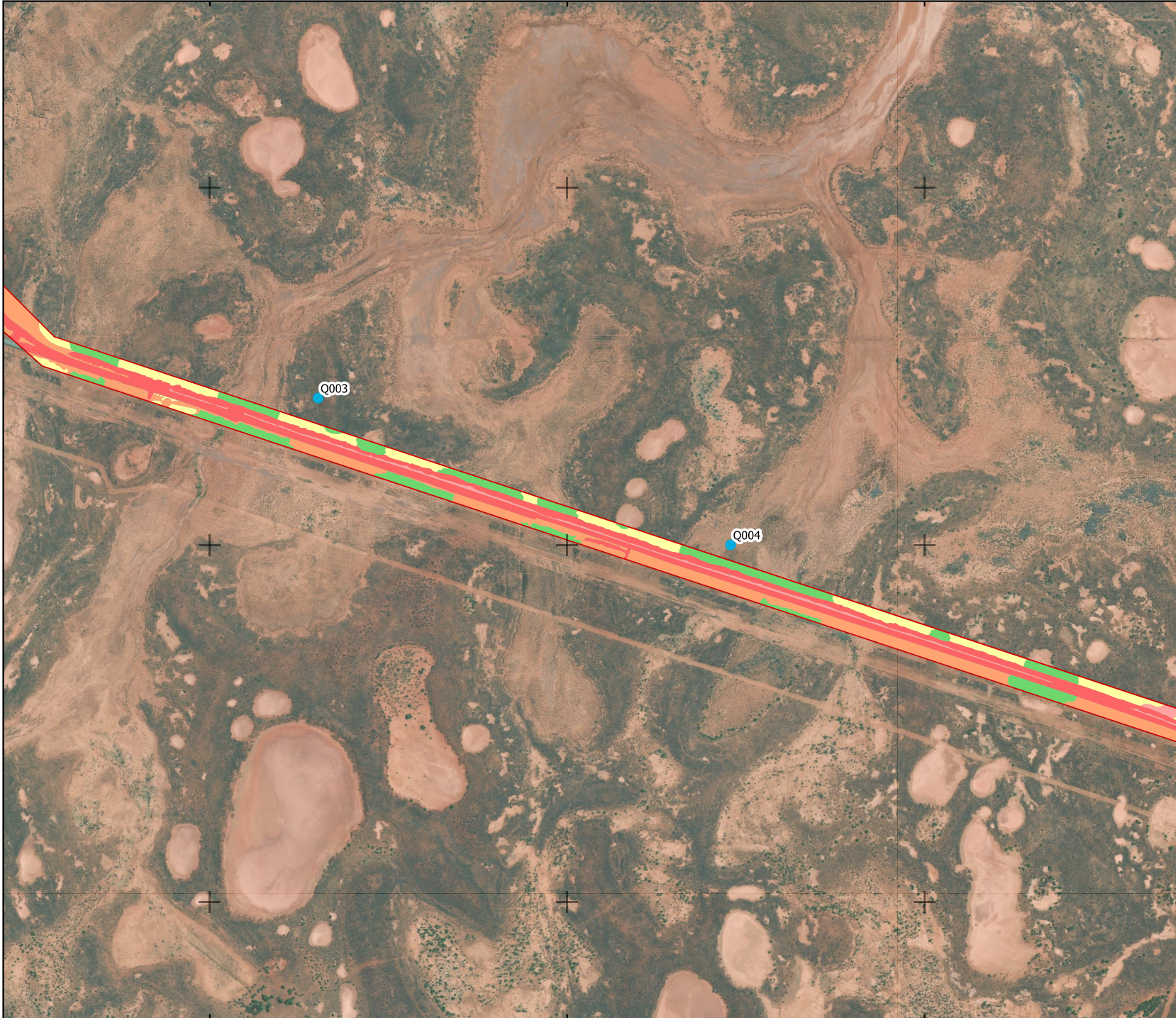
295000

296000

7593000

7592000

7591000



Legend

Survey Area

Flora Survey Sites

Quadrat

Releve

Vegetation Condition

Very Good

Good

Poor

Degraded

Completely Degraded (Cleared)



0 0.25 0.5 km

Scale 1:15,000 @ A4

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



Author: RD

Date: 02-02-2022

Vegetation Condition – Map C

HV Carriageway in Warrirda Road
Reserve

Prepared for
Main Roads
Western Australia

MAP

3.15



Legend

- Survey Area
- Flora Survey Sites
- Quadrat
- Releve
- Vegetation Condition
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded (Cleared)

0 0.25 0.5 km
 Scale 1:15,000 @ A4
Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter

Author: RD Date: 02-02-2022

Vegetation Condition – Map D

HV Carriageway in Warrirda Road
Reserve

301000

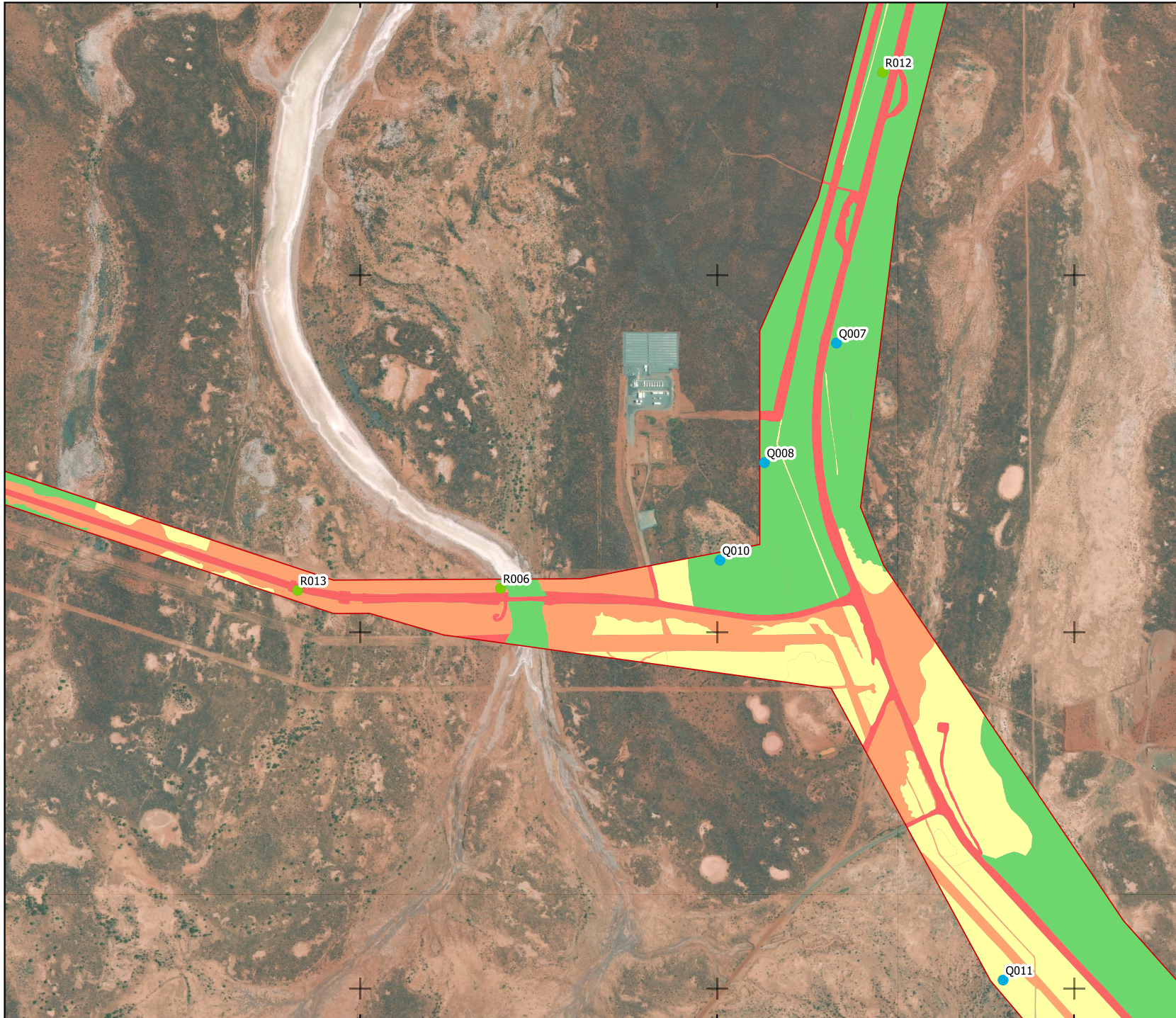
302000

303000

7591000

7590000

7589000



Legend

Survey Area

Flora Survey Sites

Quadrat

Releve

Vegetation Condition

Very Good

Good

Poor

Degraded

Completely Degraded (Cleared)



0 0.25 0.5 km

Scale 1:15,000 @ A4

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



Author: RD

Date: 02-02-2022

Vegetation Condition – Map E

HV Carriageway in Warrirda Road
Reserve

Prepared for
Main Roads
Western Australia

MAP
3.17

302000

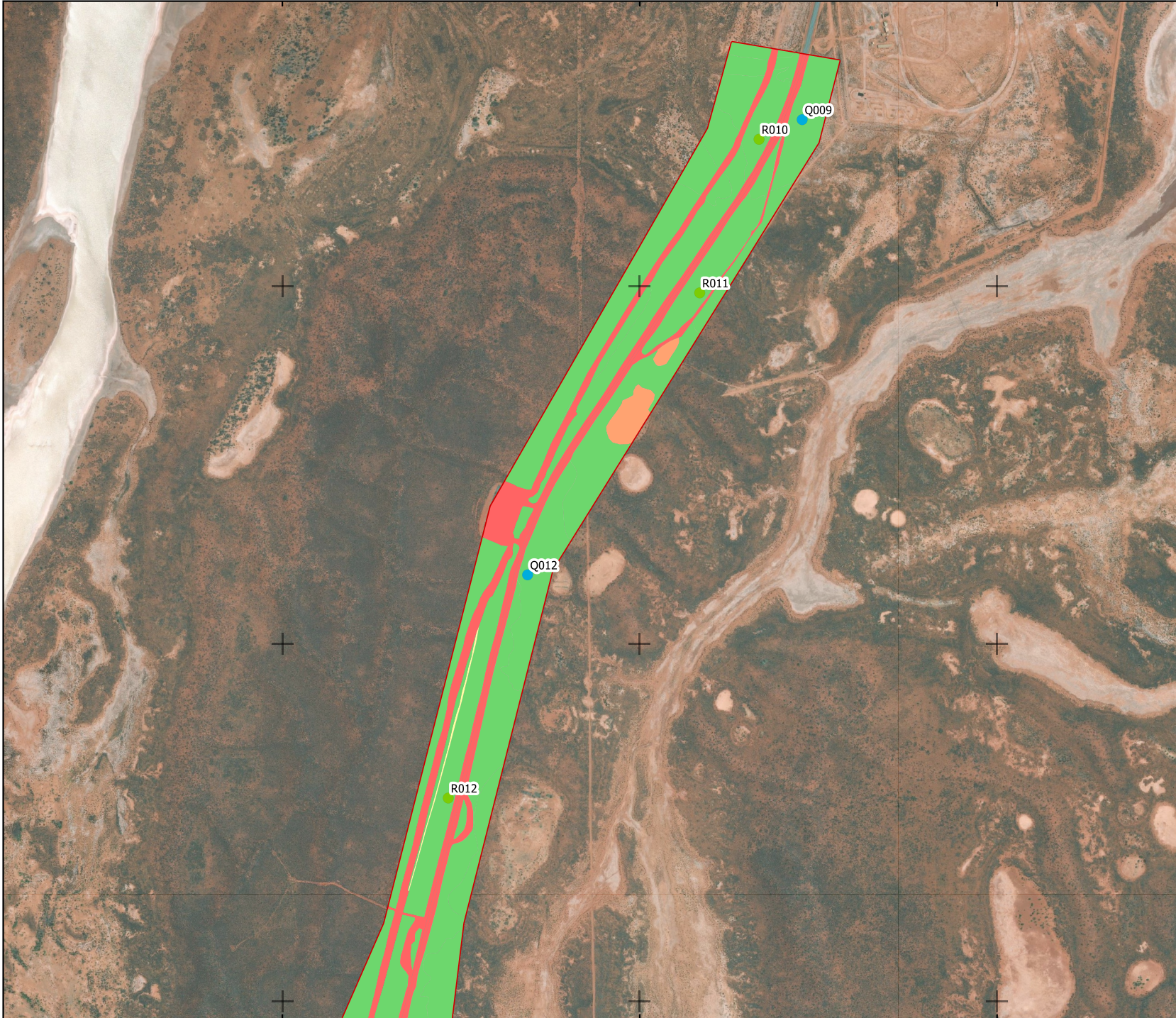
303000

304000

7593000

7592000

7591000



Legend

Survey Area

Flora Survey Sites

Quadrat

Releve

Vegetation Condition

Very Good

Good

Poor

Degraded

Completely Degraded (Cleared)



0 0.25 0.5 km

Scale 1:15,000 @ A4

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



Author: RD

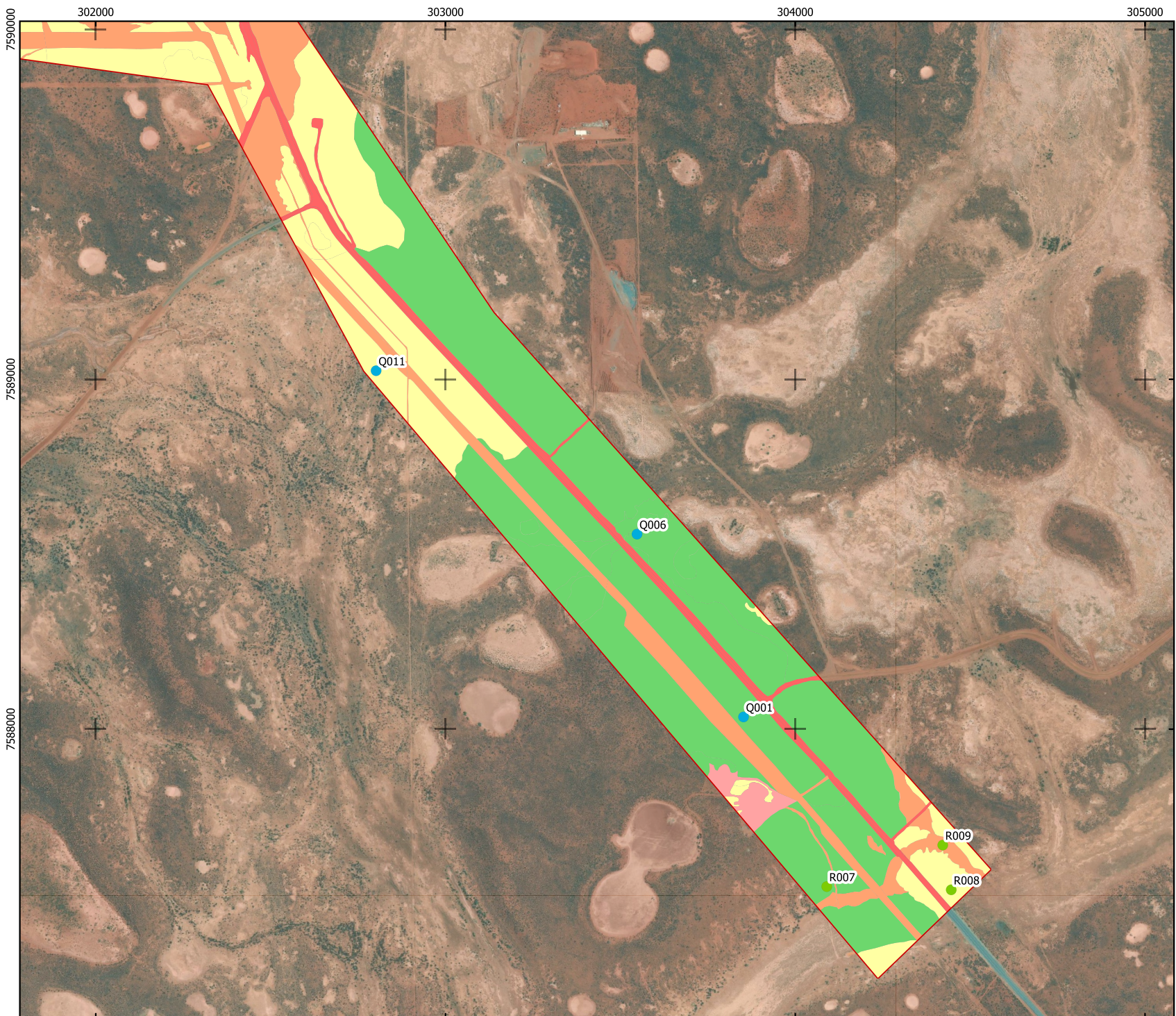
Date: 02-02-2022

Vegetation Condition – Map F

HV Carriageway in Warrirda Road
Reserve

Prepared for
Main Roads
Western Australia

MAP
3.18



Legend

- Survey Area
- Flora Survey Sites**
- Quadrat
- Releve
- Vegetation Condition**
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded (Cleared)

0 0.25 0.5 km
 Scale 1:15,000 @ A4
Coordinate System: GDA 1994 MGA Zone 50
 Projection: Transverse Mercator
 Units: Meter

Author: RD Date: 02-02-2022

Vegetation Condition – Map G

HV Carriageway in Warrirda Road
Reserve

4. RESULTS & DISCUSSION – FAUNA

4.1. Fauna Desktop Assessment

Three public databases on vertebrate fauna were accessed, and five fauna surveys were reviewed to provide information to support the current assessment (Table 4.1). These sources identified 17 non-volant native mammals, nine introduced mammals, eight bats, 209 birds, 86 reptiles and seven amphibians in the Study Area (Appendix E)

There were 59 significant fauna species identified that have the potential to occur within the Survey Area including seven mammals, 50 birds and two reptiles (Map 4.1, Map 4.2). One species of mammal has a Very Low likelihood of occurring in the Survey Area, five mammals, 12 birds and one reptile have a Low likelihood of occurrence, 11 birds and one reptile have a Medium likelihood of occurrence, and one mammal and 23 birds have a High likelihood of occurrence. Four species of bird have been recorded within the Survey Area, two of which were in the past ten years – Oriental Pratincole and Caspian Tern.

Table 4.1: Summary of Vertebrate Fauna Species Previously Recorded

Data Source	Level of Survey	Mammals (Native/ Introduced)	Birds	Bats	Reptiles	Amphibians	Total
Literature							
Survey for Migratory Waterbirds in the Wheatstone LNG Project Area November 2008 and March 2009	Targeted - waterbird	-	76	-	-	-	76
Wheatstone Project Terrestrial Fauna Survey	Detailed	9/3	59	5	44	4	124
Onslow Material Pits Environmental Impact Assessment and Environmental Management Plan	Basic	1/4	50	-	11	2	68
A Level 1 Vertebrate Fauna Assessment of the Proposed Turbridgi to Wheatstone Gas Pipeline, Western Australia	Basic	3/2	52	-	12	-	69
ANSIA Stage 2 Fauna Assessment	Basic	2/3	61	-	2	-	68
Database							
DBCA Threatened Fauna Database	-	4	45	1	2	0	52
NatureMap	-	17/7	192	5	81	5	307
PMST	-	1	22	2	1	-	26
ALA		10/4	210	2	60	4	
Total		17/9	209	8	86	7	336

4.1.1. Short Range Endemic Invertebrates

The Western Australian Museum Invertebrate Database search identified a total of 15 terrestrial potential short range endemic species in the Study Area (Table 4.2, Map 4.3). This list comprised of 15 Arachnids (14 spiders and one centipede).

The SRE status of invertebrates is based on categories which were developed by the Western Australian Museum (WAM). Several factors are considered when assessing a specimen for potential SRE status including:

- The collected specimen belongs to an SRE target group;
- The specimen is a juvenile or female. The majority of SRE taxa require an adult male for identification;
- The taxon has previously not been collected and is not present within the reference collection. There can be more than one reference collection which limits the likelihood that certain taxon are present;
- Taxonomic status is unresolved. The taxon is new and has not been previously collected;
- Lack of taxonomic resolution. Taxonomic resolution alone does not necessarily provide the required information to assess a species' SRE status. Species groups are preferably worked on by a taxonomist, or a reference collection is publicly available; and
- Taxon exhibits morphological peculiarities that limit the species ability to disperse and distribute widely.

Following the Precautionary Principle, all data deficient species from known SRE target groups are regarded as potential short-range endemics.

Many SRE species are associated with permanently moist, shaded, and sheltered microhabitats. In arid landscapes, these habitat types are typically limited and isolated by barriers of exposed, dry habitat not conducive to the dispersal SRE species. Habitat types that have been recognised as potentially harbouring SRE species include (Harvey, 2002; Durrant, 2011; Environmental Protection Authority, 2016d):

- Deep gorges
- Isolated ranges, mesas, and rock outcrops
- Rainforest patches
- Islands
- Drainage systems
- Vine thickets
- Hillslopes with south-west facing aspects
- Fire refuge areas such as cliffs and rock piles.

Regionally extensive and exposed habitat types with high connectivity such as those found in the Survey Area are unlikely to host SRE taxa (Durrant, 2011). Other than those species recorded on offshore islands, the taxa returned in the WAM database were not recorded in the typical habitats for SRE taxa. It is likely these species are widespread and have been given potential SRE status based on the criteria listed above.

Table 4.2: Potential SRE Invertebrate Species Returned in the Database Search

Class/ Order/ Family	Species	Distance and Direction and Habitat (if known) of Nearest Record from Survey Area
ARACHNIDA		
Araneae		
Araneidae	<i>Trichonephila`edulis`?</i>	Recorded from Great Sandy Islands and Serrurier Island 33 km west of the Survey Area.
Anamidae	<i>Aname vernonorum</i>	Several records from two locations 19 and 28 km east of the Survey Area.
Anamidae	<i>Aname`MYG109`</i>	Records from sand dunes and alluvial plains in all directions from the Survey Area.
Anamidae	<i>Aname`MYG709`</i>	Records from between 16 and 26 km south west of the Survey Area from loam and clay loam plains.

Class/ Order/ Family	Species	Distance and Direction and Habitat (if known) of Nearest Record from Survey Area
ARACHNIDA		
Anamidae	<i>Aname</i> `MYG711`	One record 35 km west of the Survey Area, fore dune.
Anamidae	<i>Aname</i> `MYG712`	Records from between 7 and 24 km from the Survey Area. Records from foredunes, transverse and longitudinal dunes.
Anamidae	<i>Kwonkan</i> `MYG090`	Recorded 14 km east of the Survey Area
Anamidae	<i>Kwonkan</i> `MYG710`	Recorded from alluvial plains between 15 and 20 km west of the Survey Area.
Barychelidae	<i>Idiommata</i> `MYG110`	One record, 41 km south east of the Survey Area.
Halonoproctidae	<i>Conothele</i> `MYG713`	Recorded from two locations 24 and 42 km south west of the Survey Area. Clay loam plain, longitudinal and transverse dunes.
Halonoproctidae	<i>Conothele</i> `MYG714`	Recorded from two locations 13 and 20 km west of the Survey Area. Alluvial plains.
Lycosidae	<i>Lycosa</i> `sp. (gibsoni group)`	Recorded from two locations 5 and 9 km north of the Survey Area.
Oonopidae	<i>Opopaea</i> `blind sp.`	Recorded 42 km south west, tidal flats
Salticidae	<i>Simaetha</i> `sp. indet. (juvenile)`	Recorded from Great Sandy Islands and Serrurier Island 33 km west of the Survey Area
Scutigerida		
Scutigerae	`Genus indet.` `sp. indet. (male)`	One record from <i>Triodia</i> plain 23 km south east of the Survey Area.

255000 270000 285000 300000 315000

7620000

7605000

7590000



Legend

- Survey Area
- EPBC Act: Endangered/ BC Act: Critically Endangered
- EPBC Act/ BC Act: Endangered
- EPBC Act: Endangered/ BC Act: Vulnerable
- DBCA: Priority 4
- DBCA: Priority 1
- BC Act: Other Specially Protected Fauna



0 3 6 9 km
Scale 1:300,000 @ A4

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



Author: NP

Date: 08-09-2021

Desktop Assessment Significant Fauna

HV Carriageway in Warrirda Road Reserve

Prepared for
Main Roads
Western Australia

MAP

4.1

255000 270000 285000 300000 315000

7620000

7605000

7590000



Legend

- Survey Area
- EPBC Act/ BC Act: Critically Endangered
- EPBC Act: Critically Endangered & Migratory/ BC Act: Migratory
- EPBC Act: Endangered & Migratory/ BC Act: Endangered
- EPBC Act: Endangered & Migratory/ BC Act: Migratory
- EPBC Act/ BC Act: Vulnerable
- EPBC Act: Vulnerable & Migratory/ BC Act: Migratory
- EPBC Act/ BC Act: Migratory



0 3 6 9 km
 Scale 1:300,000 @ A4

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



Author: NP

Date: 08-09-2021

Desktop Assessment Significant Fauna - Shorebirds

HV Carriageway in Warrirda Road
 Reserve

Prepared for
 Main Roads
 Western Australia

MAP
4.2



Legend

- Survey Area
- Arachnids Database search**
- `Genus indet.` `sp. indet. (male)`
- Aname `MYG109`
- Aname `MYG709`
- Aname `MYG711`
- Aname `MYG712`
- Aname vernonorum
- Conothele `MYG713`
- Conothele `MYG714`
- Idiommata `MYG110`
- Kwonkan `MYG090`
- Kwonkan `MYG710`
- Lycosa `sp. (gibsoni group)`
- Opopaea `blind sp.`
- Simaetha `sp. indet. (juvenile)`
- Trichonephila `edulis`?

0 3 6 9 km

Scale 1:400,000 @ A4

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

Author: NP Date: 08-09-2021

Desktop Assessment Short Range Endemic Invertebrates

HV Carriageway in Warrirda Road Reserve

4.2. Terrestrial Fauna Assessment

4.2.1. Fauna Habitat Types

Five fauna habitat types based on the vegetation types described in Section 3.3.1 were recorded from the Survey Area. The extent of each habitat type is shown in Map 4.4 and listed in Table 4.3 along with the associated vegetation units. Descriptions of each fauna habitat type are provided in the sections below. Cleared areas including existing tracks and roads comprised 18.7 % of the Survey Area.

All five habitat types recorded are representative of those described by Biota (Biota Environmental Sciences, 2010) and are therefore widespread in the region and are not limited to within the Survey Area. The Tidal Mudflats and Claypans provide foraging habitat for water and shorebirds including 28 species listed under the EPBC and BC Acts.

Table 4.3: Fauna Habitat Types Recorded at the Survey Area

Habitat Type	Sites	Associated Vegetation Type	Extent (ha)	% of Survey Area
Sand Plains	WR S1, WR S12, WR S17, WR S19, WR S21, WR S22, WR S23	P1a, P1b, P2, P3	181.48	48.8
Sand Dunes	WR S3, WR S16, WR S18, WR S20,	D1	77.14	20.7
Tidal Mudflats and Claypans	WR S2, WR S5, WR S8, WR S9, WR S13, WR S15	Tidal mud flat	26.51	7.1
Tecticornia Shrubland	WR S4, WR S7, WR S10, WR S11, WR S14	C1	15.44	4.2
Tall Mesquite Shrubland	WR S6	Drainage	1.91	0.5
Cleared			69.58	18.7

4.2.1.1. Sand Plains

The Sand Plains were the most abundant fauna habitat type recorded and were found throughout the Survey Area (Map 4.4). It covered 181.48 ha which represented 48.8% of the Survey Area. The Sand Plains consisted of scattered shrubs comprising *Acacia tetragonophylla.*, *A synchronicia*, and **Vachellia farnesiana*. Some leaf litter has accumulated under the larger shrubs and woody litter was limited to fallen sticks and branches under shrubs. There was moderate to open grass cover comprising *Triodia epactia* and **Cenchrus ciliaris*. The native grass cover was typically sparse while **Cenchrus ciliaris* is common throughout and dense in some areas, especially along the road verges. The soil was red sand and sandy clay (Plate 4.1). The sand plains provide suitable substrate and vegetation for the Northern Short-tailed Mouse (*Leggadina lakedownensis*).

The Sand Plains were intersected by a series of drainage lines and clay pans, that while lacking vegetation were not considered distinct enough to constitute a separate fauna habitat type.



Plate 4.1: Sand Plains Recorded at the Survey Area

4.2.1.2. Sand Dunes

The Sand Dune habitat was predominantly recorded in the east of the Survey Area (Map 4.4). It covered 77.14 ha representing 20.7% of the Survey Area. These red sand dunes were characterised by a sparse to moderate shrubs including *Acacia stellaticeps*, *Scaevola sericophylla* and *Grevillea stenobotrya* with a ground layer of *Triodia epactia* (Plate 4.2) Some leaf litter and small woody debris had accumulated under shrubs but was absent elsewhere. **Cenchrus ciliaris* was abundant in some areas of previous disturbance.



Plate 4.2: Sand Dunes Recorded at the Survey Area

4.2.1.3. Tidal Mudflats & Claypans

Tidal Mudflats and Claypans were recorded in the western half of the Survey Area (Map 4.4) with smaller patches found in the east. They covered 26.51 ha representing 7.1% of the Survey Area. The Tidal Mudflats and Claypans were lacking vegetation, leaf litter or woody debris. A narrow layer of fringing vegetation would sometimes be present around the depressions and consisted of *Tecticornia auriculata* or *Tecticornia indica subsp. leiostachya* with **Cenchrus ciliaris* present in some areas.

The Tidal Mudflats and Claypans inundate seasonally and/or tidally and support an assemblage of wading bird and shorebirds passing through. As such, they provide foraging habitat for these species including migratory species.



Plate 4.3: Tidal Mudflats & Claypans Recorded at the Survey Area

4.2.1.4. Tecticornia Shrublands

The Tecticornia Shrubland was distributed in patches throughout the Survey Area (Map 4.4). It covered 15.44 ha which represented 4.2% of the Survey Area. It was characterised by scattered *Tecticornia auriculata* or *Tecticornia indica* subsp. *leiostachya* shrubs with sparse *Eragrostis pergracilis* or **Cenchrus ciliaris* which was present in some areas ranging from a sparse to dense layer (Plate 4.4). There was little to no leaf litter present and small woody debris was only found under or around shrubs. The soil was orange clay. Water can collect in these habitats after heavy rainfall events.



Plate 4.4: Tecticornia Shrubland Recorded at the Survey Area

4.2.1.5. Tall Mesquite Shrubland

The Tall Mesquite Shrubland was found from one area in the centre of the Survey Area (Map 4.4). It covered 1.91 ha which represents 0.5% of the Survey Area. It consisted of a dense thicket of *Prosopis pallida* (Mesquite) over *Cenchrus ciliaris* grass on sandy clay. Leaf litter and woody debris has accumulated under the shrubs (Plate 4.5). While this habitat type was small, it was distinct in the level of cover and density of vegetation.



Plate 4.5: Tall Mesquite Shrubland Recorded at the Survey Area

294000

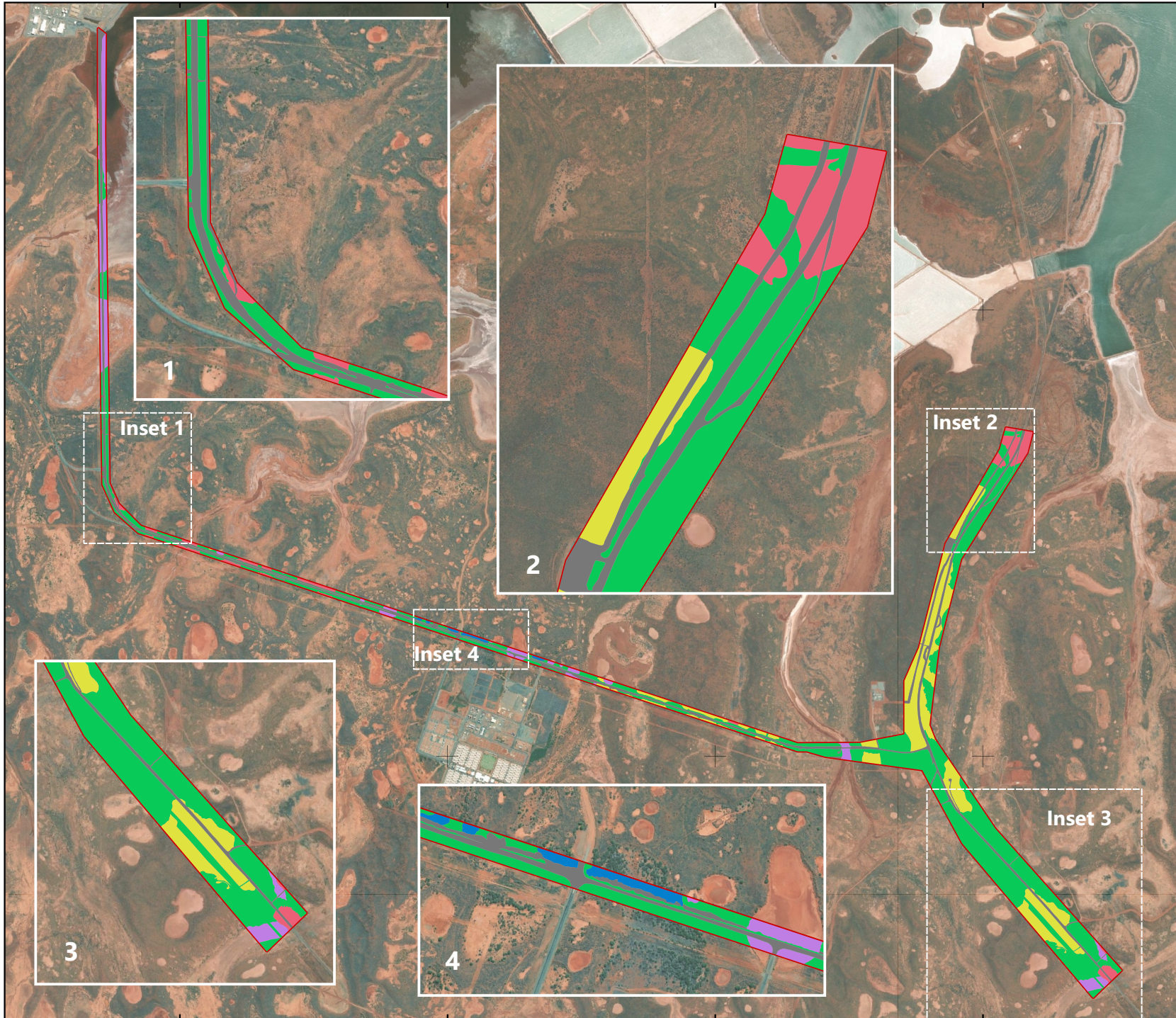
297000

300000

303000

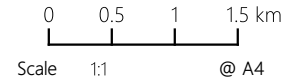
7595000

7590000



Legend

- Survey Area
- Fauna habitats**
- Cleared
- Sand dunes
- Sand plains
- Tall mesquite shrubland
- Tecticornia shrubland
- Tidal mudflats and claypans



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



Author: NP

Date: 12-07-2021

Fauna Habitat Types

HV Carriageway in Warrirda Road Reserve

Prepared for
 Main Roads
 Western Australia

MAP
4.4

4.2.2. Vertebrate Fauna

A total of 44 vertebrate fauna species were recorded during the survey: one native mammal, four introduced species of mammals, 34 species of birds, and five species of reptiles. Two species of conservation significance were recorded – Gull-billed Tern (*Sterna macrotarsa*) and Little Tern (*Sterna albifrons*) (both species: EPBC Act – Migratory; BC Act – Migratory).

Table 4.4: Fauna Species Recorded at the Survey Area

Common name	Scientific name	Details
Mammals		
Spinifex Hopping Mouse	<i>Notomys alexis alexis</i>	Pop holes & tracks
Rabbit*	<i>Oryctolagus cuniculus</i>	Diggings
Donkey / Horse*	<i>Equus africanus asinus</i> / <i>Equus ferus caballus</i>	Scats
Horse*	<i>Equus ferus caballus</i>	Skeleton
European Cattle*	<i>Bos primigenius taurus</i>	Scats
Birds		
Australian Wood Duck	<i>Chenonata jubata</i>	
Horsfield's Bronze Cuckoo	<i>Chrysococcyx basilis</i>	
Pallid Cuckoo	<i>Cacomantis pallidus</i>	
Common Bronzewing	<i>Phaps chalcoptera</i>	
Crested Pigeon	<i>Ocyphaps lophotes</i>	
Spinifex Pigeon	<i>Geophaps plumifera</i>	
Diamond Dove	<i>Geopelia cuneata</i>	
Little Button Quail	<i>Turnix velox</i>	
Silver Gull	<i>Larus novaehollandiae</i>	
Gull-billed Tern	<i>Sterna macrotarsa</i>	EPBC Act – Migratory; BC Act – Migratory
Little Tern	<i>Sterna albifrons</i>	
Black-shouldered Kite	<i>Elanus axillaris</i>	
Wedge-tailed Eagle	<i>Aquila audax</i>	
Spotted Harrier	<i>Circus assimilis</i>	
Whistling Kite	<i>Haliastur sphenurus</i>	
Rainbow Bee-eater	<i>Meerops ornatus</i>	
Australian Kestrel	<i>Falco cenchroides</i>	
Cockatiel	<i>Nymphicus hollandicus</i>	
Galah	<i>Cacatua roseicapilla</i>	
Budgerigar	<i>Melopsittacus undulatus</i>	
White-winged Fairywren	<i>Malurus leucopterus</i>	
Singing Honeyeater	<i>Gavicalis virescens</i>	
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	
Willie Wagtail	<i>Rhipidura leucophrys</i>	
Magpie-lark	<i>Grallina cyanoleuca</i>	
Torresian Crow	<i>Corvus orru</i>	
Horsfield's Bush Lark	<i>Mirafrja javanica</i>	

Common name	Scientific name	Details
Fairy Martin	<i>Petrochelidon ariel</i>	
Spinifexbird	<i>Poodytes carteri</i>	
Rufous Songlark	<i>Cincloramphus mathewsi</i>	
Painted Finch	<i>Emblema pictum</i>	
Zebra Finch	<i>Taeniopygia guttata</i>	
Australian Pipit	<i>Anthus australis</i>	
Reptiles		
Western Hooded Scaly-foot	<i>Pygopus nigriceps</i>	
Leopard Ctenotus	<i>Ctenotus pantherinus ocellifer</i>	
Western Bearded Dragon	<i>Pogona minor minor</i>	Skeleton
Children's Python	<i>Antaresia childreni</i>	Skeleton
Mulga Snake	<i>Pseudechis australis</i>	Skin

*Introduced species

4.2.3. Significant Fauna

The significant fauna species identified in the desktop assessment were given a likelihood of occurrence scoring following the field assessment and fauna habitat mapping (Table 4.5). Two species have been recorded within the Survey Area in previous surveys – Oriental Pratincole and Caspian Tern. A total of 25 species were assessed to have a High likelihood of occurrence in the Survey Area including one mammal and 24 birds. Eleven species were assessed to have a Medium likelihood of occurrence, and 19 species were assessed to have a Low to Very Low likelihood of occurrence.

Two species of significant fauna were recorded during this survey – two Gull-billed Terns and one Little Tern. Both species were observed flying over the Survey Area (Map 4.5).

Table 4.5: Significant Fauna Species Likely to Occur

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Mammals						
Northern Quoll (<i>Dasyurus hallucatus</i>)	EN	EN	-	Critical denning habitats include rocky gorges, basalt hills, escarpments, mesas, boulder piles, caves and adjacent cliff faces. Foraging occurs in adjacent habitat with suitable cover and food resources (Department of the Environment, 2016).	Five records, two of which occur within the Survey Area. The closest 'certain' records are from 64 km south east of the Survey Area.	Low: There is no suitable rocky habitat within the Survey Area. Records from within the Survey Area are uncertain.
Shark Bay Bandicoot (<i>Perameles bougainville</i>)	EN	VU	-	Considered extinct on mainland Australia outside of feral-free fenced areas. Was thought to occur in dense scrub, low heath and hummock grasslands (Friend, 2008).	Two undated records and low spatial accuracy. Inaccurate records.	Very low: The species is regionally extinct.
Ghost Bat (<i>Macroderma gigas</i>)	VU	VU	-	Use a range of structures including caves, rock piles and abandoned mines for transient and feeding roosts. Foraging can occur up to 2 km from roosting sites. Maternity roosts require caves with specific warm, dark and humid microclimates (Armstrong and Anstee, 2000).	PMST record only – species or species habitat may occur in the area.	Low: Suitable roosting structures do not occur within 2 km of the Survey Area.
Pilbara Leaf-nosed Bat (<i>Rhinioncteris aurantia</i> (Pilbara form))	VU	VU	-	Dissected rocky escarpments with suitable roost caves with high humidity and stable temperatures. Forages in a variety of habitats, particularly along water bodies and riparian vegetation (Armstrong, 2001; Cramer et al., 2016).	PMST record only – species or species habitat likely occur in the area.	Low: Suitable rocky caves and foraging habitat do not occur within the Survey Area.
North-western Free-tailed Bat (<i>Mormopterus cobourgiensis</i>)	-	-	P1	Found in coastal areas from Exmouth to Broome, as well as the Northern Territory and Queensland. Roosts in small spouts and dead branches of mangroves. Foraging occurs in mangroves, vine thickets and waterways (Churchill, 2009; Burbidge, Harrison and Woinarski, 2014).	Two DBCA records from Thevenard Island. Recorded by Biota in mangrove habitat approximately 2.5 km north of the Survey Area (Biota Environmental Sciences, 2010).	Low: Suitable roosting and foraging habitat does not occur within the Survey Area.

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Northern Short-tailed Mouse (<i>Leggadina lakedownensis</i>)	-	-	P4	Occur on a variety of habitats from spinifex and tussock grasslands, samphire shrublands, sedgeland and open woodland. Most are recorded from seasonally inundated sandy or cracking clay (Kutt and Kemp, 2005; Moro and Kutt, 2008).	Over 300 records in the vicinity of the Survey Area. Many of the records are from Thevenard and Serrurier Islands. Those associated with the Wheatstone project have a low degree of certainty and accuracy.	High: The Survey Area contains spinifex and tussock grasslands over sandy clay that may support the species.
Western Pebble-mound Mouse (<i>Pseudomys chapmani</i>)	-	-	P4	Found on gentle slopes of rocky ranges with pebbled soil, hard spinifex and scattered shrubs. The habitat is patchy but widespread (Start, 2008).	Five records in the vicinity of the Survey Area, four of which have low spatial accuracy. One record is within 300 m of the Survey Area. An inactive mound was recorded by Biota south east of the Survey Area (Biota Environmental Sciences, 2010).	Low: Suitable rocky slopes do not occur within the Survey Area.
Birds						
Bar-tailed Godwit (Northern Siberian) (<i>Limosa lapponica menzebieri</i>)	CR	CR	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al., 2019).	Four records – two from 1901, two undated.	Low: Suitable foraging habitat is present within the Survey Area however there are few species records in the vicinity of the Survey Area.
Curlew Sandpiper (<i>Calidris ferruginea</i>)	CR & MI	CR	-	Most abundant on tidal flats but also occurs on brackish and fresh inland wetlands	Five records from coastal flats or islands.	High: Suitable foraging habitat is present in the tidal flats. The species has been recorded in the vicinity of the Survey Area.
Eastern Curlew (<i>Numenius madagascariensis</i>)	CR & MI	MI	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al., 2019).	26 records from coastal flats and islands in the vicinity of the Survey Area.	High: Suitable foraging habitat is present in the tidal flats. The species have been frequently recorded in the vicinity of the Survey Area.
Great Knot (<i>Calidris tenuirostris</i>)	CR & MI	MI	-		Six records. One, from 2008, is within the Survey Area with an accuracy of 25 km.	
Night Parrot (<i>Pezoporus occidentalis</i>)	EN	CR	-	Roosting sites located in <i>Triodia</i> grasslands where it shelters in <i>Triodia</i> hummocks. Foraging sites are in treeless non- <i>Triodia</i> open grasslands and herb fields.	Single record from 1967.	Low: Suitable habitat does not occur within the Survey Area; the single record is over fifty years old.

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Lesser Sand Plover (<i>Charadrius mongolus</i>)	EN & MI	EN	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al., 2019).	19 records from coastal areas and islands in the vicinity of the Survey Area. One record from 2008 is within the Survey Area.	High: Suitable foraging habitat is present in the tidal flats. The species have been frequently recorded in the vicinity of the Survey Area.
Australian Painted Snipe (<i>Rostratula australis</i>)	EN	EN	-	Shallow terrestrial freshwater wetlands, lakes and swamps, typically with low, dense fringing vegetation. Favours sites with shallow water and exposed mud (Menkhorst et al., 2019).	PMST record only – species or species habitat may occur within the area.	Low: Suitable habitat does not occur in the Survey Area and the species has not been recorded in proximity of the Survey Area.
Southern Giant Petrel (<i>Macronectes giganteus</i>)	EN	EN	-	Seabird, migrates to tropical waters in winter.	PMST record only – species or species habitat may occur within the area.	Low: Seabird, suitable habitat does not occur within the Survey Area; species has not been recorded in proximity to the Survey Area.
Red Knot (<i>Calidris canutus</i>)	EN & MI	MI	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al., 2019).	Recorded three times in the 1980's.	Medium: Suitable foraging habitat is present within the Survey Area however there are few species records in the vicinity of the Survey Area.
Fairy Tern (<i>Sternula nereis nereis</i>)	VU	VU	-	Coastal – most species forage over water with depth and proximity to shore varying between species. Nesting occurs on sandbars, spits, and rocky islands. Roosting on ocean beaches, rock platforms and man-made structures.	All records are from coastal margins or islands.	Medium: Records returned in the database searches are all from islands and coastal margins.
Grey Falcon (<i>Falco hypoleucos</i>)	VU	VU	-	Triodia grassland, Acacia shrubland, and lightly timbered arid woodland.	Recorded flying over in the area by (GHD, 2011); did not report which sites it was recorded from.	Medium: Suitable nesting habitat is not present in the Survey Area however the species may forage over the Survey Area
Greater Sand Plover (<i>Charadrius leschenaultii</i>)	VU & MI	MI	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al., 2019).	91 records from coastal areas and islands in the vicinity of the Survey Area. One record from 2008 is within the Survey Area.	High: Suitable foraging habitat is present in the tidal flats. The species have been frequently recorded in the vicinity of the Survey Area.

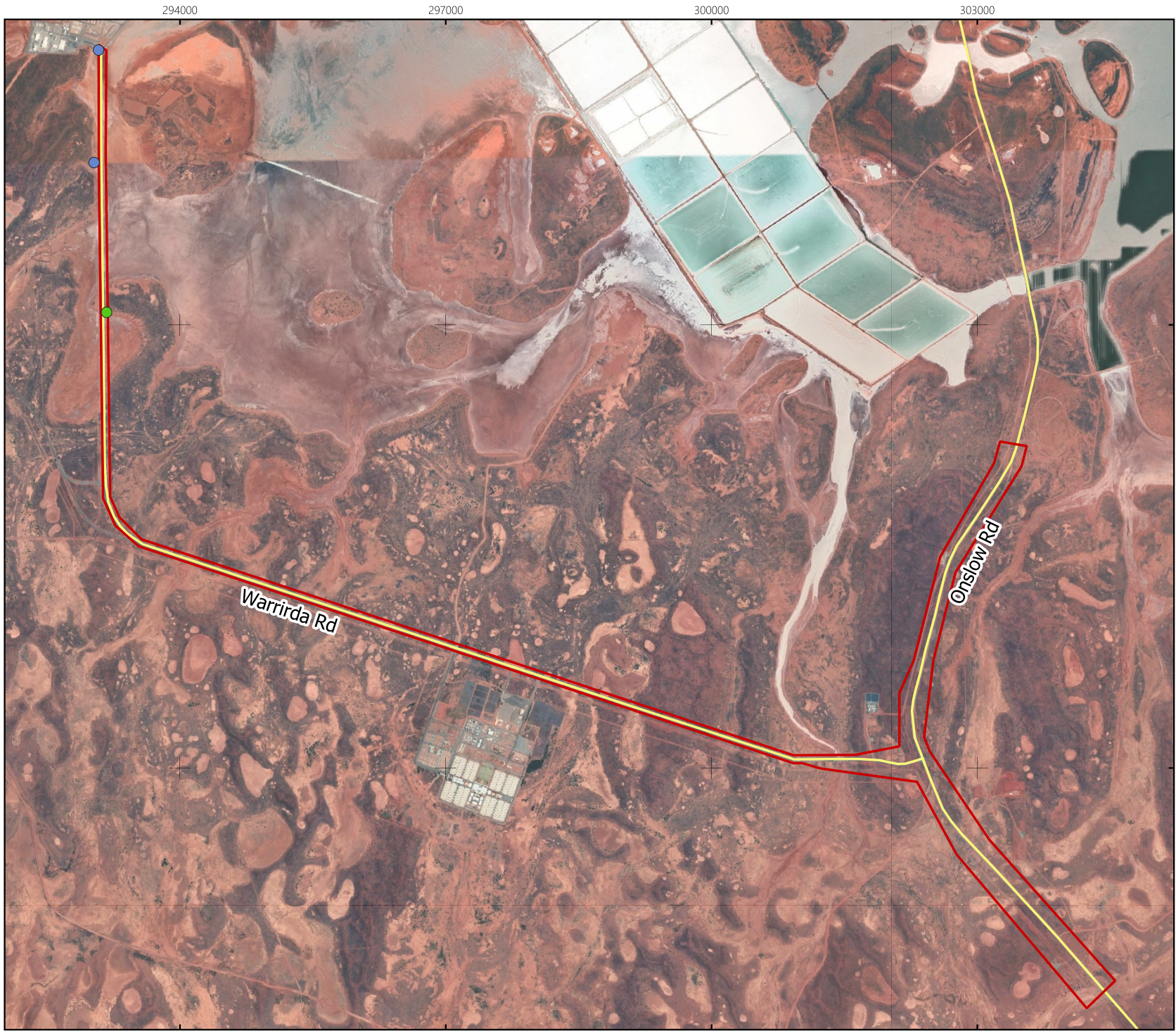
Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Grey-tailed Tattler (<i>Tringa brevipes</i>)	MI	MI	P4	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al., 2019).	71 records, mostly from coastal areas and islands. One record from 2008 is from within the Survey Area.	High: Suitable foraging habitat is present in the tidal flats. The species is frequently recorded in the vicinity of the Survey Area.
Fork-tailed swift (<i>Apus pacificus</i>)	MI	MI	-	Highly nomadic and rarely land spending much of their time foraging in large flocks high above the canopy; associated with storm fronts (DAWE 2020).	Ten records in the vicinity of the Survey Area of which three are within less than 1 km.	High: Always a possibility as the species is associated with storm fronts.
Pacific Golden Plover (<i>Pluvialis fulva</i>)	MI	MI	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al., 2019).	Five records, all from offshore islands.	Medium: Suitable foraging habitat is present within the Survey Area however there are few species records in the vicinity of the Survey Area, all of which are from islands.
Grey Plover (<i>Pluvialis squatarola</i>)					21 records from coastal areas and islands in the vicinity of the Survey Area.	
Whimbrel (<i>Numenius phaeopus</i>)					Forty records from coastal areas and islands in the vicinity of the Survey Area. One record from 2008 is within the Survey Area.	
Bar-tailed Godwit (<i>Limosa lapponica</i>)					88 records on of which from 2008 is within the Survey Area. The remaining records are from coastal areas and islands.	
Ruddy Turnstone (<i>Arenaria interpres</i>)					78 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey.	
Sanderling (<i>Calidris alba</i>)					64 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey.	

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Terek Sandpiper (<i>Xenus cinereus</i>)					Three records, all of which are on offshore islands.	Medium: Suitable foraging habitat is present within the Survey Area however there are few species records in the vicinity of the Survey Area, all of which are from offshore islands.
Marsh Sandpiper (<i>Tringa stagnatilis</i>)					One coastal record 34 km west of the Survey Area.	Medium: Suitable foraging habitat is present within the Survey Area however there is only one species records in the vicinity of the Survey Area
Oriental Plover (<i>Charadrius veredus</i>)	MI	MI	-	Found on thinly vegetated grasslands and plains e.g. those that have been recently burnt or intensively grazed (Menkhorst et al., 2019).	Three records, one of which is within 100 m of the Survey Area.	Medium: Both species have been recorded in proximity to the Survey Area in the last 20 years.
Little Curlew (<i>Numenius minutus</i>)					Recorded twice, 12 and 14 km north east of the Survey Area.	
Black-tailed Godwit (<i>Limosa limosa</i>)	MI	MI	-	Shallow inland wetlands.	Three records. Two, from 1978 and 1978 are 8 km from the Survey Area. One from 2007 is from Serrurier Island.	Low: Records in proximity to the Survey Area are from over 40 years ago. Suitable habitat may be present when claypans are inundated.
Pectoral Sandpiper (<i>Calidris melanotos</i>)					Three records from a 2015 survey, all from within 100 m of the Survey Area.	High: Suitable habitat is likely to be present when tidal mudflats claypans are inundated; the species have been recorded in the vicinity of the Survey Area.
Wood Sandpiper (<i>Tringa glareola</i>)					Single record from 2008 is within the Survey Area.	
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	MI	MI	-	A variety of habitats including saline inland wetlands, damp grasslands and tidal flats	13 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey Area with an accuracy of 25 km.	High: Suitable foraging habitat is present in the tidal flats. The species has been recorded in the vicinity of the Survey Area.
Red-necked Stint (<i>Calidris ruficollis</i>)	MI	MI	-	Most abundant on tidal flats but also occurs on brackish and fresh inland wetlands	63 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey.	High: Suitable foraging habitat is present in the tidal flats. The species has been frequently recorded in the vicinity of the Survey Area.

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Common Sandpiper (<i>Actitis hypoleucos</i>)	MI	MI	-	Narrow, steep shorelines, mangrove lined creeks and steep sided sewage ponds and dams	Sixty records in the vicinity of the Survey Area. One record falls within the Survey Area, the remaining records are from coastal areas, islands and waterways.	Medium Suitable foraging habitat does not occur within the Survey Area however the species was recorded in 2008.
Common Greenshank (<i>Tringa nebularia</i>)	MI	MI	-	Coastal to freshwater habitats with mud flats or still shallow water	33 records; one from of which from 2008 is within the Survey Area. Four records from 2015 are within 100 m of the Survey Area.	High: Suitable foraging habitat is present in the tidal flats and claypans. The species has been frequently recorded in the vicinity of the Survey Area.
Oriental Pratincole (<i>Glareola maldivarum</i>)	MI	MI	-	Open country associated with water such as plains, tidal flats, beaches and wetlands.	Four records of which three are within the Survey Area (previous surveys).	Recorded: Likely forages over the claypans and tidal mudflats.
Gull-billed Tern (<i>Gelochelidon nilotica</i>)	MI	MI	-	Common on coastlines with tidal flats; also found in freshwater swamps, brackish and salt lakes, beaches, floodwaters, and sewage farms. Breeds on large ephemeral lakes, marshes, and wetlands. Forages over water and grassy plains	13 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey Area.	Recorded: Likely forages over the claypans and tidal mudflats.
Caspian Tern (<i>Hydroprogne caspia</i>)	MI	MI	-	Coastal – most species forage over water with depth and proximity to shore varying between species. Nesting occurs on sandbars, spits, and rocky islands. Roosting on ocean beaches, rock platforms and man-made structures.	Over 100 records six of which were within the Survey Area. Recorded inside the Survey Area are from 2008 and within 100 m of the Survey Area in 2015.	Recorded: Use of the Survey Area is likely to be limited to flying over.
Crested Tern (<i>Thalasseus bergii</i>)					47 records in the vicinity of the Survey Area. Most records are coastal or on islands.	High: Frequently recorded nearby; use of the Survey Area likely to be limited to flying over.
Little Tern (<i>Sterna albifrons</i>)					34 records, mostly from coastal areas and islands. One record from 2008 is from within the Survey Area.	Recorded: Use of the Survey Area is likely to be limited to flying over.
Roseate Tern (<i>Sterna dougalli</i>)					36 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey Area with an accuracy of 25 km.	High: Frequently recorded nearby; use of the Survey Area likely to be limited to flying over.

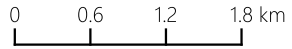
Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Common Tern (<i>Sterna hirundo</i>)					Forty records of which one from 2008 is within the Survey Area with an accuracy of 25 km. The remaining records are coastal or on islands.	
Bridled Tern (<i>Onychoprion anaethetus</i>)	MI	MI	-	Seabird breeding on rocky islands and foraging far offshore.	All records are on islands.	Low: Seabird, suitable habitat does not occur within the Survey Area, all records are from islands.
White-winged Black Tern (<i>Sterna leucoptera</i>)	MI	MI	-	Found on fresh to saline wetlands.	Ten records, one of which is 1 km from the Survey Area. The remaining records are primarily from islands.	High: May forage in the claypans and tidal mudflats.
Wilson's Storm-petrel (<i>Oceanites oceanicus</i>)	MI	MI	-	Seabird, migrates to tropical waters in winter.	Single record 15 km north east of the Survey Area.	Low: Seabird, suitable habitat does not occur within the Survey Area.
Wedge-tailed Shearwater (<i>Ardenna pacifica</i>)	MI	MI	-	Seabird, breeding occurs on islands.	Recorded 296 times, the majority of which are from islands.	Low: Seabird, suitable habitat does not occur within the Survey Area.
Brown Booby (<i>Sula leucogaster</i>)	MI	MI	-		Four records, all on islands.	Low: Seabird, suitable habitat does not occur within the Survey Area
Glossy Ibis (<i>Plegadis falcinellus</i>)	MI	MI	-	Found near shallow fresh and estuarine waters or dry grasslands. Roosts in trees near water.	Two records 4 and 5 km west of the Survey Area.	Medium: Suitable habitat is unlikely to occur in the Survey Area however the species has been recorded in close proximity.
Osprey (<i>Pandion haliaetus</i>)	MI	MI	-	Coastal and terrestrial wetlands of tropical and temperate Australia and offshore islands, occasionally ranging inland along rivers.	Over 160 records in the vicinity of the Survey Area. One record from 2008 is within the Survey Area.	High: Suitable nesting habitat is not present in the Survey Area however the species may forage over the Survey Area.
Barn Swallow (<i>Hirundo rustica</i>)	MI	MI	-	Open country with low vegetation, farmlands and meadows (DoE 2020).	10 records 15 km from the Survey Area.	High: Suitable habitat occurs on the sandy plains, several records in proximity to the Survey Area.

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Yellow Wagtail (<i>Motacilla flava</i>)	MI	MI	-	Common migrant, found in open, muddy, grassy or moist areas, sewage treatment areas and bare ground such as sports fields.	PMST record only – species or species habitat may occur within the area	Low: Suitable habitat does not occur within the Survey Area and there are no nearby records.
Grey Wagtail (<i>Motacilla cinerea</i>)	MI	MI	-	Scarce visitor to Australia, preference for wet habitats – beaches and rock pools, fast flowing rocky waterways and waterfalls.	PMST record only – species or species habitat may occur within the area	Low: Suitable habitat does not occur within the Survey Area and there are no nearby records.
Peregrine Falcon (<i>Falco peregrinus</i>)	-	OS	-	Occur across much of Australia inhabiting cliffs, coastal habitats, rivers, wooded water courses and lakes. Require secure nesting sites preferring cliffs, riverine gorges, and open woodland near water (Birdlife Australia, 2012).	Five records between 500 m and 5 km from the Survey Area.	High: Suitable nesting habitat is not present in the Survey Area. Nearby records are likely foraging birds.
Letter-winged Kite (<i>Elanus scriptus</i>)	-	-	P4	Found in arid and semi-arid Australia occupying open country and grasslands. The species booms following high rodent populations with individuals found in coastal areas during dry spells following a boom (Menkhorst et al., 2019).	Single record from 1979.	Low: The Survey Area is not in the species preferred habitat; the single record is from over 40 years ago.
Reptiles						
Olive Python (<i>Liasis olivaceus barroni</i>)	VU	VU	-	Inhabits gorges, gullies, stony ranges, rock piles and along watercourses. Often associated with permanent and temporary water bodies though is not restricted to them. Habitat requirements are likely to vary throughout the year (Department of Sustainability Environment Water Population and Communities, 2011).	Single record with low certainty 5 km from the Survey Area.	Low: Suitable habitat does not occur within the Survey Area.
Maryan's Keeled Slider (<i>Lerista planiventralis maryani</i>)	-	-	P4	Found in loose sand and soil associated with coastal consolidated dunes and low shrubland (Cogger, 2018).	Two DBCA records in the vicinity of the Survey Area, both with low spatial accuracy.	Medium: The species may be found in the sand dunes but tends to be associated with coastal dunes.



Legend

- Survey Area
- Project Roads
- Australian Gull-billed Tern
- Little Tern



Scale 1:60,000 @ A4

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



Author: NP Date: 09-09-2021

**Significant Fauna
Recorded**

HV Carriageway in Warrirda Road Reserve

Prepared for
Main Roads
Western Australia

MAP
4.5

4.2.4. Mammals

4.2.4.1. Northern Short-tailed Mouse (*Leggadina lakedownensis*)

Conservation Status

DBCAs: Priority 4.

Distribution, Ecology & Habitat: The Northern Short-tailed Mouse has been recorded sporadically across northern Australia from the tropical coast extending to semi-arid regions (Moro and Kutt, 2008). They are found in a variety of habitats including spinifex and tussock grasslands, samphire shrublands, sedgeland and open woodlands. Most records are from seasonally inundated sandy clay or cracking clay soils in which it constructs simple, single chambered burrows (Kutt and Kemp, 2005). Diet consists primarily of invertebrates with some plants consumed to supplement water requirements.

Occurrence in the Survey Area: There were no individuals or signs of the Northern Short-tailed Mouse recorded in the Survey Area during this assessment. There have been over 300 records of the species in the vicinity of the Survey Area. Many of these are from Thevenard and Serrurier Islands where there are well-studied populations of the species (Moro and Kutt, 2008) while over 50 records are on the mainland with records from within 2 km of the Survey Area (Map 4.1). The Sand Plains habitat of the Survey Area contains suitable sandy clay and spinifex that may support the species.

4.2.5. Birds

4.2.5.1. Migratory shorebirds of the East Asian-Australasian Flyway

Distribution, Ecology & Habitat: There are 37 species of migratory shorebirds in Australia that utilise the East Asian-Australasian Flyway (EAAF). This flyway describes a migratory pattern whereby birds breed in the northern hemisphere and migrate through eastern Asia to spend a non-breeding period in the southern hemisphere (Hansen *et al.*, 2016). While movements vary between species, the non-breeding period spent in Australia is typically from the Austral spring to autumn (CoA 2015). Feeding and roosting habitats used by migratory shorebirds in Australia include coastal and inland wetlands, estuaries, mudflats, tidal flats, rocky inlets, sandy beaches, floodplains, and grassland areas. The non-breeding diet of most species consists of invertebrates including crustaceans, gastropods and bivalves (Commonwealth of Australia, 2015).

Occurrence in the Survey Area: Database searches returned 25 shorebirds of the EAAF that could potentially occur in the Survey Area (Table 4.6). No species were recorded during this field assessment. One species of migratory shorebird has been assessed as recorded in the Survey Area – there are records of the Oriental Pratincole inside the Survey Area from 2008, 2013 and 2017. A further 16 species have been assessed to have a High likelihood of occurrence as they have been frequently observed in close proximity to the Survey Area. The Tidal Mudflats and Claypans provides foraging habitat for shorebirds that feed on aquatic invertebrates. Migratory shorebirds likely forage within that habitat type while in Australia (from spring to autumn). This habitat is widespread in the region (Biota Environmental Sciences, 2010) and species is not restricted to the Survey Area.

Table 4.6: Shorebirds of the East Asian-Australasian Flyway that Potentially Occur at the Survey Area

Species	Likelihood of Occurrence	Species	Likelihood of Occurrence
Curlew Sandpiper (<i>Calidris ferruginea</i>)	High	Grey-tailed Tattler (<i>Tringa brevipes</i>)	High
Eastern Curlew (<i>Numenius madagascariensis</i>)	High	Marsh Sandpiper (<i>Tringa stagnatilis</i>)	Medium
Great Knot (<i>Calidris tenuirostris</i>)	High	Oriental Plover (<i>Charadrius veredus</i>)	Medium

Species	Likelihood of Occurrence	Species	Likelihood of Occurrence
Lesser Sand Plover (<i>Charadrius mongolus</i>)	High	Little Curlew (<i>Numenius minutus</i>)	Medium
Red Knot (<i>Calidris canutus</i>)	Medium	Black-tailed Godwit (<i>Limosa limosa</i>)	Low
Greater Sand Plover (<i>Charadrius leschenaultii</i>)	High	Pectoral Sandpiper (<i>Calidris melanotos</i>)	High
Pacific Golden Plover (<i>Pluvialis fulva</i>)	Medium	Wood Sandpiper (<i>Tringa glareola</i>)	High
Grey Plover (<i>Pluvialis squatarola</i>)	High	Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	High
Whimbrel (<i>Numenius phaeopus</i>)	High	Red-necked Stint (<i>Calidris ruficollis</i>)	High
Bar-tailed Godwit (<i>Limosa lapponica</i>)	High	Common Sandpiper (<i>Actitis hypoleucos</i>)	Medium
Ruddy Turnstone (<i>Arenaria interpres</i>)	High	Common Greenshank (<i>Tringa nebularia</i>)	High
Sanderling (<i>Calidris alba</i>)	High	Oriental Pratincole (<i>Glareola maldivarum</i>)	Recorded
Terek Sandpiper (<i>Xenus cinereus</i>)	Medium		

4.2.5.2. Fork-tailed Swift (*Apus pacificus*)

Conservation Status

EPBC Act: Migratory & BC Act: Migratory

Distribution, Ecology & Habitat: The Fork-tailed Swift is a terrestrial migratory visitor to Australia from Asia occurring across all states. In Western Australia records are highest in coastal regions of the south-west, and scattered in the Pilbara and Kimberly regions (Australian Government & Department of Agriculture Water and the Environment, 2020). This medium sized swift is characterised by its forked tail and white rump with back swept wings that taper to a fine point. The tail is deeply forked when spread (Menkhorst *et al.*, 2019). The species is known to be highly nomadic and rarely lands spending much of their time foraging high above the canopy. Large flocks are often associated with low pressure storm systems where they feed on insects (Menkhorst *et al.*, 2019; Australian Government & Department of Agriculture Water and the Environment, 2020).

Occurrence in the Survey Area: The Fork-tailed Swift was not recorded during this assessment. There are nine records of the species from the vicinity of the Survey Area. It is likely to overfly the Survey Area in association with low pressure systems but is unlikely to land or utilise the habitats of the Survey Area due to its almost entirely aerial lifestyle.

4.2.5.3. Little Tern (*Sterna albifrons*), Roseate Tern (*Sterna dougallii*) and Common Tern (*Sterna hirundo*)

Conservation Status

EPBC Act: Migratory & BC Act: Migratory

Distribution, Ecology & Habitat:

These species of Tern are migrants from Asian breeding grounds, arriving in Australia in spring and returning to Asia in autumn (Menkhorst *et al.*, 2019). Some individuals may also spend their first and second winters in Australia. Some small populations of Little Terns breed in Australia. The three species are distributed on coastal margins of tropical northern Australia. Little and Common Terns also occur along the east coast while the Roseate and Common Terns are found in coastal areas of the south west.

Foraging for small fish occurs on the wing over coastal waters. Roseate Terns are rarely seen foraging in inshore waters while Common Terns will also forage over coastal wetlands including estuaries, rivers and

swamps. Nesting also takes place on coastal habitats - Little Terns nest in colonies in open, sandy areas, Roseate Terns nest on beaches above the high-water mark while Common Terns nest on ocean beaches, rock platforms and man-made structures.

Occurrence in the Survey Area: The Little Tern was recorded flying over the Survey Area during this field assessment; the Roseate and Common Terns were recorded in the Survey Area in 2008. All three species have been recorded frequently in the vicinity of the Survey Area. Their use of the Survey Area is likely to be limited to flying over.

4.2.5.4. White-winged Black Tern (*Sterna leucoptera*)

Conservation Status

EPBC Act: Migratory & BC Act: Migratory

Distribution, Ecology & Habitat: The White-winged Black Tern is a non-breeding migrant. It arrives in Australia from its north Asian breeding grounds in spring and departs in autumn (DAWE 2021c). In Australia it is common on the south-west, northern and central-eastern coasts. White-winged Black Terns forage on the wing over coastal wetlands and their associated tidal mudflats, freshwater wetlands and grasslands (Menkhorst *et al.*, 2019). They feed on a variety of invertebrates including aquatic and terrestrial insects, spiders, small fish, tadpoles, frogs, and skinks. Roosting occurs on the ground at the edges of wetlands, sandflats, mudflats beaches and spits (Department of Agriculture Water and the Environment, 2021c).

Occurrence in the Survey Area: The White-winged Black Tern was not recorded inside the Survey Area during this field assessment but was assessed to have a High likelihood of occurrence in the Survey Area. It has been recorded frequently in the vicinity of the Survey Area and may forage over the Tidal Mudflats and Claypans. There is also potential roosting habitat on the edges of tidal mudflats.

4.2.5.5. Gull-billed Tern (*Gelochelidon nilotica*)

Conservation Status

EPBC Act: Migratory & BC Act: Migratory

Distribution, Ecology & Habitat: The Gull-billed Tern has a widespread distribution around the world occurring on all continents except Antarctica. In Australia the species is most common on coastlines with tidal mudflats but is also found inland on ephemeral lakes and wetlands (Menkhorst *et al.*, 2019). Individuals will breed inland all year if sufficient resources are available however many individuals move to the north coast for winter (Rogers *et al.*, 2005). Gull-billed Terns forage over mudflats, shallow water and grasslands, feeding on fish, crabs lizards and mice. They are often found near Whimbrels from which they have been observed taking crabs in behaviour described as kleptoparasitic (Rogers *et al.*, 2005). Breeding occurs colonially on large lakes and wetlands (Menkhorst *et al.*, 2019).

Occurrence in the Survey Area: The Gull-billed Tern was recorded inside the Survey Area twice during this field assessment and has been recorded frequently in the vicinity of the Survey Area. They may forage from the air over the Tidal Mudflats and Claypans however most use of the Survey Area is likely to be flying over. The Tidal Mudflats and Claypans habitat is widespread (Biota Environmental Sciences, 2010) and foraging likely occurs throughout the region.

4.2.5.6. Caspian Tern (*Hydroprogne caspia*)

Conservation Status

EPBC Act: Migratory & BC Act: Migratory

Distribution, Ecology & Habitat: Caspian Terns occur globally in North America, Europe, Africa, Asia, Australia, and New Zealand. In Australia, the species is common with a widespread, predominantly coastal distribution, however there are sparse inland records. It is resident at breeding sites; seasonal patterns consistent with migration are observed from non-breeding areas (DAWE 2021b). It is found in sheltered coastal areas such as harbours, lagoons and bays, and inland wetlands such as salt lakes, ephemeral wetlands, waterholes and reservoirs (Menkhorst *et al.*, 2019). It forages on small fish over open wetlands and coastal waters. Caspian Terns nest in the open or among low or sparse vegetation including tussock grasses and samphire. Roosting occurs beaches, lakes estuaries and lagoons (Department of Agriculture Water and the Environment, 2021b).

Occurrence in the Survey Area: The Caspian Tern was not recorded during this field assessment. The species has been recorded within the Survey Area five times in the last ten years and has been recorded frequently in the vicinity of the Survey Area. Use of the Survey Area is likely to be limited to flying over.

4.2.5.7. Crested Tern (*Thalasseus bergii*)

Conservation Status

EPBC Act: Migratory & BC Act: Migratory

Distribution, Ecology & Habitat: Crested Terns are found in coastal areas around Australia often forming flocks with Silver Gulls and other terns. They forage on small fish over coastal seas, roosting on sandy beaches, rocks and man-made structures (Menkhorst *et al.*, 2019). Crested Terns nest in colonies laying a single egg in a scrape on sparsely vegetated rocky or sandy islands (Langham and Hulsman, 1986).

Occurrence in the Survey Area: The Crested Tern was not recorded during this field assessment. It was assessed to have a High likelihood of occurrence in the Survey Area due to the number and frequency of nearby records. Their use of the Survey Area is likely to be limited to flying over.

4.2.5.8. Osprey (*Pandion haliaetus*)

Conservation Status

EPBC Act: Migratory & BC Act: Migratory

Distribution, Ecology & Habitat: Ospreys occur across most of coastal Australia, with higher densities in the northern tropical and subtropical regions and a sparser distribution in the temperate regions (Dennis and Clancy, 2014). They are mostly restricted to coastal areas including estuaries but may also travel along major rivers, particularly in the north of Australia. Foraging for food sources including fish, especially mullet, occurs over areas of open fresh, brackish or saline water (DAWE 2021d). Ospreys are mostly resident around breeding territories where breeding occurs in monogamous pairs. Nesting occurs in tall dead or living trees and artificial structures such as power poles. In areas lacking coastal forests nests may be built on low cliff-faces or wave cut platforms (Dennis and Clancy, 2014).

Occurrence in the Survey Area: The Osprey was not recorded inside the Survey Area during this field assessment. Ospreys have been recorded regularly in the vicinity of the Survey Area including a record inside the Survey Area from 2008. Given the sedentary nature of breeding pairs it is likely the species is resident to the area. Marginal foraging habitat in the Survey Area comprises the Tidal Mudflats and Claypans

habitat when inundated, and the creek line that crosses the Survey Area. Use of the Survey Area is likely limited to flying over, and occasional foraging.

4.2.5.9. Barn Swallow (*Hirundo rustica*)

Conservation Status

EPBC Act: Migratory & BC Act: Migratory

Distribution, Ecology & Habitat: The Barn Swallow is a migratory bird that breeds in temperate and sub-tropical regions of North America, Europe, northern Africa, and Asia, migrating to the southern hemisphere for the northern winter. In Australia it is found from the Pilbara coast to Fraser Island in Queensland. It occupies coastal lowlands often near water, towns, and cities where it is often seen on powerlines and consumes flying insects.

Occurrence in the Survey Area: The Barn Swallow was not recorded within the Survey Area during this field assessment. There have been ten records of Barn Swallows in proximity to the Survey Area. The species may visit the Survey Area where suitable habitat exists in the Tecticornia Shrublands and Sand Plains. Use of the Survey Area is likely to be limited to flying over and aerial foraging on flying insects.

4.2.5.10. Peregrine Falcon (*Falco peregrinus*)

Conservation Status

BC Act: OS

Distribution, Ecology & Habitat: The Peregrine Falcon is one of the most widespread birds in the world, breeding on all continents except Antarctica (Olsen *et al.*, 2006). It occurs across most of Australia, although it is an uncommon species and is rare across all states and territories (Birdlife Australia, 2012). They are known to be both a nomadic and sedentary species. They inhabit cliffs, coastal habitats, rivers, wooded water courses and lakes, as well as urban environments. Peregrine Falcons usually nest by making a scrape on a high cliff-edge but will also use stick nests of other large birds and tree hollows in some areas (Olsen *et al.*, 2006). Hunting is mainly done during the day and feeding is primarily on small- to medium-sized birds caught in flight, often above drainage lines and rivers. Favoured prey species include the Galah (*Eolophus roseicapilla*) and Sulphur-crested Cockatoo (*Cacatua galerita*) (Birdlife Australia, 2012).

Occurrence in the Survey Area: Peregrine Falcons were not recorded within the Survey Area during this assessment. They have been recorded five times in close proximity to the Survey Area; all records were made within the past twenty years. There is no breeding habitat present in the Survey Area, and any use of the area is likely to be flying over the Survey Area or foraging along drainage lines. The species typically occurs in low densities and is likely to only occur infrequently.

5. CONCLUSION

5.1. Flora

No Threatened flora taxa were recorded during the desktop assessment or considered likely to occur within the Survey Area.

Eremophila forrestii subsp. *viridis* (Priority 3) was recorded widespread across the swales and footslopes of the red sand dunes, with 1,073 individuals recorded during the assessment. Of these, 950 individuals were recorded within, and 123 individuals were recorded outside of the Survey Area. Due to time constraints the entire population was not walked outside of the Survey Area.

Eremophila forrestii subsp. *viridis* is previously known from two previous locations in the vicinity of the Survey Area at approximately 2.5 km (no abundance or habitat details) and 9 km (6-20 plants on red sand dune). There were four other previously known locations recorded within, or very close to, the Survey Area. It is likely to be widespread across the sand dune and sandy areas in vicinity of the Survey Area. *Eremophila forrestii* subsp. *viridis* is known from multiple locations across Western Australia, and has been recorded on sandy and rocky habitats across six IBRA regions (Carnarvon, Pilbara, Little Sandy Desert, Great Sandy Desert, Great Victoria Desert, Central Ranges) and is therefore not regionally restricted (Chinnock, 2007).

Triumfetta echinata (Priority 3) was recorded scattered along the dune crests with 103 individuals recorded. Of these, one individual was recorded outside of the Survey Area. Due to time constraints the entire population was not walked outside of the Survey Area.

Triumfetta echinata is previously known from six locations in the vicinity of the Survey Area at approximately 0.6 km (no abundance or habitat details), 3.9 km (on red sand dune, no abundance details), 17 km (no abundance or habitat details), 28 km (on red sand, no abundance details), 26 km (on red sand dune, common abundance), and 28 km (on red sand dune, no abundance details). There were two other previously known locations recorded within, or very close to, the Survey Area. These records were all found on red sand dunes. It is likely to be widespread across the sand dune and sandy areas in vicinity of the Survey Area. *Triumfetta echinata* is known from multiple locations across Western Australia, and has been recorded on red sand and sand dune habitats across three IBRA regions (Carnarvon, Gascoyne, and Pilbara) and is therefore not regionally restricted (Western Australian Herbarium, 2020).

5.2. Vegetation

Based on the definitions of significant vegetation listed in section 2.4 (EPA 2016a) vegetation Type D1 is considered significant as it acts as a role as refuge (providing habitat) for the two Priority 3 flora species, *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata*, found exclusively on the dunes and this vegetation type.

The majority of vegetation type D1 was recorded on sand dunes and swales that are mapped and associated with the Dune land system. Some areas were also mapped on sand dunes associated within the Onslow land system. Dunes account for approximately 5% of the total area of the Onslow land system with the majority of landforms described as clay plains, saline flats, drainage floors, and sand plains (Van Vreeswyk *et al.*, 2004) which are not suitable habitat for vegetation type D1.

Vegetation type D1 is likely to be widespread in the local area as dune landforms are common. Vegetation type D1 is mapped as 77 ha of the Survey Area. There is 20,512 ha of the Dune land system mapped in the desktop Study Area, therefore of the potential habitat for vegetation type D1 within the desktop Study Area, 0.3% is mapped within the Survey Area.

The Dune land system is mostly restricted to small patches along the coastline of the Carnarvon region. Within the Carnarvon region there is 37,448 ha or 84% of the total area (44,402 ha in Western Australia) of the Dune land system mapped within. The Onslow land system extends 100 km further east into the Pilbara region along the coastline and may provide some habitat for vegetation type D1 however as the habitats within this land system are not dominated by dune landforms, it is not likely to be widespread. Therefore vegetation type D1 is likely to be restricted regionally.

Vegetation condition varied within vegetation types based on previous disturbances and proximity to the road verge. Weeds were common, with **Cenchrus ciliaris* (Buffel Grass) recorded commonly across the Survey Area, especially along the roadside, and forming the dominant understory species in three vegetation types (P1b, P3, DL1) and **Prosopis pallida* (Mesquite) forming the dominant structural overstorey component in vegetation type P3.

5.3. Fauna

Five fauna habitats were recorded. The Sand Plains habitat was the most abundant one, covering 159.4 ha (42.8% of the Survey Area) and may provide habitat for the Northern Short-tailed Mouse (*Leggadina lakedownensis*). The Tidal Mudflats and Claypans (7.6% of the Survey Area) represent foraging habitat for water and shorebirds including 28 EPBC listed migratory species.

Two significant fauna species were recorded within the Survey Area during this assessment – one Little Tern and two Gull-Billed Terns were observed flying over the north of the survey area (Tidal flats). Two species have been recorded within the Survey Area in previous surveys within the last ten years (but were not recorded in the current survey) – Oriental Pratincole and Caspian Tern. A total of 25 species were assessed to have a High likelihood of occurrence in the Survey Area including one mammal and 24 birds. Eleven species were assessed to have a Medium likelihood of occurrence, and 19 species were assessed to have a low to very Low likelihood of occurrence.

The desktop assessment identified 15 potential SRE species (all arachnids) as previously recorded from the region. However, the Survey Area does not contain typical habitat for restricted terrestrial invertebrate fauna species such as rocky gorges and springs, and the species are likely widespread.

6. REFERENCES

- Armstrong, K. N. (2001) 'The roost habitat and distribution of the orange leaf-nosed bat, *Rhinonicteris aurantius*, in the Pilbara region of Western Australia.', *Wildlife Research*, 28, pp. 95–104.
- Armstrong, K. N. and Anstee, S. D. (2000) 'The ghost bat in the pilbara: 100 years on.', *Australian Mammalogy*, 22, pp. 93–101.
- Australian Government & Department of Agriculture Water and the Environment (2020) *Species Profile and Threats Database. Apus pacificus - Fork-tailed Swift*.
- Bamford Consulting Ecologists (2009) *Survey for Migratory Waterbirds in the Wheatstone LNG Project Area, November 2008 and March 2009*. Unpublished report for URS Australia Pty Ltd and Chevron Australia Pty Ltd.
- Bamford Consulting Ecologists (2018) *ANSIA Stage 2 Fauna Assessment*. Unpublished report for RPS Australia Asia Pacific.
- Biota Environmental Sciences (2010) *Wheatstone Project Terrestrial Fauna Survey*. Unpublished report for URS Australia Pty Ltd and Chevron Australia Pty Ltd.
- Birdlife Australia (2012) 'Peregrine Falcon'.
- Burbidge, A. ., Harrison, P. . and Woinarski, J. . (2014) *The Action Plan for Australian Mammals 2012*. Collingwood, Vic.: CSIRO Publishing.
- Bureau of Meteorology (2021) 'Climate Data Online'.
- Chinnock, R. J. (2007) *Eremophila and allied genera. A Monograph of the Myoporaceae*. 1st edn. Kenthurst: Rosenberg Publishing Pty Ltd.
- Chiu, C.-H. *et al.* (2014) 'An improved nonparametric lower bound of species richness via a modified good-turing frequency formula', *Biometrics*, 70(3), pp. 671–682. doi: 10.1111/biom.12200.
- Churchill, S. (2009) *Australian Bats*. 2nd Editio. Allen & Unwin.
- Cogger, H. G. (2018) *Reptiles and Amphibians of Australia*. 7th Editio. Collingwood, Victoria: CSIRO Publishing.
- Commonwealth of Australia (2015) *Wildlife Conservation Plan for Migratory Shorebirds*.
- Cramer, V. A. *et al.* (2016) 'Research priorities for the Pilbara leaf-nosed bat (*Rhinonicteris aurantia* Pilbara form)', *Australian Mammalogy*. CSIRO, 38(2), pp. 149–157.
- Dennis, T. E. and Clancy, G. P. (2014) 'The status of the Osprey (*Pandion haliaetus cristatus*) in Australia', *The Journal of Raptor Research*, 48(4), pp. 408–414.
- Department of Agriculture and Food Western Australia (2016) *Rangeland land system mapping Western Australia*.
- Department of Agriculture Water and the Environment (2021a) 'Collaborative Australian Protected Areas Database (CAPAD) 2020 - Terrestrial'. Commonwealth of Australia.
- Department of Agriculture Water and the Environment (2021b) *Species Profile and Threats Database. Caspian Tern (Hydroprogne caspia)*.
- Department of Agriculture Water and the Environment (2021c) *Species Profile and Threats Database. Chlidonias leucopterus - White-winged Black Tern*.

Department of Agriculture Water and the Environment (2021d) *Species Profile and Threats Database. Pandion haliaetus - Osprey.*

Department of Biodiversity Conservation and Attractions (2017a) 'Priority Ecological Communities for Western Australia Version 27'. Species and Communities Branch, Department of Biodiversity, Conservation and Attractions.

Department of Biodiversity Conservation and Attractions (2017b) 'Threatened and Priority Flora Report Form - Field Manual'. 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 Environment Regulation (2014) 'A guide to the assessment of applications to clear native vegetation. Under Part V Division 2 of the Environmental Protection Act 1986'. State of Western Australia.

Department of Mines Industry Regulation and Safety (2020) *1:500 000 State interpreted bedrock geology of Western Australia, 2020.*

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 reptiles. Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999'.

Department of the Environment (2016) *EPBC Act referral guideline for endangered northern quoll Dasyurus hallucatus. EPBC Act Policy Statement.*

Department of the Environment (2020) *Species Profile and Threats Database - Barn Swallow Hirundo rustica.*

Department of the Environment and Energy (2019) 'Australian Wetlands Database'. Australian Government. Available at: <https://www.environment.gov.au/water/wetlands/australian-wetlands-database>.

Department of Water and Environmental Regulation (2019) 'Clearing Regulations - Environmentally Sensitive Areas'. Government of Western Australia.

Durrant, B. J. (2011) *Short-range endemism in the Central Pilbara.*

Environmental Protection Authority (2000) 'EPA Position Statement No. 2: Environmental Protection of Native Vegetation in Western Australia'.

Environmental Protection Authority (2002) 'EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection'. Environmental Protection Authority.

Environmental Protection Authority (2016a) 'Environmental Factor Guideline: Terrestrial Fauna'. Environmental Protection Authority.

Environmental Protection Authority (2016b) 'EPA Environmental Factor Guideline: Flora and Vegetation'. Environmental Protection Authority.

Environmental Protection Authority (2016c) 'EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment'. Environmental Protection Authority.

Environmental Protection Authority (2016d) 'Technical Guidance: Sampling of short range endemic invertebrate fauna'. Environmental Protection Authority.

- Environmental Protection Authority (2016e) *Technical Guidance - Sampling methods for terrestrial vertebrate fauna*. Perth, Western Australia.
- Environmental Protection Authority (2020) 'Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment'. Western Australia: EPA.
- 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.
- Friend, J. A. (2008) 'Western Barred Bandicoot *Perameles bougainville*', in Van Dyck, S. and Strahan, R. (eds) *The Mammals of Australia*. Third. Reed New Holland, pp. 181–182.
- Galili, T. (2015) *Dendextend: an R package for visualizing, adjusting, and comparing trees of hierarchical clustering*. *Bioinformatics*. doi: 10.1093/bioinformatics/btv428.
- GHD (2011) *Onslow Material Pits Environmental Impact Assessment and Environmental Management Plan*. Unpublished report for Main Roads Western Australia.
- GHD (2017) *Targeted Flora Survey - Onslow Utilities Infrastructure Upgrade Project - Horizon Power*.
- Government of Western Australia (2007) 'Biosecurity and Agriculture Management Act (BAM Act) 2007'.
- 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>.
- Hansen, B. D. *et al.* (2016) *Revision of the East Asian-Australasian Flyway population estimates for 37 listed migratory shorebird species*. Unpublished report for the Department of Environment, Birdlife Australia, Melbourne.
- Harvey, M. S. (2002) 'Short-range endemism among the Australian fauna: some examples from non-marine environments.', *Invertebrate Systematics*, 16, pp. 555–570.
- Jari Oksanen, F. Guillaume Blanchet, Michael Friendly, Roeland Kindt, Pierre Legendre, Dan McGlinn, Peter R. Minchin, R. B. O'Hara, G. L. and Simpson, Peter Solymos, M. Henry H. Stevens, E. S. and H. W. (2019) *vegan: Community Ecology Package*. *R package version 2.5-6*.
- Kendrick, P. and Mau, R. (2001) 'Carnarvon 1 (CAR1 - Cape Range subregion)', in *A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002*. Department of Conservation and Land Management, pp. 69–86.
- Kutt, A. S. and Kemp, J. E. (2005) 'Distribution, habitat and conservation status of *Leggadina lakedownensis* (Rodentia: Muridae) in Queensland', *Australian Zoologist*, 33(2), pp. 258–264.
- Langham, N. P. and Hulsman, K. (1986) 'The breeding biology of the Crested Tern (*Sterna bergii*)', *Emu*, 86(1), pp. 23–32.
- Main Roads (2018) *Onslow Road Phase 2 Reconnaissance Survey*.
- Mattiske Consulting (2014) *Level 1 flora and vegetation survey of the Ashburton North Gas Pipeline (ANGP) project area*.
- Menkhorst, P. *et al.* (2019) *The Australian Bird Guide*. Revised. Csiro Publishing.

- Moro, D. and Kutt, A. . (2008) 'Northern Short-tailed Mouse *Leggadina lakedownensis*', in Van Dyck, S. and Strahan, R. (eds) *The Mammals of Australia*. Third. Reed New Holland, pp. 583–584.
- Ninox Wildlife Consulting (2013) *A Level 1 vertebrate fauna assessment of the proposed Turbridgi to Wheatstone Gas Pipeline, Western Australia*. Unpublished report for Mattiske Consulting Pty Ltd.
- Olsen, J. *et al.* (2006) 'Male Peregrine Falcon *Falco peregrinus* fledged from a cliff-nest found breeding in a stick-nest', *Australian Field Ornithology*. Bird Observers Club of Australia (BOCA), 23(1), pp. 8–14.
- Phoenix Environmental Sciences (2017) *Flora and vegetation survey and terrestrial fauna survey for the proposed Pilbara Regional Waste Management Facility. Prepared for Talis Consultants*.
- Phoenix Environmental Sciences (2018) *Detailed flora and vegetation survey for the Pilbara Regional Waste Management Facility. Prepared for Talis Consultants*.
- R Core Team (2021) 'R: A language and environment for statistical computing.' Vienna.
- Rogers, D. I. *et al.* (2005) 'Gull-billed Terns in north-western Australia: subspecies identification, moults and behavioural notes', *Emu-Austral Ornithology*, 105(2), pp. 145–158.
- Shepherd, D. P., Beeston, G. R. and Hopkins, A. J. M. (2001) *Native vegetation in Western Australia: Extent, type and status. Technical Report 249*.
- Start, A. N. (2008) 'Western Pebble-mound Mouse *Pseudomys chapmani*', in Van Dyck, S. and Strahan, R. (eds) *The Mammals of Australia*. Third. Reed New Holland, pp. 621–622.
- Thackway, R. and Cresswell, I. D. (1995) 'An Interim Biogeographic Regionalisation for Australia (IBRA)'.
- Trudgen, M. E. (1988) 'A Report on the Flora and Vegetation of the Port Kennedy Area. Unpublished report prepared for Bowman Bishaw and Associates, West Perth.'
- Vicki Long & Associates (2020) *Pilbara Ports Authority - Port of Ashburton - Eastern Port Precinct - Additional Clearing Areas Flora Survey*.
- Van Vreeswyk, A. M. E. *et al.* (2004) 'An inventory and condition survey of the Pilbara region, Western Australia'. Department of Agriculture and Food.
- Western Australian Government (1986) *Environmental Protection Act 1986*.
- Western Australian Government (2016) *Biodiversity Conservation Act*. Western Australia: Government of Western Australia.
- Western Australian Herbarium (2020) 'FloraBase—the Western Australian Flora. Department of Biodiversity, Conservation and Attractions', p. <https://florabase.dpaw.wa.gov.au/>.

Appendix A: Conservation Codes



Appendix A1: Definitions of Conservation Categories under the EPBC Act

Category	Definition
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered, or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Appendix A2: Definitions of Conservation Categories Under the BC Act

Code	Definition (BC Act)
Threatened Species (T)	<p>Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the Biodiversity Conservation Act 2016 (BC Act).</p> <p>Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna.</p> <p>Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora.</p> <p>The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.</p>
Critically Endangered (CR)	<p>Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines".</p> <p>Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.</p>
Endangered (EN)	<p>Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines".</p> <p>Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.</p>
Vulnerable (VU)	<p>Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines".</p> <p>Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.</p>
Extinct species	
Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.	
Extinct species (EX)	<p>Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).</p> <p>Published as presumed extinct under schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for extinct fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.</p>
Extinct in the wild species (EW)	<p>Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).</p> <p>Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.</p>

Code	Definition (BC Act)
<p>Specially protected species</p> <p>Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.</p> <p>Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.</p>	
Migratory species (MI)	<p>Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).</p> <p>Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.</p> <p>Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.</p>
Conservation Dependent (CD)	<p>Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).</p> <p>Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018</p>
Other specially protected fauna (OS)	<p>Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).</p> <p>Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018</p>
<p>Priority species (P)</p> <p>Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.</p> <p>Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.</p> <p>Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.</p>	
Priority 1: Poorly-known species (P1)	<p>Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.</p>

Code	Definition (BC Act)
Priority 2: Poorly-known species (P2)	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3: Poorly-known species (P3)	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4: Rare, Near Threatened and other species in need of monitoring (P4)	<p>(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.</p> <p>(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

Appendix A3: Legal Status Definition of Listed Plants in Western Australia

Legal Status	Definition
Declared Pest, Prohibited – s12	Prohibited organisms are declared pests by virtue of section 22(1) and may only be imported and kept subject to permits.
Declared Pest – s22(2)	Declared pests must satisfy any applicable import requirements when imported and may be subject to control keeping requirements.
Permitted – s11	Permitted organisms must satisfy applicable import requirements and import permits (where required).
Permitted, Requires Permit – r73	Regulation 73 permitted organisms may be subject to restriction under legislation other than the BAM Act (2007).
Unlisted	Unlisted organisms are prohibited in WA.
Control Categories	Definition
C1 Exclusion	Organisms should be excluded from parts or all of WA.
C2 Eradication	Organisms should be eradicated from all or parts of WA.
C3 Management	Organisms should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism.
Unassigned	Declared pest that are recognised as having a harmful impact under certain circumstances where their subsequent control requirements are determined by a plan or other legislative arrangements under the Act.
Keeping Categories	Definition
Prohibited keeping	Can only be kept under a permit for public display, education or scientific purposes.
Restricted keeping	Kept under a permit by private individuals due to a low risk of becoming a problem for the environment.
Exempt keeping	No permit or conditions are required for keeping. Organism may be subject to restrictions under the Wildlife Conservation Act (WCA, 1950).

Appendix B: Flora Quadrat & Relevé Site Data





Site: Q001		Type: Quadrat		Size: 50 x 50		Date: 04/05/2021		Botanist: Melissa Hay	
Landform:	Hill, Crest, Hill								
Slope, aspect:	3° - Gentle None								
Soil:	Sand, Orange								
Rocks:	No rocks								
Abundance:	-								
Size:	-								
Fire:	> 5 yrs								
Condition:	Very Good								
Notes:	Weeds (Low)								
Veg Unit:	D1								
Location (NW):	50 303852 7588035								
Species			Height	Cover	Species			Height	Cover
<i>Abutilon</i> sp. Dioicum (A.A. Mitchell PRP 1618)			0.25	0.1	<i>Ptilotus polystachyus</i>			0.2	0.1
<i>Acacia stellaticeps</i>			1.2	1	<i>Scaevola sericophylla</i>			1.2	4
<i>Adriana tomentosa</i> var. <i>tomentosa</i>			0.4	0.1	<i>Senna notabilis</i>			0.2	0.1
<i>Bonamia erecta</i>			0.3	0.1	<i>Sida fibulifera</i>			0.3	0.1
<i>Bulbostylis barbata</i>			0.2	0.1	<i>Solanum lasiophyllum</i>			0.2	0.1
<i>Cassytha capillaris</i>			1	0.1	<i>Trachymene pilbarensis</i>			0.2	0.1
* <i>Cenchrus ciliaris</i>			0.3	0.1	<i>Trianthema pilosum</i>			0.1	0.1
<i>Crotalaria cunninghamii</i> subsp. <i>sturtii</i>			0.3	0.1	<i>Tribulus hystrix</i>			0.2	0.1
<i>Euphorbia myrtoides</i>			0.1	0.1	<i>Trichodesma zeylanicum</i>			0.2	0.1
<i>Grevillea stenobotrya</i>			2.2	12	<i>Triodia epactia</i>			0.4	35
<i>Hakea stenophylla</i> subsp. <i>stenophylla</i>			1	0.1	<i>Triodia schinzii</i>			0.4	0.5
<i>Hibiscus sturtii</i> var. <i>?platyklamys</i>			0.2	0.1	<i>Urochloa holosericea</i> subsp. <i>velutina</i>			0.1	0.1
<i>Indigofera colutea</i>			0.2	0.1	<i>Yakirra australiensis</i> var. <i>australiensis</i>			0.1	0.1
<i>Ptilotus axillaris</i>			0.1	0.1					



Site: Q002		Type: Quadrat		Size: 50 x 50		Date: 05/05/2021		Botanist: Melissa Hay	
Landform:	Drainage, Salt pan								
Slope, aspect:	<1° - Level -								
Soil:	Clay, Orange, Brown								
Rocks:	No rocks								
Abundance:	-								
Size:	-								
Fire:	> 5 yrs								
Condition:	Very Good								
Notes:	Weeds (Medium)								
Veg Unit:	C1								
Location (NW):	50 293299 7592949								
Species			Height	Cover	Species			Height	Cover
* <i>Cenchrus ciliaris</i>			0.3	10	<i>Flaveria trinervia</i>			0.2	0.1
<i>Chloris pumilio</i>			0.2	0.1	<i>Iseilema vaginiflorum</i>			0.1	0.1
<i>Cucumis melo</i>			0.6	0.1	<i>Lawrenca viridigrisea</i>			0.2	0.1
<i>Cullen cinereum</i>			0.1	0.1	<i>Tecticornia auriculata</i>			0.5	35
<i>Dactyloctenium radulans</i>			0.1	0.1	<i>Tecticornia</i> sp. 1			0.3	0.1
<i>Dichanthium sericeum</i> subsp. <i>humilius</i>			0.2	0.1	<i>Urochloa occidentalis</i> var. <i>occidentalis</i>			0.1	0.1
<i>Eragrostis pergracilis</i>			0.1	0.1					





Site: Q003		Type: Quadrat		Size: 50 x 50		Date: 05/05/2021		Botanist: Melissa Hay	
Landform:	Flat, Plain								
Slope, aspect:	3° - Gentle None								
Soil:	Sand, Orange								
Rocks:	No rocks								
Abundance:	-								
Size:	-								
Fire:	> 5 yrs								
Condition:	Very Good								
Notes:	Weeds (Medium)								
Veg Unit:	D1								
Location (NW):	50 294303 7592411								
									
Species	Height	Cover	Species	Height	Cover	Species	Height	Cover	Species
<i>Bonamia erecta</i>	0.3	0.1	<i>Indigofera colutea</i>	0.3	15				
<i>Bulbostylis barbata</i>	0.1	0.1	<i>Indigofera linifolia</i>	0.4	1				
<i>Cassytha capillaris</i>	0.4	0.1	<i>Polymeria ambigua</i>	0.4	0.3				
* <i>Cenchrus ciliaris</i>	0.3	0.5	<i>Ptilotus polystachyus</i>	0.4	0.5				
<i>Crotalaria cunninghamii</i> subsp. <i>sturtii</i>	0.3	0.1	<i>Salsola australis</i>	0.2	0.1				
<i>Dactyloctenium radulans</i>	0.1	0.1	<i>Scaevola sericophylla</i>	1	1				
<i>Euphorbia myrtilloides</i>	0.2	0.1	<i>Sida rohlenae</i> subsp. <i>rohlenae</i>	0.5	0.1				
<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	0.1	0.1	<i>Trianthema pilosum</i>	0.1	0.1				
<i>Goodenia forrestii</i>	0.1	0.1	<i>Triodia epactia</i>	0.3	60				
<i>Grona filiformis</i>	0.3	0.1	<i>Urochloa holosericea</i> subsp. <i>velutina</i>	0.2	0.2				
<i>Hibiscus sturtii</i> var. <i>?platyklamys</i>	0.4	0.1	<i>Yakirra australiensis</i> var. <i>australiensis</i>	0.1	0.1				


Site: Q004		Type: Quadrat		Size: 50 x 50		Date: 05/05/2021		Botanist: Melissa Hay	
Landform:	Drainage, Salt pan								
Slope, aspect:	<1° - Level -								
Soil:	Clay, Orange, Brown								
Rocks:	No rocks								
Abundance:	-								
Size:	-								
Fire:	> 5 yrs								
Condition:	Very Good								
Notes:	Weeds (High)								
Veg Unit:	C1								
Location (NW):	50 295458 7592000								
									
Species	Height	Cover	Species	Height	Cover	Species	Height	Cover	Species
* <i>Cenchrus ciliaris</i>	0.3	5	<i>Iseilema vaginiflorum</i>	0.2	0.1				
<i>Chloris pumilio</i>	0.3	1	<i>Lawrenca viridigrisea</i>	0.3	0.1				
<i>Cullen cinereum</i>	0.3	0.2	<i>Nicotiana occidentalis</i> subsp. <i>?occidentalis</i>	0.2	0.4				
<i>Cyperus bulbosus</i>	0.1	0.5	<i>Portulaca oleracea</i>	0.1	0.1				
<i>Dactyloctenium radulans</i>	0.1	0.1	<i>Swainsona pterostylis</i>	0.3	0.1				
<i>Eragrostis pergracilis</i>	0.1	0.1	<i>Tecticornia auriculata</i>	0.8	20.25				
<i>Flaveria trinervia</i>	0.3	1	<i>Urochloa occidentalis</i> var. <i>occidentalis</i>	0.2	0.1				


Site: Q005		Type: Quadrat		Size: 50 x 50		Date: 05/05/2021		Botanist: Melissa Hay	
Landform:	Hill, Ridge, Dune								
Slope, aspect:	3° - Gentle None								
Soil:	Sand, Red, Orange								
Rocks:	No rocks								
Abundance:	-								
Size:	-								
Fire:	> 5 yrs								
Condition:	Very Good								
Notes:	Weeds (Low)								
Veg Unit:	D1								
Location (NW):	50 299460 7590671								
Species			Height	Cover	Species			Height	Cover
<i>Abutilon</i> sp. Dioicum (A.A. Mitchell PRP 1618)			0.2	0.1	<i>Heliotropium cunninghamii</i>			0.2	0.1
<i>Acacia coriacea</i> subsp. <i>coriacea</i>			1.6	0.1	<i>Indigofera colutea</i>			0.3	0.1
<i>Acacia stellaticeps</i>			1.2	2	<i>Polymeria ambigua</i>			0.1	0.2
<i>Adriana tomentosa</i> var. <i>tomentosa</i>			1.2	0.1	<i>Ptilotus polystachyus</i>			0.3	0.1
<i>Alyogyne pinoniana</i>			1.2	0.1	<i>Scaevola sericophylla</i>			0.8	5
<i>Bonamia erecta</i>			0.3	0.1	<i>Senna notabilis</i>			0.2	0.1
<i>Bulbostylis barbata</i>			0.1	0.1	<i>Sida rohlenae</i> subsp. <i>rohlenae</i>			0.5	0.1
<i>Cassyltha capillaris</i>			1	0.1	<i>Solanum lasiophyllum</i>			0.3	0.2
<i>Corchorus elachocarpus</i>			0.1	0.1	<i>Tephrosia rosea</i> var. <i>clementii</i>			0.5	0.1
<i>Crotalaria cunninghamii</i> subsp. <i>sturtii</i>			0.3	0.1	<i>Trianthema pilosum</i>			0.1	0.1
<i>Euphorbia myrtoides</i>			0.1	0.1	<i>Trichodesma zeylanicum</i>			0.2	0.1
<i>Evolvulus alsinoides</i> var. <i>decumbens</i>			0.2	0.1	<i>Triodia epactia</i>			0.4	45
<i>Grevillea stenobotrya</i>			2.5	4	<i>Urochloa holosericea</i> subsp. <i>velutina</i>			0.6	0.1
<i>Hakea stenophylla</i> subsp. <i>stenophylla</i>			1.3	2	<i>Yakirra australiensis</i> var. <i>australiensis</i>			0.1	0.1
<i>Haloragis gossei</i>			0.2	0.1					





Site: Q006		Type: Quadrat	Size: 50 x 50	Date: 05/05/2021	Botanist: Melissa Hay	
Landform:	Flat, Plain					
Slope, aspect:	1° - Very Gentle None					
Soil:	Sand, Red, Orange					
Rocks:	No rocks					
Abundance:	-					
Size:	-					
Fire:	> 5 yrs					
Condition:	Very Good					
Notes:	Weeds (Low)					
Veg Unit:	P1a					
Location (NW):	50 303548 7588557					
						
Species	Height	Cover	Species	Height	Cover	
<i>Abutilon</i> sp. Dioicum (A.A. Mitchell PRP 1618)	0.2	0.1	<i>Grona filiformis</i>	0.2	0.1	
<i>Acacia stellaticeps</i>	1.3	0.1	<i>Indigofera colutea</i>	0.2	0.2	
<i>Acacia synchronicia</i>	1.4	0.2	<i>Indigofera linifolia</i>	0.3	0.1	
<i>Acacia tetragonophylla</i>	2.35	3	<i>Portulaca oleracea</i>	0.1	0.1	
* <i>Aerva javanica</i>	0.2	0.1	<i>Ptilotus exaltatus</i>	0.1	0.1	
<i>Aristida holathera</i> var. <i>holathera</i>	0.3	0.1	<i>Ptilotus polystachyus</i>	0.2	0.5	
<i>Atriplex semilunaris</i>	0.3	0.1	<i>Rhagodia eremaea</i>	1	0.1	
<i>Bulbostylis barbata</i>	0.1	0.1	<i>Salsola australis</i>	0.3	0.1	
* <i>Cenchrus ciliaris</i>	0.6	5	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	1	0.1	
<i>Crotalaria cunninghamii</i> subsp. <i>sturtii</i>	0.2	0.1	<i>Solanum lasiophyllum</i>	0.3	0.1	
<i>Crotalaria ramosissima</i>	0.2	0.1	<i>Trachymene pilbarensis</i>	0.1	0.1	
<i>Dactyloctenium radulans</i>	0.1	0.1	<i>Trianthema pilosum</i>	0.3	0.1	
<i>Enchylaena tomentosa</i>	0.5	0.1	<i>Trianthema triquetrum</i>	0.3	0.1	
<i>Eragrostis setifolia</i>	0.3	0.1	<i>Triodia epactia</i>	0.5	35	
<i>Eriachne gardneri</i>	0.3	0.1	<i>Yakirra australiensis</i> var. <i>australiensis</i>	0.1	0.1	
<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	0.2	0.1				

Site: Q007		Type: Quadrat	Size: 50 x 50	Date: 06/05/2021	Botanist: Melissa Hay	
Landform:	Flat, Plain					
Slope, aspect:	<1° - Level -					
Soil:	Sandy clay, Sand, Red, Orange					
Rocks:	No rocks					
Abundance:	-					
Size:	-					
Fire:	> 5 yrs					
Condition:	Very Good					
Notes:	Weeds (Low)					
Veg Unit:	P1a					
Location (NW):	50 302335 7590809					
						
Species	Height	Cover	Species	Height	Cover	
<i>Acacia stellaticeps</i>	1	0.1	<i>Polycarpaea corymbosa</i>	0.2	0.1	
<i>Acacia synchronicia</i>	1	0.1	<i>Ptilotus axillaris</i>	0.1	0.1	
<i>Acacia tetragonophylla</i>	2.2	2	<i>Ptilotus exaltatus</i>	0.3	0.1	
<i>Bulbostylis barbata</i>	0.15	0.1	<i>Ptilotus polystachyus</i>	0.3	0.1	
* <i>Cenchrus ciliaris</i>	0.3	2	<i>Salsola australis</i>	0.5	0.1	
<i>Dactyloctenium radulans</i>	0.1	0.1	<i>Senna glutinosa</i> subsp. <i>×luerssenii</i>	1	0.1	
<i>Euphorbia drummondii</i>	0.2	0.1	<i>Swainsona pterostylis</i>	0.2	0.1	
<i>Grona filiformis</i>	0.3	0.1	<i>Trachymene pilbarensis</i>	0.1	0.1	
<i>Haloragis gossei</i>	0.1	0.1	<i>Trianthema turgidifolium</i>	0.2	0.1	
<i>Indigofera colutea</i>	0.4	1	<i>Triodia epactia</i>	0.5	45	
<i>Indigofera linifolia</i>	0.3	0.1	<i>Urochloa holosericea</i> subsp. <i>velutina</i>	0.4	0.1	
<i>Ipomoea optica</i>	0.1	0.1	<i>Yakirra australiensis</i> var. <i>australiensis</i>	0.1	0.1	

Site: Q008		Type: Quadrat	Size: 50 x 50	Date: 06/05/2021	Botanist: Melissa Hay	
Landform:	Hill, Ridge, Dune					
Slope, aspect:	3° - Gentle None					
Soil:	Sand, Red, Orange					
Rocks:	No rocks					
Abundance:	-					
Size:	-					
Fire:	2-5 yrs					
Condition:	Very Good					
Notes:	Weeds (Low)					
Veg Unit:	D1					
Location (NW):	50 302133 7590475					
Species	Height	Cover	Species	Height	Cover	
<i>Abutilon</i> sp. Dioicum (A.A. Mitchell PRP 1618)	0.5	0.2	<i>Indigofera colutea</i>	0.3	0.1	
<i>Adriana tomentosa</i> var. <i>tomentosa</i>	1.3	0.1	<i>Indigofera georgei</i>	1	0.2	
<i>Aristida holathera</i> var. <i>holathera</i>	0.3	0.5	<i>Ipomoea muelleri</i>	1	0.1	
<i>Bonamia erecta</i>	0.5	0.1	<i>Polymeria ambigua</i>	0.2	0.1	
<i>Bulbostylis barbata</i>	0.1	0.1	<i>Ptilotus polystachyus</i>	1	1	
* <i>Cenchrus ciliaris</i>	0.4	10	<i>Scaevola sericophylla</i>	1	0.1	
<i>Crotalaria cunninghamii</i> subsp. <i>sturtii</i>	1	1	<i>Sida rohlenae</i> subsp. <i>rohlenae</i>	0.5	0.1	
<i>Cullen martinii</i>	1	0.1	<i>Trianthema pilosum</i>	0.1	0.5	
<i>Eriachne gardneri</i>	0.4	0.1	<i>Tribulus hystrix</i>	0.3	0.3	
<i>Euphorbia myrtoides</i>	0.1	0.2	<i>Trichodesma zeylanicum</i>	1	0.1	
<i>Grevillea stenobotrya</i>	2.2	8	<i>Triodia epactia</i>	0.5	35	
<i>Heliotropium cunninghamii</i>	0.1	0.1	<i>Triumfetta echinata</i>	0.3	0.2	
<i>Hibiscus sturtii</i> var. <i>?platyklamys</i>	0.4	0.1	<i>Yakirra australiensis</i> var. <i>australiensis</i>	0.2	0.3	

Site: Q009		Type: Quadrat	Size: 50 x 50	Date: 06/05/2021	Botanist: Melissa Hay	
Landform:	Drainage, Salt pan					
Slope, aspect:	<1° - Level -					
Soil:	Clay, Orange, Cream					
Rocks:	No rocks					
Abundance:	-					
Size:	-					
Fire:	> 5 yrs					
Condition:	Very Good					
Notes:	Weeds (Medium)					
Veg Unit:	C1					
Location (NW):	50 303455 7593467					
Species	Height	Cover	Species	Height	Cover	
* <i>Cenchrus ciliaris</i>	0.3	0.1	<i>Nicotiana occidentalis</i> subsp. <i>?occidentalis</i>	0.1	0.2	
<i>Chloris pumilio</i>	1	0.1	<i>Portulaca oleracea</i>	0.2	0.1	
<i>Cullen cinereum</i>	0.1	0.1	<i>Salsola australis</i>	0.2	0.1	
<i>Cyperus rigidellus</i>	0.1	0.1	<i>Streptoglossa decurrens</i>	0.1	0.1	
<i>Dactyloctenium radulans</i>	0.1	0.1	<i>Swainsona pterostylis</i>	0.3	0.1	
<i>Eragrostis pergracilis</i>	0.2	2	<i>Tecticornia auriculata</i>	0.8	15	
<i>Flaveria trinervia</i>	0.2	0.5	<i>Trianthema triquetrum</i>	0.1	0.1	
<i>Iseilema vaginiflorum</i>	0.1	0.1				

Site: Q010		Type: Quadrat	Size: 50 x 50	Date: 07/05/2021	Botanist: Melissa Hay
Landform:	Depression				
Slope, aspect:	<1° - Level -				
Soil:	Clay, Sandy clay, Red, Orange				
Rocks:	No rocks				
Abundance:	-				
Size:	-				
Fire:	> 5 yrs				
Condition:	Very Good				
Notes:	Weeds (Medium)				
Veg Unit:	P2				
Location (NW):	50 302008 7590201				
					
Species	Height	Cover	Species	Height	Cover
<i>Acacia synchronicia</i>	2.5	5	<i>*Prosopis pallida</i>	3	0.2
<i>Acacia tetragonophylla</i>	2.4	5	<i>Ptilotus exaltatus</i>	0.2	0.1
<i>*Aerva javanica</i>	0.4	0.1	<i>Ptilotus xerophilus</i>	0.3	0.1
<i>Boerhavia burbridgeana</i>	0.2	0.1	<i>Rhagodia eremaea</i>	0.7	0.1
<i>Cassutha capillaris</i>	0.5	0.1	<i>Salsola australis</i>	0.3	0.1
<i>*Cenchrus ciliaris</i>	0.4	0.5	<i>Scaevola spinescens</i>	1.2	8
<i>Dactyloctenium radulans</i>	0.1	0.1	<i>Sclerolaena costata</i>	0.3	0.1
<i>Diplachne fusca</i> subsp. <i>fusca</i>	0.3	1	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	1	0.1
<i>Enchylaena tomentosa</i>	1	0.5	<i>Sesbania cannabina</i>	1	0.1
<i>Eriachne flaccida</i>	0.3	0.1	<i>Streptoglossa decurrens</i>	0.4	0.5
<i>Eulalia aurea</i>	0.5	3	<i>Trianthema turgidifolium</i>	0.1	0.1
<i>Gomphrena affinis</i> subsp. <i>pilbarensis</i>	0.3	0.1	<i>*Vachellia farnesiana</i>	2	0.2
<i>Portulaca oleracea</i>	0.1	0.1			

Site: Q011		Type: Quadrat	Size: 50 x 50	Date: 07/05/2021	Botanist: Melissa Hay
Landform:	Drainage, Depression				
Slope, aspect:	<1° - Level -				
Soil:	Clay, Sandy clay, Red, Orange, Cream				
Rocks:	No rocks				
Abundance:	-				
Size:	-				
Fire:	> 5 yrs				
Condition:	Good				
Notes:	Grazing, Weeds, Vegetation structure altered (High)				
Veg Unit:	P2				
Location (NW):	50 302802 7589025				
					
Species	Height	Cover	Species	Height	Cover
<i>Acacia synchronicia</i>	3	1	<i>Eriachne benthamii</i>	0.6	45
<i>Acacia tetragonophylla</i>	2.5	2	<i>Eulalia aurea</i>	0.3	0.1
<i>Bergia</i> sp.	0.1	0.1	<i>Ipomoea coptica</i>	0.3	0.1
<i>*Cenchrus ciliaris</i>	0.4	1	<i>Marsilea exarata</i>	0.1	1
<i>Chloris pumilio</i>	0.3	0.2	<i>Rhagodia eremaea</i>	1	0.1
<i>Cucumis variabilis</i>	1	0.1	<i>Scaevola spinescens</i>	1	0.1
<i>Cullen cinereum</i>	0.1	1.05	<i>Sesbania cannabina</i>	0.5	10
<i>Cyperus iria</i>	0.1	0.5	<i>Solanum cleistogamum</i>	0.3	0.1
<i>Cyperus rigidellus</i>	0.1	0.5	<i>Stemodia</i> sp. Onslow (A.A. Mitchell 76/148)	0.5	0.1
<i>Diplachne fusca</i> subsp. <i>fusca</i>	0.2	5	<i>Trianthema triquetrum</i>	0.1	0.1
<i>Enchylaena tomentosa</i>	0.6	0.1	<i>*Vachellia farnesiana</i>	2.5	5

Site: Q012		Type: Quadrat		Size: 50 x 50		Date: 07/05/2021		Botanist: Melissa Hay	
Landform:	Flat, Plain								
Slope, aspect:	<1° - Level -								
Soil:	Clay, Sandy clay, Red, Orange								
Rocks:	No rocks								
Abundance:	-								
Size:	-								
Fire:	> 5 yrs								
Condition:	Very Good								
Notes:	Weeds (Low)								
Veg Unit:	P1a								
Location (NW):	50 302686 7592193								
Species			Height	Cover	Species			Height	Cover
<i>Abutilon</i> sp. Dioicum (A.A. Mitchell PRP 1618)			0.3	0.1	<i>Indigofera colutea</i>			0.3	2
<i>Acacia synchronicia</i>			2	0.1	<i>Indigofera linifolia</i>			0.3	2
<i>Acacia tetragonophylla</i>			2	0.1	<i>Portulaca oleracea</i>			0.1	0.1
<i>Bulbostylis barbata</i>			0.1	0.1	<i>Ptilotus polystachyus</i>			0.3	0.1
* <i>Cenchrus ciliaris</i>			0.3	1	<i>Rhagodia eremaea</i>			1	0.1
<i>Crotalaria medicaginea</i> var. <i>neglecta</i>			0.2	0.1	<i>Senna glutinosa</i> subsp. <i>×luerssenii</i>			2	0.1
<i>Dactyloctenium radulans</i>			0.1	0.1	<i>Trachymene pilbarensis</i>			0.1	0.1
<i>Enchylaena tomentosa</i>			0.3	0.1	<i>Trianthema turgidifolium</i>			0.2	0.1
<i>Fimbristylis dichotoma</i>			0.2	0.1	<i>Triodia epactia</i>			0.4	30
<i>Grona filiformis</i>			0.3	0.1	<i>Urochloa holosericea</i> subsp. <i>velutina</i>			0.5	0.1
<i>Haloragis gossei</i>			0.1	0.1	<i>Yakirra australiensis</i> var. <i>australiensis</i>			0.1	0.1



Site: R001		Type: Releve		Size: -		Date: 05/05/2021		Botanist: Melissa Hay	
Landform:	Flat, Plain								
Slope, aspect:	<1° - Level -								
Soil:	Sandy clay, Red, Orange								
Rocks:	No rocks								
Abundance:	-								
Size:	-								
Fire:	> 5 yrs								
Condition:	Poor								
Notes:	Clearing, Weeds (High)								
Veg Unit:	P1b								
Location (NW):	50 293088 7596916								
Species			Height	Cover	Species			Height	Cover
* <i>Aerva javanica</i>			0.4	1	<i>Frankenia ambita</i>			0.4	0.1
* <i>Cenchrus ciliaris</i>			0.5	65	<i>Neobassia astrocarpa</i>			0.2	0.5
<i>Dactyloctenium radulans</i>			0.1	0.1	<i>Salsola australis</i>			0.3	0.1
<i>Eragrostis pergracilis</i>			0.2	0.1	<i>Triodia epactia</i>			0.4	0.5




Site: R002		Type: Releve	Size: -	Date: 05/05/2021	Botanist: Melissa Hay	
Landform:	Drainage, Salt pan					
Slope, aspect:	<1° - Level -					
Soil:	Clay, Orange, Brown					
Rocks:	No rocks					
Abundance:	-					
Size:	-					
Fire:	> 5 yrs					
Condition:	Very Good					
Notes:	None					
Veg Unit:	C2					
Location (NW):	50 293125 7596924					
Species			Height	Cover	Species	
<i>Tecticornia auriculata</i>			0.5	0.1		





Site: R003		Type: Releve	Size: -	Date: 05/05/2021	Botanist: Melissa Hay	
Landform:	Flat, Plain					
Slope, aspect:	<1° - Level -					
Soil:	Sandy clay, Red, Orange					
Rocks:	No rocks					
Abundance:	-					
Size:	-					
Fire:	> 5 yrs					
Condition:	Completely Degraded					
Notes:	Clearing, Weeds (Medium)					
Veg Unit:	P1b					
Location (NW):	50 293113 7595290					
Species			Height	Cover	Species	
<i>Acacia synchronica</i>			3	1	<i>*Cenchrus ciliaris</i>	
					0.5	
					5	





Site: R004		Type: Releve	Size: -	Date: 05/05/2021	Botanist: Melissa Hay	
Landform:	Drainage, Floodplain					
Slope, aspect:	<1° - Level -					
Soil:	Clay, Sandy clay, Red, Orange					
Rocks:	No rocks					
Abundance:	-					
Size:	-					
Fire:	> 5 yrs					
Condition:	Degraded					
Notes:	Clearing, Weeds (High)					
Veg Unit:	P1b					
Location (NW):	50 293195 7593645					
Species			Height	Cover	Species	
<i>Atriplex codonocarpa</i>			0.5	0.5	<i>Indigofera linifolia</i>	
<i>*Cenchrus ciliaris</i>			0.3	65	<i>Lawrenca viridigrisea</i>	
<i>Indigofera colutea</i>			0.4	2	<i>Triodia epactia</i>	
					0.5	
					0.1	
					4	





Site: R005		Type: Revele	Size: -	Date: 05/05/2021	Botanist: Melissa Hay
Landform:	Drainage, Depression				
Slope, aspect:	<1° - Level -				
Soil:	Sandy clay, Sand, Red, Orange				
Rocks:	No rocks				
Abundance:	-				
Size:	-				
Fire:	> 5 yrs				
Condition:	Poor				
Notes:	No native understorey, Weeds & Vegetation structure altered (High)				
Veg Unit:	P3				
Location (NW):	50 297173 7591361				
Species	Height	Cover	Species	Height	Cover
* <i>Cenchrus ciliaris</i>	0.5	35	* <i>Malvastrum americanum</i>	0.3	0.1
* <i>Cenchrus setiger</i>	0.5	5	* <i>Prosopis pallida</i>	4	40

Site: R006		Type: Revele	Size: -	Date: 05/05/2021	Botanist: Melissa Hay
Landform:	Drainage, Creek/River				
Slope, aspect:	<1° - Level -				
Soil:	Sandy clay loam, Orange, Cream				
Rocks:	No rocks				
Abundance:	-				
Size:	-				
Fire:	> 5 yrs				
Condition:	Poor				
Notes:	Clearing, Weeds (High), No native understorey				
Veg Unit:	P1b				
Location (NW):	50 301394 7590122				
Species	Height	Cover	Species	Height	Cover
* <i>Aerva javanica</i>	1	0.5	<i>Neobassia astrocarpa</i>	0.3	0.5
* <i>Cenchrus ciliaris</i>	0.5	5			


Site: R007		Type: Revele	Size: -	Date: 07/05/2021	Botanist: Melissa Hay
Landform:	Flat, Plain				
Slope, aspect:	<1° - Level -				
Soil:	Clay, Sandy clay, Red, Orange				
Rocks:	No rocks				
Abundance:	-				
Size:	-				
Fire:	> 5 yrs				
Condition:	Very Good				
Notes:	Grazing (Low), Weeds (Low)				
Veg Unit:	P1a				
Location (NW):	50 304090 7587550				
Species	Height	Cover	Species	Height	Cover
<i>Acacia tetragonophylla</i>	3	15	<i>Triodia epactia</i>	0.5	35

Site: R008		Type: Releve	Size: -	Date: 07/05/2021	Botanist: Melissa Hay	
Landform:	Drainage, Depression					
Slope, aspect:	<1° - Level -					
Soil:	Clay, Orange, Cream					
Rocks:	No rocks					
Abundance:	-					
Size:	-					
Fire:	> 5 yrs					
Condition:	Good					
Notes:	Weeds (Medium)					
Veg Unit:	C1					
Location (NW):	50 304446 7587541					
Species	Height	Cover	Species	Height	Cover	
* <i>Cenchrus ciliaris</i>	0.4	5	<i>Tecticornia indica</i> subsp. <i>leiostachya</i>	0.3	15	
<i>Portulaca oleracea</i>	0.3	2				


Site: R009		Type: Releve	Size: -	Date: 07/05/2021	Botanist: Melissa Hay	
Landform:	Drainage, Creek/River					
Slope, aspect:	<1° - Level -					
Soil:	Sandy clay, Clay loam, Red, Orange, Brown					
Rocks:	No rocks					
Abundance:	-					
Size:	-					
Fire:	> 5 yrs					
Condition:	Poor					
Notes:	Weeds (High), Vegetation structure altered (High)					
Veg Unit:	DL1					
Location (NW):	50 304422 7587668					
Species	Height	Cover	Species	Height	Cover	
<i>Acacia synchronicia</i>	3	1	<i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i>	4	5	
<i>Acacia tetragonophylla</i>	2.5	15	<i>Ipomoea muelleri</i>	1	0.1	
* <i>Cenchrus ciliaris</i>	0.6	15	* <i>Vachellia farnesiana</i>	3	5	

Site: R010		Type: Releve	Size: -	Date: 07/05/2021	Botanist: Melissa Hay	
Landform:	Drainage, Depression					
Slope, aspect:	<1° - Level -					
Soil:	Clay, Sandy clay, Orange, Cream					
Rocks:	No rocks					
Abundance:	-					
Size:	-					
Fire:	> 5 yrs					
Condition:	Very Good					
Notes:	Weeds (Low)					
Veg Unit:	C1					
Location (NW):	50 303334 7593412					
Species	Height	Cover	Species	Height	Cover	
* <i>Cenchrus ciliaris</i>	0.3	3	<i>Eragrostis pergracilis</i>	0.1	5	
<i>Dysphania kalpari</i>	0.1	0.1	<i>Tecticornia indica</i> subsp. <i>leiostachya</i>	0.4	15	


Site: R011		Type: Releve	Size: -	Date: 07/05/2021	Botanist: Melissa Hay		
Landform:	Flat, Plain						
Slope, aspect:	<1° - Level -						
Soil:	Sandy clay, Sand, Red, Orange						
Rocks:	No rocks						
Abundance:	-						
Size:	-						
Fire:	> 5 yrs						
Condition:	Very Good						
Notes:	Weeds (Low)						
Veg Unit:	P1a						
Location (NW):	50 303168 7592982						
Species			Height	Cover	Species		
<i>Acacia tetragonophylla</i>			2	0.5	<i>Triodia epactia</i>		



Site: R012		Type: Releve	Size: -	Date: 07/05/2021	Botanist: Melissa Hay		
Landform:	Hill, Ridge, Dune						
Slope, aspect:	1° - Very Gentle E						
Soil:	Sand, Red, Orange						
Rocks:	No rocks						
Abundance:	-						
Size:	-						
Fire:	> 5 yrs						
Condition:	Very Good						
Notes:	Weeds (Low)						
Veg Unit:	D1						
Location (NW):	50 302464 7591568						
Species			Height	Cover	Species		
<i>Acacia stellaticeps</i>			1	5	<i>Triodia epactia</i>		
<i>Grevillea stenobotrya</i>			2.1	4			



Site: R013		Type: Releve	Size: -	Date: 07/05/2021	Botanist: Melissa Hay		
Landform:	Flat, Plain						
Slope, aspect:	<1° - Level -						
Soil:	Sandy clay, Red, Orange						
Rocks:	No rocks						
Abundance:	-						
Size:	-						
Fire:	> 5 yrs						
Condition:	Poor						
Notes:	Weeds (High)						
Veg Unit:	P1b						
Location (NW):	50 300825 7590116						
Species			Height	Cover	Species		
* <i>Cenchrus ciliaris</i>			0.5	20	<i>Triodia epactia</i>		



Appendix C: Significant Flora Likelihood of Occurrence



Pre-survey Likelihood	Post-survey Likelihood	Status	Taxon	Longevity	Flowering time	Closest Record to Project (km)	Description	Habitat	WA Herbarium	Nature Map	GHD (2011)	Mattiske (2014)	GHD (2017)	Phoenix (2017, 2018)	Main Roads (2018)	VLA (2020)
Recorded	Recorded	P3	<i>Eremophila forrestii</i> subsp. <i>viridis</i>	Perennial	Aug.	0	Much-branched shrub, ca 1 m high. Flowers pink-cream.	Red sand dunes.	X	X	X	X	X			
Recorded	Recorded	P3	<i>Triumfetta echinata</i>	Perennial	Aug.	0	Prostrate shrub, to 0.3 m high. Flowers yellow. Spiky, round seed pods approximately 2–3 cm in diameter.	Red sandy soils. Sand dunes.	X	X	X	X	X	X		
High	Low	P3	<i>Abutilon</i> sp. Pritzelianum (S. van Leeuwen 5095)	Perennial	-	2.7	Tall grey spreading shrub with yellow flowers, growing up to 2 m tall.	Sandplain with orange brown sandy loam. Roadsides.	X	X				X		X
High	Low	P3	<i>Eleocharis papillosa</i>	Annual	Nov.	0.1	Herb. Fl. Brown. Grows to around 10 centimetres (cm) in height.	Red clay over granite, open clay flats. Claypans.	X	X						
High	Low	P3	<i>Stackhousia clementii</i>	Perennial	-	7.5	Dense broom-like perennial, herb, to 0.45 m high. Fl. green/yellow/brown.	Skeletal soils. Sandstone hills.	X	X						
Medium	Low	P1	<i>Abutilon</i> sp. Onslow (F. Smith s.n. 10/9/61)	Perennial	Aug to Oct	4.1	Shrub, grows in a flat, spreading shape to about 10 cm in height and 100 cm in diameter. It has green-grey foliage, yellow flowers, and pinwheel like seed pods.	Flat, stony plain. Roadsides.	X	X						X
Low	Low	P3	<i>Carpobrotus</i> sp. Thevenard Island (M. White 050)	Perennial	Aug.	26.8	Prostrate, succulent perennial, herb, leaves sessile, triangular in cross-section, fruit turbinate. Fl. Cream.	Coarse white sand. Dune tops, disturbed areas.	X	X						
Low	Low	P1	<i>Isotropis forrestii</i>	Perennial	Apr to Sep or Dec.	-	Erect shrub, 0.4-1.5 m high. Fl. yellow/orange & red.	Stony clay loam, sandy alluvium. Along drainage lines.		X						
Low	Low	P1	<i>Myriocephalus scalpellus</i>	Perennial	-	-	Semi-erect herb, 0.03-0.08 m high.	Clay. Depression on flood plain.		X						

Appendix D: Site by Species Matrix



Family	Taxon Name	Lifeform	Naturalised Status	C1																						DL	NA		
				C1	C2					D1		P1a			P1b				P2		P3								
				Q002	Q004	Q009	R008	R010	R002	Q001	Q003	Q005	Q008	R012	Q006	Q007	Q012	R007	R011	R001	R003	R004	R006	R013	Q010	Q011	R005	R009	Opp
Aizoaceae	<i>Trianthema pilosum</i>	Herb	Native							x	x	x	x		x														
	<i>Trianthema triquetrum</i>	Herb	Native			x									x											x			x
	<i>Trianthema turgidifolium</i>	Shrub	Native													x	x								x				x
Amaranthaceae	* <i>Aerva javanica</i>	Herb	Weed												x					x			x		x				x
	<i>Gomphrena affinis</i> subsp. <i>pilbarensis</i>	Herb	Native																						x				x
	<i>Ptilotus axillaris</i>	Herb	Native							x						x													
	<i>Ptilotus exaltatus</i>	Herb	Native												x	x									x				x
	<i>Ptilotus polystachyus</i>	Herb	Native							x	x	x	x		x	x	x												
	<i>Ptilotus xerophilus</i>	Herb	Native																						x				
Araliaceae	<i>Trachymene pilbarensis</i>	Herb	Native							x					x	x	x												
Asteraceae	<i>Calotis plumulifera</i>	Herb	Native																										x
	* <i>Flaveria trinervia</i>	Herb	Weed	x	x	x																							
	<i>Streptoglossa decurrens</i>	Herb	Native			x																			x				
Boraginaceae	<i>Heliotropium crispatum</i>	Herb	Native																										x
	<i>Heliotropium cunninghamii</i>	Herb	Native									x	x																
	<i>Trichodesma zeylanicum</i>	Herb	Native							x		x	x																
Caryophyllaceae	<i>Polycarpaea corymbosa</i>	Herb	Native													x													
Chenopodiaceae	<i>Atriplex bunburyana</i>	Shrub	Native																										x
	<i>Atriplex codonocarpa</i>	Herb	Native																			x							x
	<i>Atriplex semilunaris</i>	Shrub	Native												x														
	<i>Dissocarpus paradoxus</i>	Shrub	Native																										x

Family	Taxon Name	Lifeform	Naturalised Status	C1 C2 D1 P1a P1b P2 P3 DL NA																									
				Q002	Q004	Q009	R008	R010	R002	Q001	Q003	Q005	Q008	R012	Q006	Q007	Q012	R007	R011	R001	R003	R004	R006	R013	Q010	Q011	R005	R009	Opp
	<i>Dysphania kalpari</i>	Herb	Native					x																					
	<i>Enchylaena tomentosa</i>	Shrub	Native												x		x								x	x			
	<i>Neobassia astrocarpa</i>	Shrub	Native																x			x							x
	<i>Rhagodia eremaea</i>	Shrub	Native												x		x								x	x			x
	<i>Salsola australis</i>	Herb	Native				x								x	x				x					x				x
	<i>Sclerolaena costata</i>	Shrub	Native																						x				
	<i>Tecticornia auriculata</i>	Shrub	Native	x	x	x				x																			x
	<i>Tecticornia indica</i> subsp. <i>leiostachya</i>	Shrub	Native					x	x																				x
	<i>Tecticornia</i> sp. 1	Shrub	Native	x																									
	<i>Tecticornia</i> sp. 2	Shrub	Native																										x
Cleomaceae	<i>Arivela viscosa</i>	Herb	Native																										x
Convolvulaceae	<i>Bonamia erecta</i>	Shrub	Native																										
	<i>Bonamia linearis</i>	Herb	Native																										x
	<i>Cressa australis</i>	Herb	Native																										x
	<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	Herb	Native																										
	<i>Ipomoea coptica</i>	Climber	Native																										
	<i>Ipomoea muelleri</i>	Climber	Native																										
	<i>Polymeria ambigua</i>	Herb	Native																										
Cucurbitaceae	<i>Cucumis melo</i>	Climber	Native	x																									
	<i>Cucumis variabilis</i>	Climber	Native																										
Cyperaceae	<i>Bulbostylis barbata</i>	Sedge	Native																										
	<i>Cyperus bulbosus</i>	Sedge	Native			x																							
	<i>Cyperus iria</i>	Sedge	Native																										
	<i>Cyperus rigidellus</i>	Sedge	Native				x																						x

Family	Taxon Name	Lifeform	Naturalised Status	C1		C2 D1					P1a			P1b					P2		P3	DL	NA					
				Q002	Q004	Q009	R008	R010	R002	Q001	Q003	Q005	Q008	R012	Q006	Q007	Q012	R007	R011	R001	R003	R004	R006	R013	Q010	Q011	R005	R009
	<i>Fimbristylis dichotoma</i>	Sedge	Native												x													x
Elatinaceae	<i>Bergia</i> sp.	Herb	Native																					x				
Euphorbiaceae	<i>Adriana tomentosa</i> var. <i>tomentosa</i>	Shrub	Native							x		x	x															
	<i>Euphorbia drummondii</i>	Herb	Native											x														
	<i>Euphorbia myrtilodes</i>	Herb	Native							x	x	x	x															
Fabaceae	<i>Acacia ancistrocarpa</i>	Shrub	Native																									x
	<i>Acacia bivenosa</i>	Shrub	Native																									x
	<i>Acacia colei</i> var. <i>colei</i>	Shrub	Native																									x
	<i>Acacia coriacea</i> subsp. <i>coriacea</i>	Shrub	Native																									
	<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>	Shrub	Native																									x
	<i>Acacia stellaticeps</i>	Shrub	Native							x		x		x	x													
	<i>Acacia synchronicia</i>	Shrub	Native											x	x	x				x				x	x		x	x
	<i>Acacia tetragonophylla</i>	Shrub	Native											x	x	x	x	x					x	x			x	x
	<i>Acacia trachycarpa</i>	Shrub	Native																									x
	<i>Acacia xiphophylla</i>	Shrub	Native																									x
	<i>Crotalaria cunninghamii</i> subsp. <i>sturtii</i>	Shrub	Native								x	x	x	x														
	<i>Crotalaria medicaginea</i> var. <i>neglecta</i>	Herb	Native													x												
	<i>Crotalaria ramosissima</i>	Herb	Native											x														x
	<i>Cullen cinereum</i>	Herb	Native	x	x	x																		x				
	<i>Cullen leucochaites</i>	Shrub	Native																									x
	<i>Cullen martinii</i>	Shrub	Native																									x

Family	Taxon Name	Lifeform	Naturalised Status	C1		C2 D1					P1a					P1b					P2		P3	DL	NA					
				Q002	Q004	Q009	R008	R010	R002	Q001	Q003	Q005	Q008	R012	Q006	Q007	Q012	R007	R011	R001	R003	R004	R006	R013	Q010	Q011	R005	R009	Opp	
	<i>Grona filiformis</i>	Herb	Native										x	x	x													x		
	<i>Indigofera bovipерda</i> subsp. <i>bovipерda</i>	Herb	Native																									x		
	<i>Indigofera colutea</i>	Herb	Native										x	x	x						x							x		
	<i>Indigofera georgei</i>	Shrub	Native																									x		
	<i>Indigofera linifolia</i>	Herb	Native											x	x	x					x							x		
	<i>Indigofera linnaei</i>	Herb	Native																									x		
	* <i>Prosopis pallida</i>	Tree	Weed																					x		x				
	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	Shrub	Native											x										x				x		
	<i>Senna glutinosa</i> subsp. <i>luerssenii</i>	Shrub	Native												x	x														
	<i>Senna notabilis</i>	Shrub	Native											x		x														
	<i>Sesbania cannabina</i>	Shrub	Native																						x	x			x	
	* <i>Stylosanthes hamata</i>	Shrub	Weed																										x	
	<i>Swainsona pterostylis</i>	Herb	Native													x														
	<i>Tephrosia rosea</i> var. <i>clementii</i>	Shrub	Native																											
	<i>Tephrosia</i> sp. B Kimberley Flora (C.A. Gardner 7300)	Shrub	Native																										x	
	* <i>Vachellia farnesiana</i>	Shrub	Weed																						x	x		x	x	
Frankeniaceae	<i>Frankenia ambita</i>	Shrub	Native																											
Goodeniaceae	<i>Goodenia forrestii</i>	Herb	Native																											
	<i>Goodenia microptera</i>	Herb	Native																											x
	<i>Scaevola sericophylla</i>	Shrub	Native																											
	<i>Scaevola spinescens</i>	Shrub	Native																											x

Family	Taxon Name	Lifeform	Naturalised Status	C1		C2 D1					P1a					P1b					P2		P3	DL	NA															
				Q002	Q004	Q009	R008	R010	R002	Q001	Q003	Q005	Q008	R012	Q006	Q007	Q012	R007	R011	R001	R003	R004	R006	R013	Q010	Q011	R005	R009	Opp											
Gyrostemonaceae	<i>Codonocarpus cotinifolius</i>	Shrub	Native																																x					
Haloragaceae	<i>Haloragis gossei</i>	Herb	Native																																	x				
Lamiaceae	<i>Quoya paniculata</i>	Shrub	Native																																	x				
Lauraceae	<i>Cassytha capillaris</i>	Climber	Native																																					
Malvaceae	<i>Abutilon</i> sp. Dioicum (A.A. Mitchell PRP 1618)	Shrub	Native																																		x			
	<i>Alyogyne pinoniana</i>	Shrub	Native																																					
	<i>Corchorus elachocarpus</i>	Shrub	Native																																			x		
	<i>Hibiscus sturtii</i> var. <i>?platychlamys</i>	Shrub	Native																																			x		
	<i>Lawrenia viridigrisea</i>	Shrub	Native	x	x																																			
	* <i>Malvastrum americanum</i>	Herb	Weed																																					
	<i>Sida fibulifera</i>	Shrub	Native																																					
	<i>Sida rohlenae</i> subsp. <i>rohlenae</i>	Shrub	Native																																				x	
	<i>Triumfetta echinata</i>	Shrub	Native																																				x	
Marsileaceae	<i>Marsilea exarata</i>	Herb	Native																																					
Meliaceae	<i>Owenia reticulata</i>	Tree	Native																																					
Myrtaceae	<i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i>	Tree	Native																																					
	<i>Melaleuca argentea</i>	Tree	Native																																					
Nyctaginaceae	<i>Boerhavia burbridgeana</i>	Herb	Native																																					
Plantaginaceae	<i>Stemodia</i> sp. Onslow (A.A. Mitchell 76/148)	Shrub	Native																																					

Family	Taxon Name	Lifeform	Naturalised Status	C1		C2 D1					P1a					P1b					P2		P3	DL	NA															
				Q002	Q004	Q009	R008	R010	R002	Q001	Q003	Q005	Q008	R012	Q006	Q007	Q012	R007	R011	R001	R003	R004	R006	R013	Q010	Q011	R005	R009	Opp											
Poaceae	<i>Aristida holathera</i> var. <i>holathera</i>	Other Grass	Native										x		x																			x						
	* <i>Cenchrus ciliaris</i>	Other Grass	Weed	x	x	x	x	x																										x	x	x				
	* <i>Cenchrus setiger</i>	Other Grass	Weed																																x	x				
	<i>Chloris pumilio</i>	Other Grass	Native	x	x	x																														x				
	<i>Chrysopogon fallax</i>	Other Grass	Native																																		x			
	<i>Cymbopogon obtectus</i>	Other Grass	Native																																		x			
	<i>Dactyloctenium radulans</i>	Other Grass	Native	x	x	x																																		
	<i>Dichanthium sericeum</i> subsp. <i>humilius</i>	Other Grass	Native	x																																				
	<i>Diplachne fusca</i> subsp. <i>fusca</i>	Other Grass	Native																																			x		
	<i>Eragrostis pergracilis</i>	Other Grass	Native	x	x	x																																		
	<i>Eragrostis setifolia</i>	Other Grass	Native																																					
	<i>Eriachne benthamii</i>	Other Grass	Native																																					
	<i>Eriachne flaccida</i>	Other Grass	Native																																					
	<i>Eriachne gardneri</i>	Other Grass	Native																																					
	<i>Eulalia aurea</i>	Other Grass	Native																																					
	<i>Iseilema vaginiflorum</i>	Other Grass	Native	x	x	x																																		
	<i>Panicum decompositum</i>	Other Grass	Native																																					
	<i>Paractaenum refractum</i>	Other Grass	Native																																					
	<i>Setaria dielsii</i>	Other Grass	Native																																					
	<i>Sorghum plumosum</i>	Other Grass	Native																																					
	<i>Triodia epactia</i>	Hummock Grass	Native																																					

Family	Taxon Name	Lifeform	Naturalised Status	C1		C2 D1					P1a				P1b				P2		P3	DL	NA												
				Q002	Q004	Q009	R008	R010	R002	Q001	Q003	Q005	Q008	R012	Q006	Q007	Q012	R007	R011	R001	R003	R004	R006	R013	Q010	Q011	R005	R009	Opp						
	<i>Triodia schinzii</i>	Hummock Grass	Native									x																							
	<i>Triraphis mollis</i>	Other Grass	Native																															x	
	<i>Urochloa holosericea</i> subsp. <i>velutina</i>	Other Grass	Native									x	x	x				x	x																
	<i>Urochloa occidentalis</i> var. <i>occidentalis</i>	Other Grass	Native	x	x																														
	<i>Yakirra australiensis</i> var. <i>australiensis</i>	Other Grass	Native									x	x	x	x			x	x	x															
Portulacaceae	<i>Portulaca oleracea</i>	Herb	Native		x	x	x								x		x								x								x		
Proteaceae	<i>Grevillea eriostachya</i>	Shrub	Native																															x	
	<i>Grevillea stenobotrya</i>	Shrub	Native								x		x	x	x																				
	<i>Hakea stenophylla</i> subsp. <i>stenophylla</i>	Shrub	Native								x		x																						
Pteridaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	Herb/fern	Native																															x	
Scrophulariaceae	<i>Eremophila forrestii</i> subsp. <i>viridis</i>	Shrub	Native																															x	
Solanaceae	<i>Nicotiana occidentalis</i> subsp. <i>?occidentalis</i>	Herb	Native		x	x																													
	<i>Solanum cleistogamum</i>	Shrub	Native																																x
	<i>Solanum lasiophyllum</i>	Shrub	Native								x		x			x																			
Surianaceae	<i>Stylobasium spathulatum</i>	Shrub	Native																															x	
Tamaricaceae	* <i>Tamarix aphylla</i>	Tree	Weed																															x	
Thymelaeaceae	<i>Pimelea ammocharis</i>	Shrub	Native																															x	
Zygophyllaceae	<i>Tribulus hystrix</i>	Herb	Native								x			x																					

Appendix E: Fauna Desktop Assessment



Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
MAMMALS														
TACHYGLOSSIDAE														
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna					x						x		
DASYURIDAE														
<i>Dasykaluta rosamondae</i>	Little Red Kaluta					x		x						
<i>Dasyurus hallucatus</i>	Northern Quoll	EN	EN		x	x	x							
<i>Ningui timealeyi</i>	Pilbara Ningui					x		x	x					
<i>Planigale ingrami</i>	Long-tailed Planigale					x			x					
<i>Planigale maculata</i>	Common Planigale							x						
<i>Pseudantechinus roryi</i>	Rory's Pseudantechinus					x								
<i>Sminthopsis macroura</i>	Stripe-faced Dunnart					x		x	x					
<i>Sminthopsis youngsoni</i>	Lesser Hairy-footed Dunnart					x		x						
PERAMELIDAE														
<i>Perameles bougainville</i>	Shark Bay Bandicoot	VU	VU		x	x								
MACROPODIDAE														
<i>Macropus robustus</i>	Euro					x			x	x	x	x		
<i>Macropus rufus</i>	Red Kangaroo					x		x	x		x	x		
MURIDAE														
<i>Leggadina lakedownensis</i>	Northern Short-tailed Mouse			P4	x	x		x						
<i>Notomys alexis</i>	Spinifex Hopping-mouse					x		x	x				x	
<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse			P4	x	x			x					
<i>Pseudomys desertor</i>	Desert Mouse					x			x					
<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse					x		x	x					
<i>Rattus tunneyi</i>	Pale Field-rat					x		x						
PTEROPODINAE														
<i>Pteropus scapulatus</i>	Little Red Flying-fox					x								
HIPPOSIDERIDAE														
<i>Chaerephon jobensis</i>	Greater Northern Freetail-bat					x								
RHINONYCTERIDAE														
<i>Rhinonicteris aurantia</i>	Pilbara Leaf-nosed Bat	VU	VU					x						
MEGADERMATIDAE														
<i>Macroderma gigas</i>	Ghost Bat	VU	VU					x						

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
VESPERTILIONIDAE														
<i>Chalinolobus gouldii</i>	Gould's Wattle Bat					x			x					
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat					x								
<i>Scotorepens greyii</i>	Little Broad-nosed Bat								x					
<i>Vespadelus finlaysoni</i>	Inland Cave Bat								x					
MOLOSSIDAE														
<i>Austronomus australis</i>	White-striped Free-tailed Bat							x						
<i>Mormopterus cobourgiensis</i>	North-western Free-tailed Bat				x			x	x					
<i>Mormopterus loriae</i>	Little Northern Freetail-bat					x			x					
INTRODUCED MAMMALS														
* <i>Bos taurus</i>	European Cattle					x			x	x	x	x	x	
* <i>Equus caballus</i>	Horse					x				x			x	
* <i>Equus africanus asinus</i>	Donkey												x	
* <i>Capra hircus</i>	Goat							x		x				
* <i>Vulpes</i>	Red Fox					x								
* <i>Canis familiaris</i>	Dog							x			x	x?		
* <i>Felis catus</i>	Cat					x		x	x	x	x			
* <i>Oryctolagus cuniculus</i>	Rabbit					x							x	
* <i>Mus musculus</i>	House Mouse					x		x	x					
* <i>Rattus rattus</i>	Black Rat					x								
BIRDS														
CASUARIIDAE														
<i>Dromaius novaehollandiae</i>	Emu					x		x	x	x				
PHASIANIDAE														
<i>Coturnix pectoralis</i>	Stubble Quail					x		x						
<i>Coturnix ypsilophora</i>	Brown Quail					x		x						
ANATIDAE														
<i>Dendrocygna eytoni</i>	Plumed Whistling Duck					x		x						
<i>Cygnus atratus</i>	Black Swan					x		x						
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck					x		x						
<i>Chenonetta jubata</i>	Australian Wood Duck					x		x				x	x	
<i>Anas superciliosa</i>	Pacific Black Duck					x		x	x		x	x		

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Anas gracilis</i>	Grey Teal					x		x		x				
<i>Aythya australis</i>	Hardhead					x		x			x	x		
PODARGIDAE														
<i>Podargus strigoides</i>	Tawny Frogmouth					x								
CAPRIMULGIDAE														
<i>Eurostopodus argus</i>	Spotted Nightjar					x		x						
AEGOTHELIDAE														
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar					x		x	x					
APODIDAE														
<i>Apus pacificus</i>	Fork-tailed Swift	MI	MI		x	x		x	x					
OTIDIDAE														
<i>Ardeotis australis</i>	Australian Bustard					x		x	x	x	x	x		
CUCULIDAE														
<i>Centropus phasianinus</i>	Pheasant Coucal					x		x						
<i>Chrysococcyx basalis</i>	Horsfield's Bronze Cuckoo					x		x	x	x	x		x	
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo					x								
<i>Cacomantis pallidus</i>	Pallid Cuckoo					x		x					x	
COLUMBIDAE														
* <i>Columba livia</i>	Domestic Pigeon					x		x						
<i>Phaps chalcoptera</i>	Common Bronzewing					x		x					x	
<i>Phaps histrionica</i>	Flock Bronzewing					x		x			x			
<i>Ocyphaps lophotes</i>	Crested Pigeon					x		x	x	x	x	x	x	
<i>Geophaps plumifera</i>	Spinifex Pigeon					x		x	x				x	
<i>Geopelia cuneata</i>	Diamond Dove					x		x	x		x		x	
<i>Geopelia striata</i>	Zebra Dove, Peaceful Dove					x		x	x	x	x	x		
<i>Geopelia humeralis</i>	Bar-shouldered Dove					x		x						
RALLIDAE														
<i>Gallirallus philippensis</i>	Buff-banded Rail					x		x						
<i>Tribonyx ventralis</i>	Black-tailed Native-hen					x		x						
<i>Gallinula tenebrosa</i>	Dusky Moorhen							x						
<i>Fulica atra</i>	Eurasian Coot					x		x						
<i>Porzana pusilla</i>	Baillon's Crake					x								

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Porzana fluminea</i>	Australian Spotted Crane					x		x						
GRUIDAE														
<i>Grus rubicunda</i>	Brolga					x		x			x			
PODICIPEDIDAE														
<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe					x		x						
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe					x		x						
TURNICIDAE														
<i>Turnix velox</i>	Little Button-quail					x		x	x		x	x	x	
BURHINIDAE														
<i>Burhinus grallarius</i>	Bush Stone-curlew					x		x						
<i>Esacus magnirostris</i>	Beach Stone-curlew					x		x						
HEAMATOPODIDAE														
<i>Haematopus longirostris</i>	Pied Oystercater					x		x						
<i>Haematopus fuliginosus</i>	Sooty Oystercater					x		x						
RECURVIROSTRIDAE														
<i>Himantopus himantopus</i>	Black-winged Stilt					x				x		x		
<i>Cladorhynchus leucocephalus</i>	Banded Stilt					x		x						
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet					x		x						
<i>Himantopus leucophalus</i>	Pied Stilt							x			x			
CHARADRIIDAE														
<i>Vanellus tricolor</i>	Banded Lapwing					x		x						
<i>Vanellus miles</i>	Masked Lapwing					x		x						
<i>Erythronyx cinctus</i>	Red-kneed Dotterel					x		x			x	x		
<i>Pluvialis fulva</i>	Pacific Golder Plover	MI	MI		x	x		x						
<i>Pluvialis squatarola</i>	Grey Plover	MI	MI		x	x		x						
<i>Charadrius ruficapillus</i>	Red-capped Plover					x		x			x			
<i>Charadrius mongolus</i>	Lesser Sand Plover	EN & MI	EN		x	x		x						
<i>Charadrius leschenaultii</i>	Greater Sand Plover	VU & MI	MI		x	x		x	x					
<i>Charadrius veredus</i>	Oriental Plover	MI	MI		x	x	x	x		x				
<i>Elseyonis melanops</i>	Black-fronted Dotterel					x		x		x	x	x		
ROSTRATULIDAE														
<i>Rostratula australis</i>	Australian Painted Snipe	EN	EN					x						

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
SCOLOPACIDAE														
<i>Numenius phaeopus</i>	Whimbrel	MI	MI		x	x		x						
<i>Numenius minutus</i>	Little Curlew	MI	MI		x	x		x						
<i>Numenius madagascariensis</i>	Eastern Curlew	CR & MI	MI		x	x	x	x						
<i>Limosa lapponica</i>	Bar-tailed Godwit	MI	MI		x	x	x	x			x			
<i>Limosa lapponica</i> subsp. <i>menzbieri</i>	Bar-tailed Godwit (northern Siberian)	CR	CR		x	x	x							
<i>Limosa limosa</i>	Black-tailed Godwit	MI	MI		x			x						
<i>Arenaria interpres</i>	Ruddy Turnstone	MI	MI		x	x		x						
<i>Calidris tenuirostris</i>	Great Knot	CR & MI	MI		x	x	x	x						
<i>Calidris canutus</i>	Red Knot	EN & MI	MI		x		x	x						
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	MI	MI		x	x	x	x						
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR & MI	MI		x	x	x	x						
<i>Calidris ruficollis</i>	Red-necked Stint	MI	MI		x	x		x						
<i>Calidris alba</i>	Sanderling	MI	MI		x	x		x						
<i>Calidris melanotos</i>	Pectoral Sandpiper	MI	MI		x	x	x	x						
<i>Actitis hypoleucos</i>	Common Sandpiper	MI	MI		x	x	x	x						
<i>Tringa brevipes</i>	Grey-tailed Tattler	MI	MI	P4	x	x		x						
<i>Tringa stagnatilis</i>	Marsh Sandpiper	MI	MI		x			x						
<i>Tringa glareola</i>	Wood Sandpiper	MI	MI		x	x		x						
<i>Tringa nebularia</i>	Common Greenshank	MI	MI		x	x	x	x						
<i>Xenus cinerus</i>	Terek Sandpiper	MI	MI		x			x						
GLAREOLIDAE														
<i>Stiltia isabella</i>	Australian Pratincole					x		x		x				
<i>Glareola maldivarum</i>	Oriental Pratincole	MI	MI		x	x	x	x						
LARIDAE														
<i>Larus novaehollandiae</i>	Silver Gull					x		x	x	x	x	x	x	
<i>Larus pacificus</i>	Pacific Gull							x						
<i>Gelochelidon nilotica</i>	Gull-billed Tern	MI	MI		x	x		x				x	x	
<i>Hydroprogne caspia</i>	Caspian Tern	MI	MI		x	x		x	x			x		
<i>Sterna bergii</i>	Crested Tern	MI	MI		x	x	x	x						
<i>Sterna bengalensis</i>	Lesser Crested Tern					x		x						
<i>Sternula albifrons</i>	Little Tern	MI	MI		x	x		x				x	x	

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Sternula nereis</i>	Fairy Tern	VU	VU		x	x	x	x						
<i>Onychoprion anaethetus</i>	Bridled Tern	MI	MI		x	x		x						
<i>Sterna dougallii</i>	Roseate Tern	MI	MI		x	x		x						
<i>Sterna hirundo</i>	Common Tern	MI	MI		x	x		x						
<i>Sterna hybrida</i>	Whiskered Tern	MI	MI			x		x						
<i>Chlidonias leucopterus</i>	White-winged Black Tern	MI	MI		x	x		x						
OCEANITIDAE														
<i>Macronectes giganteus</i>	Southern Giant-petrel	EN & MI	MI				x							
<i>Oceanites oceanicus</i>	Wilson's Storm-petrel	MI	MI		x	x								
PROCELLARIIDAE														
<i>Calonectris leucomelas</i>	Streaked Shearwater							x						
<i>Ardenna pacifica</i>	Wedge-tailed Shearwater	MI	MI		x	x		x						
CICONIIDAE														
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork					x		x						
SULIDAE														
<i>Sula leucogaster</i>	Brown Booby	MI	MI		x			x						
ANHINGIDAE														
<i>Anhinga novaehollandiae</i>	Australasian Darter					x		x						
PHALACROCORACIDAE														
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant					x		x						
<i>Phalacrocorax varius</i>	Pied Cormorant					x		x						
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant					x		x						
<i>Phalacrocorax carbo</i>	Great Cormorant					x		x						
THRESKIORNITHIDAE														
<i>Plegadis falcinellus</i>	Glossy Ibis	MI	MI		x	x		x						
<i>Threskiornis moluccax</i>	Australian White Ibis							x						
<i>Threskiornis spinicollis</i>	Straw-necked Ibis					x		x	x	x				
<i>Platalea flavipes</i>	Yellow-billed Spoonbill					x		x						
<i>Platalea regia</i>	Royal Spoonbill					x		x		x				
ARDEIDAE														
<i>Nycticorax caledonicus</i>	Rufous Night Heron					x		x						
<i>Butorides striata</i>	Striated Heron							x						

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Ardea ibis</i>	Cattle Egret					x		x						
<i>Ardea pacifica</i>	White-necked Heron					x		x			x	x		
<i>Ardea modesta</i>	Great Egret					x		x			x	x		
<i>Ardea intermedia</i>	Intermediate Egret					x		x						
<i>Ardea novaehollandiae</i>	White-faced Heron					x		x		x	x	x		
<i>Ardea garzetta</i>	Little Egret					x		x	x			x		
<i>Ardea sacra</i>	Eastern Reef Egret					x		x	x					
PELECANIDAE														
<i>Pelecanus conspicillatus</i>	Australian Pelican					x		x	x	x		x		
PANDIONIDAE														
<i>Pandion cristatus</i>	Osprey	MI	MI		x	x	x	x	x					
ACCIPITRIDAE														
<i>Elanus axillaris</i>	Black-shouldered Kite					x		x	x	x		x	x	
<i>Elanus scriptus</i>	Letter-winged Kite			P4	x			x						
<i>Hamirostra isura</i>	Square-tailed Kite							x						
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard					x		x	x					
<i>Hieraaetus morphnoides</i>	Little Eagle					x		x				x		
<i>Aquila audax</i>	Wedge-tailed Eagle					x		x	x	x		x	x	
<i>Accipiter fasciatus</i>	Brown Goshawk					x		x				x		
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk					x		x			x			
<i>Circus approximans</i>	Swamp Harrier					x		x						
<i>Circus assimilis</i>	Spotted Harrier					x		x	x			x	x	
<i>Milvus migrans</i>	Black Kite					x		x		x	x	x		
<i>Haliastur sphenurus</i>	Whistling Kite					x		x	x	x	x	x	x	
<i>Haliastur indus</i>	Brahminy Kite					x		x	x					
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle					x		x	x	x				
TYTONIDAE														
<i>Tyto alba</i>	Barn Owl					x		x						
STRIGIDAE														
<i>Ninox connivens</i>	Barking Owl					x		x						
<i>Ninox novaeseelandiae</i>	Boobook Owl							x	x					
ALCEDINIDAE														

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Dacelo leachii</i>	Blue-winged Kookaburra					x		x	x					
<i>Todiramphus chloris</i>	Collared Kingfisher					x		x						
<i>Todiramphus sanctus</i>	Sacred Kingfisher					x		x		x		x		
<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher					x		x			x			
MEROPIIDAE														
<i>Merops ornatus</i>	Rainbow Bee-eater					x		x	x	x	x	x	x	
FALCONIDAE														
<i>Falco cenchroides</i>	Australian Kestrel					x		x	x	x	x		x	
<i>Falco longipennis</i>	Australian Hobby					x		x	x		x			
<i>Falco berigora</i>	Brown Falcon					x		x			x	x		
<i>Falco hypoleucos</i>	Grey Falcon	VU	VU				x			x				
<i>Falco subniger</i>	Black Falcon					x		x				x		
<i>Falco peregrinus</i>	Peregrine Falcon			OS	x	x		x						
CACATUIDAE														
<i>Nymphicus hollandicus</i>	Cockatiel					x		x	x	x		x	x	
<i>Cacatua roseicapilla</i>	Galah					x		x	x	x	x	x	x	
<i>Cacatua sanguinea</i>	Little Corella					x		x	x		x	x		
PSITTACIDAE														
<i>Platycercus zonarius</i>	Australian Ringneck					x		x	x		x	x		
<i>Pezoporus occidentalis</i>	Night Parrot	EN	CR		x	x	x							
<i>Melopsittacus undulatus</i>	Budgerigar					x		x	x	x		x	x	
MALURIDAE														
<i>Malurus lamberti</i>	Variiegated Fairy-wren					x		x	x	x				
<i>Malurus leucopterus</i>	White-winged Fairy-wren					x		x	x		x	x	x	
<i>Malurus splendens</i>	Splendid Fairy-wren					x								
MELIPHAGIDAE														
<i>Epthianura aurifrons</i>	Orange Chat					x		x			x			
<i>Epthianura tricolor</i>	Crimson Chat					x		x		x	x	x		
<i>Certhionyx variegatus</i>	Pied Honeyeater					x		x			x			
<i>Sugomel niger</i>	Black Honeyeater							x						
<i>Lichmera indistincta</i>	Brown Honeyeater					x		x	x	x				
<i>Gavicalis virescens</i>	Singing Honeyeater					x		x	x	x	x	x	x	

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Lichenostomus kertexti</i>	Grey-headed Honeyeater							x	x	x				
<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater							x		x	x	x		
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater					x		x						
<i>Manorina flavigula</i>	Yellow-throated Miner					x		x		x	x	x		
PARDALOTIDAE														
<i>Pardalotus rubricatus</i>	Red-browed Pardalote					x		x			x			
<i>Pardalotus striatus</i>	Striated Pardalote							x						
ACANTHIZIDAE														
<i>Smicronis brevirostris</i>	Weebill					x		x						
<i>Calamanthus campestris</i>	Rufous Fieldwren					x								
<i>Pyrholaemus brunneus</i>	Redthroat					x								
<i>Gerygone fusca</i>	Western Gerygone							x						
<i>Gerygone levigaster</i>	Mangrove Gerygone					x								
<i>Gerygone tenebrosa</i>	Dusky Gerygone					x		x	x					
POMATOSTOMIDAE														
<i>Pomatostomus temporalis</i>	Grey-crowned Babbler					x		x			x	x		
PSOPHODIDAE														
<i>Psophodes occidentalis</i>	Western Wedgebill					x		x	x		x	x		
ARTAMIDAE														
<i>Artamus cinereus</i>	Black-faced Woodswallow					x		x	x	x	x	x		
<i>Artamus cyanopterus</i>	Dusky Woodswallow					x			x					
<i>Artamus leucorhynchus</i>	White-breasted Woodswallow					x		x		x	x		x	
<i>Artamus minor</i>	Little Woodswallow					x		x						
<i>Artamus personatus</i>	Masked Woodswallow					x		x		x		x		
CRACTICIDAE														
<i>Cracticus tibicen</i>	Australian Magpie					x		x				x		
<i>Cracticus torquatus</i>	Grey Butcherbird					x		x						
<i>Cracticus nigrogularis</i>	Pied Butcherbird					x		x	x	x	x			
CAMPEPHAGIDAE														
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike					x		x	x	x	x	x	x	
<i>Lalage tricolor</i>	White-winged Triller					x		x			x			
NEOSITTIDAE														

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Daphoenositta chrysoptera</i>	Varied Sittella							x						
OREOICIDAE														
<i>Oreica gutturalis</i>	Crested Bellbird					x		x	x	x	x	x		
PACHYCEPHALIDAE														
<i>Pachycephala melanura</i> subsp. <i>melanura</i>	Mangrove Golden Whistler					x		x						
<i>Pachycephala rufiventris</i>	Rufous Whistler					x		x		x				
<i>Pachycephala lanioides</i>	White-breasted Whistler					x		x						
<i>Colluricincla harmonica</i>	Grey Shrike-thrush					x		x		x				
RHIPIDURIDAE														
<i>Rhipidura leucophrys</i>	Willie Wagtail					x		x	x	x	x		x	
<i>Rhipidura albiscapa</i>	Grey Fantail					x		x						
<i>Rhipidura phasiana</i>	Mangrove Grey Fantail					x		x						
MONARCHIDAE														
<i>Grallina cyanoleuca</i>	Magpie-lark					x		x	x		x	x	x	
CORVIDAE														
<i>Corvus bennetti</i>	Little Crow					x		x	x		x			
<i>Corvus orru</i>	Torresian Crow					x		x	x	x	x	x	x	
PETROICIDAE														
<i>Eopsaltria pulverulenta</i>	Mangrove Robin					x								
<i>Petroica goodenovii</i>	Red-capped Robin					x		x						
ALAUDIDAE														
<i>Mirafrja javanica</i>	Horsfield's Bush Lark					x		x	x	x	x	x	x	
HIRUNDINIDAE														
<i>Cheramoeca leucosterna</i>	White-backed Swallow					x		x	x					
<i>Hirundo rustica</i>	Barn Swallow	MI	MI		x	x	x	x						
<i>Hirundo neoxena</i>	Welcome Swallow					x		x			x			
<i>Petrochelidon ariel</i>	Fairy Martin					x		x	x	x	x		x	
<i>Petrochelidon nigricans</i>	Tree Martin					x		x	x		x			
ACROCEPHALIDAE														
<i>Acrocephalus australis</i>	Australian Reed Warbler							x						
LOCUSTELLIDAE														
<i>Eremiornis carteri</i>	Spinifex-bird					x		x		x	x		x	

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Cincloramphus cruralis</i>	Brown Songlark							x		x	x	x		
<i>Megalurus mathewsi</i>	Rufous Songlark					x		x	x	x	x		x	
ZOSTEROPIDAE														
<i>Zosterops luteus</i>	Yellow White-eye					x		x	x					
<i>Zosterops lateralis</i>	Silvereye					x		x						
STURNIDAE														
* <i>Acridotheres tristis</i>	Common myna					x								
DICAEIDAE														
<i>Dicaeum hirundinaceum</i>	Mistletoebird							x						
PASSERIDAE														
* <i>Passer montanus</i>	Eurasian Tree Sparrow					x		x						
ESTRILDIDAE														
<i>Heteromunia pectoralis</i>	Pictorella Mannikin							x						
<i>Neochmia ruficauda</i>	Star Finch					x		x						
<i>Emblema pictum</i>	Painted Finch					x		x	x				x	
<i>Taeniopygia guttata</i>	Zebra Finch					x		x	x	x	x	x	x	
MOTACILLIDAE														
<i>Motacilla flava</i>	Yellow wagtail	MI	MI				x	x						
<i>Motacilla cinerea</i>	Grey Wagtail	MI	MI				x							
<i>Anthus australis</i>	Australian Pipit					x		x		x	x			
REPTILES														
CROCODILIDAE														
<i>Crocodylus porosus</i>	Salt-water Crocodile	X	X	X		x								
CARPHODACTYLIDAE														
<i>Nephurus levis</i>						x		x	x			x		
DIPLODACTYLIDAE														
<i>Diplodactylus bilybara</i>	Western Fat-tailed Gecko					x		x						
<i>Diplodactylus conspicillatus</i>	Fat-tailed Gecko							x	x					
<i>Diplodactylus pulcher</i>						x								
<i>Lucasium stenodactylum</i>						x		x	x			x		
<i>Rhynchoedura ornata</i>	Western Beaked Gecko					x		x						
<i>Strophurus jeanae</i>						x		x	x					

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Strophurus spinigerus</i> subsp. <i>spinigerus</i>						x		x						
<i>Strophurus strophurus</i>						x		x	x			x		
GEKKONIDAE														
<i>Gehyra australis</i>						x								
<i>Gehyra crypta</i>											x			
<i>Gehyra pilbara</i>						x		x	x			x		
<i>Gehyra punctata</i>						x		x	x					
<i>Gehyra purpurascens</i>						x		x						
<i>Gehyra variegata</i>						x		x	x			x		
* <i>Hemidactylus frenatus</i>	Asian House Gecko					x				x				
<i>Heteronotia binoei</i>	Bynoe's Gecko					x		x	x	x		x		
PYGOPODIDAE														
<i>Delma haroldi</i>						x								
<i>Delma nasuta</i>						x			x					
<i>Delma pax</i>						x				x				
<i>Delma tincta</i>						x		x	x					
<i>Lialis burtonis</i>						x		x	x					
<i>Pygopus nigriceps</i>						x		x	x				x	
AGAMIDAE														
<i>Amphibolurus gilberti</i>	Gilbert's Dragon					x		x						
<i>Amphibolurus longirostris</i>	Long-nosed Dragon					x						x		
<i>Ctenophorus caudicinctus</i>	Ring-tailed Dragon					x		x	x	x				
<i>Ctenophorus femoralis</i>	Dune Dragon					x		x						
<i>Ctenophorus isolepis</i>	Crested Dragon, Military Dragon					x		x	x	x				
<i>Ctenophorus nuchalis</i>	Central Netted Dragon					x		x	x			x		
<i>Ctenophorus reticulatus</i>	Western Netted Dragon					x								
<i>Ctenophorus rubens</i>	Red Dragon					x		x				x		
<i>Ctenophorus rufescens</i>	Red Rock Dragon					x								
<i>Diporiphora adductus</i>	Carnarvon Dragon					x		x						
<i>Diporiphora winneckeii</i>									x					
<i>Pogona minor</i>	Dwarf Bearded Dragon					x		x	x			x	x	
SCINCIDAE														

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Ctenotus calurus</i>						x			x					
<i>Ctenotus duricola</i>						x								
<i>Ctenotus grandis</i>						x		x	x					
<i>Ctenotus hanloni</i>						x		x	x	x				
<i>Ctenotus helenae</i>						x								
<i>Ctenotus iapetus</i>						x		x	x					
<i>Ctenotus maryani</i>						x		x						
<i>Ctenotus pantherinus</i>	Leopard Ctenotus					x		x	x	x			x	
<i>Ctenotus quattuordecimlineatus</i>						x								
<i>Ctenotus rufescens</i>						x		x	x					
<i>Ctenotus saxatilis</i>	Rock Ctenotus					x			x	x				
<i>Ctenotus schomburgkii</i>						x			x					
<i>Eremiascincus fasciolatus</i>								x	x					
<i>Eremiascincus isolepis</i>						x		x						
<i>Eremiascincus pallidus</i>	Western Narrow-banded Skink					x		x						
<i>Lerista baynesi</i>						x								
<i>Lerista bipes</i>						x		x	x					
<i>Lerista clara</i>						x		x	x					
<i>Lerista elegans</i>						x		x						
<i>Lerista muelleri</i>						x								
<i>Lerista onsloviana</i>						x		x	x					
<i>Lerista planiventralis</i> subsp. <i>marayani</i>	Maryan's Keeled Slider			P1	x	x		x						
<i>Lerista uniduo</i>	Spotted Broad-blazed Slider					x		x						
<i>Menetia greyii</i>						x		x	x	x				
<i>Morethia ruficauda</i>						x		x						
<i>Tiliqua multifasciata</i>	Central Blue-tongue					x			x					
VARANIDAE														
<i>Varanus acanthurus</i>	Spiny-tailed Monitor					x		x						
<i>Varanus breviceuda</i>	Short-tailed Pygmy Monitor					x			x					
<i>Varanus bushi</i>	Pilbara Mulga Monitor					x								
<i>Varanus caudolineatus</i>						x			x					
<i>Varanus eremius</i>	Pygmy Desert Monitor					x		x	x		x			

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Varanus gouldii</i>	Sand Monitor					x		x		x		x		
<i>Varanus panoptes</i>	Yellow-spotted Monitor					x						x		
<i>Varanus tristis</i>	Racehorse Monitor					x								
TYPHLOPIDAE														
<i>Aniliios grypus</i>	Beaked Blind Snake							x						
PYTHONIDAE														
<i>Liasis olivaceus subsp. barroni</i>	Pilbara Olive Python	VU	VU		x	x	x							
<i>Antaresia perthensis</i>	Pygmy Python					x								
<i>Antaresia stimsoni</i>	Stimson's Python					x		x	x				x	
<i>Aspidites melanocephalus</i>	Black-headed Python					x			x					
HOMALOPSIDAE														
<i>Fordonia leucobalia</i>	White-bellied Mangrove Snake					x								
ELAPIDAE														
<i>Acanthophis pyrrhus</i>	Desert Death Adder					x								
<i>Acanthophis wellsi</i>	Pilbara Death Adder					x								
<i>Demansia psammophis</i>	Yellow-faced Whipsnake					x		x	x					
<i>Furina ornata</i>	Moon Snake					x			x					
<i>Pseudechis australis</i>	Mulga Snake					x		x	x	x			x	
<i>Pseudonaja mengdeni</i>	Western Brown Snake					x		x						
<i>Pseudonaja modesta</i>	Ringed Brown Snake					x			x					
<i>Pseudonaja nuchalis</i>	Gwardar, Northern Brown Snake					x			x					
<i>Simoselaps anomalus</i>	Desert Banded Snake							x	x					
<i>Suta fasciata</i>	Rosen's Snake					x								
<i>Suta punctata</i>	Spotted Snake					x		x	x					
AMPHIBIAN														
PELODRYADIDAE														
<i>Cyclorana maini</i>	Sheep Frog					x		x	x					
<i>Cyclorana platycephala</i>	Water-holding Frog					x								
<i>Litoria caerulea</i>	Green Tree Frog							x		x				
<i>Litoria rubella</i>	Little Red Tree Frog					x			x	x				
Limnodynastidae														
<i>Neobatrachus aquilonius</i>	Northern Burrowing Frog							x	x					

Scientific Name	Common Name	Conservation Status				Database Result				Literature Review				
		EPBC Act	BC Act	DBCA	DBCA	NatureMap	PMST	ALA	Biota (2010)	GHD (2011)	BCE (2018)	Ninox (2013)	This Survey	
<i>Neobatrachus fulvus</i>	Tawny Trilling Frog					x								
<i>Notaden nichollsi</i>	Desert Spadefoot					x		x	x					